

**Markéta Dušková et al.**

# INTRODUCTION TO THE SURGERY

*Textbook for Students  
of Third Faculty of Medicine  
Charles University in Prague*

Praha

Univerzita Karlova v Praze  
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# **Introduction to the Surgery**

Textbook for students of Third Faculty of Medicine, Charles University in Prague

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# INTRODUCTION

The ultimate objects of scientific medicine are to prolong human life and to alleviate suffering. The two great branches of the healing art – Medicine and Surgery – are so intimately related that it is impossible to draw a hard-and-fast line between them. **Surgery may be defined as “the art of treating lesions and malformations of the human body by manual operations, mediate and immediate.”** The origin of the word surgery comes from the Greek word "cheirurgikē" (cheir – hand, ergein – work).

In order to apply his/her art intelligently and successfully, it is essential that the surgeon should not only be familiar with the normal anatomy and physiology of the body and with the various pathological conditions to which it is liable, but also with the nature of the process by which repair of injured or diseased tissues is affected. Without this knowledge he is unable to recognise such deviations from the normal as result from mal-development, injury, or disease, or rationally to direct his efforts towards the correction or removal of these.

Even a medical student does not plan to engage in any surgical specialty it is necessary for every doctor to be acquainted with basic and general principles of surgery.

**All forms of surgery are considered invasive procedures.** Surgical procedures are commonly categorized mainly by urgency, but also by type of procedure, by body system involved, by degree of invasiveness, and by special instrumentation.

The main three categories of therapeutic surgery are described – emergency, urgent, and elective.

**Emergency surgery**, such as stopping rapid internal bleeding, is performed as soon as possible; minutes can make a difference. It must be done quickly to save life, limb, or functional capacity.

**Urgent surgery**, such as removal of an inflamed appendix of coecum, is best performed within hours.

**Elective surgery**, such as replacement of a hip joint, can be delayed for some period of time, until everything has been done to optimize a person's chances of doing well during and after the surgical procedure. It done to correct a non-life-threatening condition, and is

carried out at the patient's request, subject to the surgeon's and the surgical facility's availability. These procedures usually treat a previously diagnosed disorder.

**Exploratory surgery** may belong to any type mentioned above; however it is performed to aid or confirm a diagnosis. A biopsy, in which a piece of tissue is removed for examination under a microscope, is the most common type of diagnostic surgery.

A special type of elective surgery is **aesthetic surgery**. The patient feels he/she suffers from some type of appearance problem caused by congenital fault, either by the injury or postoperative deformity, or also by the aging process. The surgery is supposed to serve for the improvement of patient's life quality, self-esteem, and social being.

There are other types of subdivision. There is a **radical** operation that removes the cause of problem (e.g., removal of appendix of caecum = appendectomy), and **palliative** one, which only facilitates following life or the treatment, but leaves the reason (for example it leaves out of the section of digestive tract, where is a continuity failure due to unremovable tumour, the surgery connects segment above and below tumour = gastrojejunoanastomosis instead of that).

Operations can be also divided according to **indications**. **Vital indication** means that patient definitely dies without a surgery. **Absolute indication** represents an ideal solution, while a relative indication is one of the treatment options. It is also possible to talk about **contraindications**, which relate to the severity of the disease and the condition of the patient as well as to the cost and burden of operation in correlation with benefit of surgery for the patient. The term absolute and relative contraindications, however, lose the unique meaning in process of time.

**There are several commonly used surgical terms. Let's explain some of the most used:**

- **Incision** means opening of the surgical wound, verbatim cut.
- **Excision** means cutting out an organ, tumour, or other tissue. Surgery terms often start with a name for the organ being excised (cut out) and the suffix **-ectomy** is added (for example mastectomy).
- **Extirpation** is complete removal of pathological lesion, which is clearly defined.

- **Resection** is partial removal of an organ or other bodily structure.
- **Amputation** involves cutting off a body part, for example a limb or a digit.
- Procedures, which involve **cutting into an organ or tissue**, end by suffix **-otomy**. For example a surgical procedure cutting through the abdominal wall to gain access to the abdominal cavity is called laparotomy.
- Procedures for formation of **an opening called a stoma** in the body have suffix **-ostomy**. The stoma is a permanent or temporary opening of tube organ (like stomach or urinary bladder), which is situated at the surface of the body.
- The surgical connection between blood vessels or other tubular or hollow structures such as loops of intestine is called **anastomosis**.
- **Replantation** involves reattaching a severed body part (for example finger).
- **Transplantation** means transfer of the harvested tissue or organ from the donor site to the recipient area. It can come from the individual and be used to the same one (autogenous), or harvested from the genetically different individual and used to the other of the same species (allogenuous). The transfer is rare between genetically identical individuals – uniovular twins (called isogenic). Xenogenous transplantation is the term used for transfer between the individuals of the different species. The tissue may be simply inserted (blood transfusion), used as a graft (skin, bone), or it is reconnected to the recipient in all necessary ways for supply and function like blood vessels, ducts, etc. (for example kidney).
- **Prosthetics** are artificial substitutes, which is used for repair or for replacement of particular part of the body or tissue. They may also serve as an anchor for specific devices. For example pins or screws may be used to set and hold bone fragments. Sections of bone may be replaced with prosthetic rods or plates. Artificial hip replacement has become more common. Heart pacemakers or valves may be inserted. Some prosthetics just increase the quality of the patient's life and substitute the missed external shape of the body; they are called epithesis (for example nasal or mammary epithesis).



In contrast to the role played by surgery in the past, surgery is more important now than ever. Surgical technology and techniques are so advanced that one through the use surgery is able to accomplish what ancient surgeons never dreamed of. However, they receive further unmistakable assistance, provided the other medical disciplines, especially anesthesiology, pharmacology and internal medicine.

Surgery is used for a great variety of diseases and involves many different surgical techniques.

But there are still **four fundamental steps inevitable for every surgeon and his/her patient**, considering any operation:

- **Analysis (patient s condition, options, risks, complications)**
- **Preparing for surgery**
- **Performing the operation**
- **Healing and recovery**

It is necessary to keep **the basic rule**:

**Every surgery must be indicated according to the particular individual, his/her health condition, need and expectations, and at last but not the least according to facility possibilities and surgeon's skill.**

M. Haas

# HISTORY OF SURGERY, SURGICAL SPECIALITIES

Many archeological evidences (signs of healed fractures on bones, signs of skull trepanation, cave paintings) prove that surgical procedures were performed in prehistoric ages.

## ANCIENT WORLD

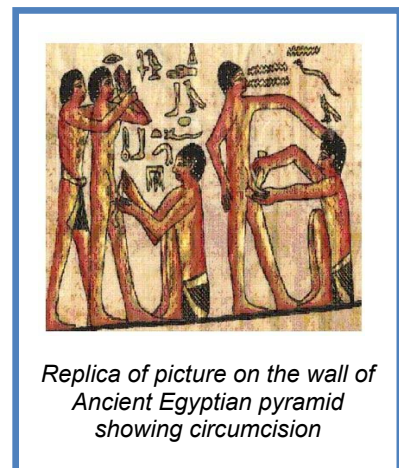
Evidence that the surgical assistance was provided can be found from the period around the year 4600 BC, the period of Assyria, Babylon, Ancient Egypt, and Indian culture. In that time priests carried out treatment and surgery. From this time the operations as circumcision, venesection, haemostasis by the hot iron, incision of absces, suture of the intestinum, hernia treatment by hot iron, reconstruction of missed parts of the body (Indian rhinoplasty) are known. Ideas of the anatomy of human body were minimal, although there was a certain manipulation with the human body in the context of embalming (Oriental nations). Operations were carried out in woozily status induced by ingestion of potion from various plants (hashish, poppy, mandrake).

### *Mesopotamia*

Sumerian civilization created the oldest form of writing characters, cuneiform. Of the 30,000 cuneiform tablets that have been discovered, about 800 of them deal with medical themes (one of these being the first prescription known to have been written). Sumerians developed several important medical techniques. They used the bronze instruments with sharpened obsidian resembling modern day scalpels, knives, trephines, etc. *Hammurabi's Code* itself contains specific legislations regulating surgeons and medical compensation as well as malpractice and victim's compensation.

### *Ancient Egypt*

In the first monarchic age (2700 BC) the first tract on surgery was written by **Imhotep**. On one of the doorjambs of the entrance to the Temple of Memphis there is the oldest recorded engraving of a medical procedure: circumcision. Engravings in Kom Ombo depict surgical tools. Still of all the discoveries made in ancient Egypt, the most important discovery relating to ancient Egyptian knowledge of medicine





is the Ebers Papyrus, named after its discoverer Georg Ebers. “*The Ebers Papyrus*” is considered one of the oldest treaties on medicine and the most important medical papyri. The text is dated to about 1550 BC and measures 20 meters in length. The text includes recipes, a pharmacopoeia and descriptions of numerous diseases as well as cosmetic treatments.

### **Ancient India**



Indian physician **Sushruta** (c. 600 BC) wrote a series of volumes which is known as “*The Susruta Samhita*”. It is the oldest known surgical text and it describes in exquisite detail the examination, diagnosis, treatment, and prognosis of numerous ailments, as well as procedures on performing various forms of plastic surgery, such as cosmetic surgery and rhinoplasty. His technique of forehead flap rhinoplasty reconstructing the nose, amputated as a punishment for crimes, is practiced almost unchanged in technique to this day. The *Susrutha Samhita* contains the first known

description of several operations, including the uniting of bowel, the removal of the prostate gland, the removal of cataract lenses and the draining of abscesses.

### **Ancient Greece**

**Hippocrates**, the father of medicine (460 – 377 BC) wrote first monography “*Corpus hippocraticum*”. This document summarized all medical knowledge and experiences of Ancient world and contains The Hippocratic Oath. First medical schools and hospitals were founded in this period.

The Greek period was relieved by Alexandria period (300 BC – 400 AD), which concentrated all the medical knowledge to Alexandria. Large fire of Alexandria Library destroyed all written material in the year 47 BC. However, reports of the human body section and basic knowledge of anatomy have been preserved. At the turn of the era the Roman period dominated medicine and surgery. At that time there was **Galenus Claudius**, who was an experienced teacher and surgeon. Based on the original Hippocratic works he summed up all the knowledge and principles of treatment of patients into the several files.

## ***Ancient China***

**Hua Tuo** was a famous Chinese physician. He was the first person who performed the surgery with the aid of anesthesia, some 1600 years before the practice was adopted by Europeans.

## **MEDIEVAL WORLD**

### ***Arabic period***

From 5<sup>th</sup> till 15<sup>th</sup> century the Arab period affected the history of surgery. In Spain living, Arabic surgeon **Albukasim** (+1106) described the findings of the treatment of the surgical diseases in manual of several volumes. **Ibn Sina** (Avicenna, 980 – 1038 AD), wrote "*Canon medicinae*". It contains medical knowledge and experiences of Arabic and Greek medicine of then world.

### ***European period***

From 13<sup>th</sup> to 16<sup>th</sup> century the development of medicine in Europe is characterized by so-called **Italian–French period**. In the 13<sup>th</sup> century many European cities began to require studies of several years from the doctors who wanted to carry out their practice in the town.

In 13<sup>th</sup> century first universities where medicine was taught were founded in Italy (Padua, Napoli, Bologna). At these universities were performed anatomical sections. In France surgery has lower status than pure medicine. Until **Rogerius Salernitanus** wrote his file "*Chirurgia*", which laid the fundamentals of modern surgery, surgery was considered a craft. Surgery was performed as ordinary craft by healers and barbers. One of these "craftsmen" **Ambroise Paré** wrote "*Five books about surgery*". These books contain knowledge about medieval surgery. He also stated five reasons to perform surgery: "*To eliminate that which is superfluous, restore that which has been dislocated, separate that which has been united, join that which has been*



*Professor Billroth demonstrating surgery to students and colleagues*

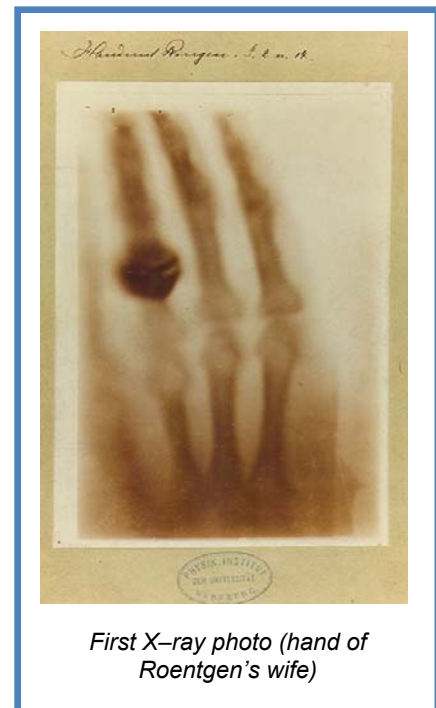
*divided and repair the defects of nature."*

At this time, the anatomy (**Vesalius, Eustachio, Fallopi**a) developed boisterously. The first physiological findings appeared (**Harvey** – large, **Servet** – low blood circulation). Since 15th century surgery was taught as a separate branch at the universities of Montpellier, Padua, and Bologna.

In London, an operating theatre or operating room from the days before modern anesthesia or antiseptic surgery still exists, and is open to the public. It is found in the roof space of St Thomas Church, Southwark, London and is called the Old Operating Theatre.

## **MODERN SURGERY**

Modern surgery and medicine developed rapidly with the scientific era. Three main developments permitted the transition to modern surgical approaches – **control of bleeding, control of infection and control of pain** (anesthesia). It means the operations without excessive risk to the patient (control of bleeding, blood transfer, knowledge of shock conditions, etc.) operations without the spread of the infection and operations without pain (anesthesia). In 1847 **L. Semmelweis** discovered basic principles of antiseptics (washing hand with chloride of lime solution) and **J. Listér** set up these principles in everyday routine. **L. Pasteur** discovered reasons of purulence. Surgeons started to disinfect operation field with disinfectants and **Halsted** set up wearing of rubber gloves for surgery. The microbiology was developing (**B. Koch**). In 1846 **Ch. Jackson** discovered ether for anesthetic use and **C. Roentgen** discovered X-rays for medical imaging. The discovery of blood groups followed (**J. Janský, K. Landsteiner**). While the first true antibiotic–penicillin was described by **Alexander Fleming** in 1929, yet during the World War II sufficient resources were spent on the research and refining of the substance (**H. W. Florey**) to be able to be used in clinical practice. The reason was the amount of infected wounds, those treatment with penicillin was unusually successful compared with situation before.



After the Second World War were discovered and used subsequent antibiotics. Many diagnostic methods were improved and new technologies were discovered (ultrasound, CT, MRI, endoscopy etc.).

## SURGERY IN BOHEMIA

**Jan Jessenius** performed first public anatomical section in Prague in 1600. In 1773 was founded "faculty of surgery" on Charles University and in 1786 was this faculty attached to faculty of medicine. Surgery rapidly developed at the end of 19<sup>th</sup> and at the beginning of 20<sup>th</sup> century especially at University Hospital facilities. During this period many Czech surgeons lived and worked in our countries, which are credited with the development of surgery. It was Albert Edward, pioneer antiseptics, he wrote four volume textbook of surgery. **Karel Maydl** wrote a monograph on "*Hernias*", "*Colon Cancer*", "*Subphrenical abscesses*". **Otakar Kukula** wrote the monograph "*The pathology and treatment of intestinal ileus*" and "*Pathology and therapy of appendicitis*". **Rudolf Jedlička** initiated the construction of the Prague Sanatorium in Podolí, foundation of the Institute for Education of Cripples and building of Radiotherapeutical Institute. As a first in the CR he promoted gastric resection for ulcerative disease and described pancreaticocystogastrostomy. **Jan Bedrna** was a pioneer of cardiosurgery, **Jan Zahradníček** of orthopaedics, **Jiří Diviš** of thoracic surgery and **Arnold Jirásek** of neurosurgery. With regard to the Royal Vineyard hospital it celebrated centennial anniversary of its founding in the 2002. Surgical field was brought fame mainly by already appointed **Jiří Diviš** and last but not least there is **František Burian**, the founder of plastic surgery in the Czech Republic and on the European continent.



*Professor František Burian*

## SURGICAL SPECIALITIES

Surgery as a medical field is very extensive and is not in human power to absorb all this knowledge. Therefore, over time, as surgery has evolved the basic field—surgery (general) remained, but the specialized branches dealing with some parts of surgery only were structured. After the medical university studies graduates are included to the branche of their choice and continue to the next, now a postgraduate education in the relevant workplace. This training is both theoretical and practical. Every specialized field has specified conditions that each physician must meet in order to pass qualifying examination (attestation) and become a specialist for specific surgical subspeciality.

### ***General surgery***

The main scope is the problems which, in general, can not be classified into the special surgical fields. In practice, most frequent focus is on the abdominal organs (esophagus, stomach, colon, liver, gall bladder and bile ducts, and often the thyroid gland) and hernias, other issues, however, shared with other disciplines may be surgical diseases of the thyroid gland, mammary glands, varicose vein, and of course certain types of injuries.

A wider indication range can be found in the smaller countryside facilities, regional and university facilities provide more specialized health care. There are super specialities in the context of general surgery with concern to hepatobiliary system, colorectal area or proctology.

### ***Thoracic surgery***

- Surgical treatment of lungs and surgery of chest cavity

### ***Cardiosurgery***

- Surgical treatment of diseases of heart and great vessels (cardiac surgery)

### ***Transplantation surgery***

- Surgical transfer of tissues and organs

### ***Orthopedic surgery***

- Treatment of acute and chronic disorders, injuries and their sequelae, degenerative processes, tumours, and other problems of the musculoskeletal system, the branche uses both surgical and non–surgical means.

### ***Maxillofacial surgery***

- Surgical treatment of injuries, congenital disorders, and diseases of the face mainly the jaws, the hard and soft tissues of the oral cavity.
- Maxillofacial surgeons are usually initially qualified in dentistry and have undergone further surgical training.

### ***Neurosurgery***

- Provides the operative treatment of disorders of the central, peripheral, autonomic nervous systems, and the hypophysis, including their supporting structures and vascular supply; also the evaluation and treatment of pathological processes that modify the function or activity of the nervous system, and the treatment of the pain.

### ***Plastic Surgery***

- Corrects surgically appearance and function of external shape of the body especially the face and hand in congenital abnormalities, deals with the treatment of fresh injuries and tumours of these sites, also with acquired defects by trauma or caused by tumours treatment, and faults arising due to degenerative processes.
- During a time in the Czech Republic the Burns Medicine almost entirely left the plastic surgery with the aim to concern to these specific types of injury.
- To a certain extent, there are also separate facilities, specializing in hand surgery and aesthetic surgery. Aesthetic surgery is considered as a health care; however, it is not paid by the health insurance, because it deals with the correction of cosmetic defects and symptoms of aging without the functional problems onto the morphological condition.

### ***Otorhinolaryngology***

- Makes diagnosis and surgical treatment of ear, resp. hearing system, nose, throat.

### ***Ophthalmology***

- Diseases and surgery of the visual pathways, including the eye and additional structures, such as the lacrimal system and eyelids.

### ***Urology***

- Focuses on the urinary tracts of males and females, and on the reproductive system of males.
- Treats urinary infections, urolithiasis, correction of congenital abnormalities and tumours of urogenital system.

### ***Pediatric surgery and its specialization***

- Deal with surgical problems characteristic for children's age, has many super specializations, like surgery of adulthood.

### ***Anesthesiology and Resuscitation***

- Anaesthesiology and Resuscitation has been completely separated over the time and has absolutely different nature. This field not only allows patients to undergo operations and other diagnostic–therapeutic procedures without painful or unpleasant experiences, but also takes care of security and restoration of their vital functions in both these cases as well as in the context of other life–threatening conditions (accidents, serious illness, etc.).

# CARDIOPULMONARY RESUSCITATION (CPR)

CPR is a complex of relatively simple and logical “step by step” procedures, which should immediately restore the flow of oxygenated blood to the brain. CPR is only likely to be effective if commenced within short period after the blood flow stops. Already in as little as 4 – 5 min after the oxygenated blood flow stops brain cells become irreversibly damaged. Even if medical professionals are able to restore an effective circulation later on, cortical cerebral functions are often permanently damaged and the quality of patient’ s life would be never the same as before. This is the main reason why is so vitally important to educate broad community in the first aid and pre–hospital CPR.

## HISTORY OF CPR

The desire to bring people back to life is very old. In the Bible, a story is described discerning a similarity to artificial ventilation in a passage from the Books of Kings (Bible, 2 Kings, IV, 34.). This first resuscitation effort described was Prophet Elisha's mouth–to–mouth method. The development had been continuing up to now. Let’s name the main steps only. In 1892, French authors recommended tongue stretching. In 1858 Henry Robert Silvester described a method of artificial ventilation: the patient lies on his or her back, with arms raised to the sides of the head, held there temporarily, then brought down and pressed against the chest. Movement should be repeated 16 times per minute. A second technique, called the Holger Nielsen technique, described a form of artificial respiration where the person was laid on their front, with their head to the side. A process of lifting their arms and pressing on their back was utilized, essentially the Silvester method with the patient flipped over.

Peter Safar (born 12<sup>th</sup> April, 1924 in Vienna; died 2<sup>nd</sup> August 2003 in Pennsylvania) was an Austrian physician of Czech descent. He is credited with pioneering modern cardiopulmonary resuscitation. Together with James Elam, he described the first two components of CPR (the airway, head tilt, chin lift - Step A and the mouth–to–mouth breathing - Step B) and influenced Norwegian doll maker Asmund Laerdal of Laerdal company to design and manufacture mannequins for CPR training called Resusci Anne ®. The next major step in resuscitation was closed chest massage (circulation- Step C), which was introduced in the 1960’s by Dr. Kouwenhoven, Dr. Jude, and a young engineer Knickerbocker. Safar

described the combination of both methods as a cardiopulmonary resuscitation (Steps ABC) in 1961.

In 1973, the American Red Cross and the American Heart Association (AHA) began a big campaign to teach the American population this method. 1992 ILCOR (*International Liaison Committee on resuscitation*) was founded; the representative organ for Europe is ERC (*European Resuscitation Council*). European Council evaluates roughly every five years new scientific publications and accordingly modifies its guidelines for CPR.

The recommendations were last time updated in 2005 (see [http://www.erc.edu/index.php/guidelines\\_download\\_2005/en/](http://www.erc.edu/index.php/guidelines_download_2005/en/))

## **BASIC LIFE SUPPORT IN ADULTS**

Basic life support consists of the following steps:

1. Make sure you, the victim and any bystanders are safe.
2. Check the victim for a response: gently shake his shoulders and ask loudly: “Are you all right?” Do not use painful stimulation.
3. If he responds
  - a. leave him in the position in which you found him provided there is no further danger
  - b. try to find out what is wrong with him and get help if needed
  - c. reassess him regularly

If he does not respond

- d. Shout for help
- e. Turn the victim onto his back and then open the airway. The most common cause of airway obstruction is that the tongue falls backwards and obstructs the airway. Tongue is anatomically connected to the jaw. Its position is dependent on the tension of masseter muscle. If one is conscious or even asleep, the airway is patent. If the patient is unconscious, muscle tension decreases, lower jaw collapses and the tongue may obstruct the airway. The simplest manoeuvre how to open the airway is an application of head tilt and chin lift. Place your hand on the victim’s forehead and gently tilt his head back keeping your thumb and index finger free to close his nose if rescue breathing is required or with your fingertips under the point of the victim’s chin, lift the chin to open the airway



4. Keeping the airway open, look, listen and feel for normal breathing.
  - a. Look for chest movement.
  - b. Listen at the victim's mouth for breath sounds.
  - c. Feel for air on your cheek. In the first few minutes after cardiac arrest, a victim may be barely breathing, or taking infrequent noisy gasps. Do not confuse this with normal breathing. Look, listen, and feel for no more than 10 s to determine whether the victim is breathing normally. If you have any doubt whether breathing is normal, act as if it is not normal.
5. If he is breathing normally
  - a. Turn him into the recovery position
  - b. Send or go for help/call for an ambulance
  - c. Check for continued breathing. If he is not breathing normally, suppose cardiac arrest. Pulsation on large vessels is not checked routinely, finding that patient's breathing is not effective should be sufficient.
6. Send someone for help or, if you are on your own, leave the victim and alert the ambulance service (in the Czech Republic **155** or less conveniently **112**); return and start chest compression as follows:
  - a. Kneel by the side of the victim
  - b. Place the heel of one hand in the centre of the victim's chest
  - c. Place the heel of your other hand on top of the first hand
  - d. Interlock the fingers of your hands and ensure that pressure is not applied over the victim's ribs. Do not apply any pressure over the upper abdomen or the bottom end of the bony sternum (breastbone)
  - e. Position yourself vertically above the victim's chest and, with your arms straight; press down on the sternum 4–5 cm normal. This should limit a risk of rib fractures.

After each compression, release all the pressure on the chest without losing contact. During relaxation phase, both heart and lungs are perfused. After each compression, all the pressure on sternum should be released. Even low pressure applied on sternum during relaxation phase decreases an efficacy of chest compressions.

Repeat at a rate of about 100 times per minute (a little less than 2 compressions per second). These manoeuvres are able to maintain artificially the circulation mainly to the heart, lungs and brain. It is vitally important that chest compressions must be

performed quickly, and without unnecessary interruptions. Compression and release should take equal amounts of time.

7. Combine chest compression with rescue breaths. After 30 compressions open the airway again using head tilt and chin lift. During cardiac arrest, it is necessary to combine chest compressions with rescue breaths. Generally, one can perform two types of artificial breathing – ‘mouth-to-mouth’ or ‘mouth-to-nose’.
  - a. Mouth to mouth ventilation
    - I. Pinch the soft part of the nose closed, using the index finger and thumb of your hand on the forehead.
    - II. Allow the mouth to open, but maintain chin lift.
    - III. Take a normal breath and place your lips around his the mouth, making sure that you have a good seal.
    - IV. Blow steadily into the mouth while watching for the chest to rise, taking about 1 s as in normal breathing; this is an effective rescue breath. The volume is approximately 500–600 ml (this is normal single breath volume at rest). Slight resistance is felt while the patient’s lungs are inflated.
    - V. Maintaining head tilt and chin lift, take your mouth away from the victim and watch for the chest to fall as air passes out
    - VI. Take another normal breath and blow into the victim’s mouth once more, to achieve a total of two effective rescue breaths. Then return your hands without delay to the correct position on the sternum and give a further 30 chest compressions.
  - b. Mouth to nose ventilation
    - I. The lips of rescuer are placed around victim’s nose and his mouth is closed with the thumb of rescuer’s hand which is placed on his chin. One should take his mouth away during expiration phase and open the mouth of the patient. His chest falls down automatically and expiration is done.
    - II. Take another normal breath and blow into the victim’s nose once more, to achieve a total of two effective rescue breaths. Then return your hands without delay to the correct position on the sternum and give further 30 chest compressions
8. Continue with chest compressions and rescue breaths in a ratio of 30:2. Stop to recheck the victim only if he starts breathing normally; otherwise do not interrupt resuscitation. If your initial rescue breath does not make the chest rise as in normal breathing, then before your next attempt:

- a. Check the victim's mouth and remove any obstruction
- b. Recheck that there is adequate head tilt and chin lift

Do not attempt more than two breaths each time before returning to chest compressions. Chest-compression-only CPR may be used as follows

- c. If you are not able or are unwilling to give rescue breaths, give chest compressions only.
- d. If chest compressions only are given, these should be continuous, at a rate of 100 per minute.

9. Continue resuscitation until

- a. Qualified help arrives and takes over CPR
- b. The victim starts breathing normally
- c. You become exhausted

Stop to recheck the victim only if he starts breathing normally; otherwise do not interrupt resuscitation.

If there is more than one rescuer present, another should take over CPR every 1 – 2 min to prevent fatigue. Ensure the minimum of delay during the changeover of rescuers. The recovering rescuer may maintain in the meantime the airway of the victim patent during chest compressions.

Resuscitation face shield is a simple device used for artificial breathing to prevent transmission of infection from the victim and to eliminate reluctance to perform mouth-to-mouth ventilation. Air-proof polyethylene membrane and one-way valve reduce both aversion and risk of cross infection. Shield is placed easily on the face of victim and artificial breathing may be performed. Pressure on the shield must be released during expiration phase.

## **PAEDIATRIC CPR**

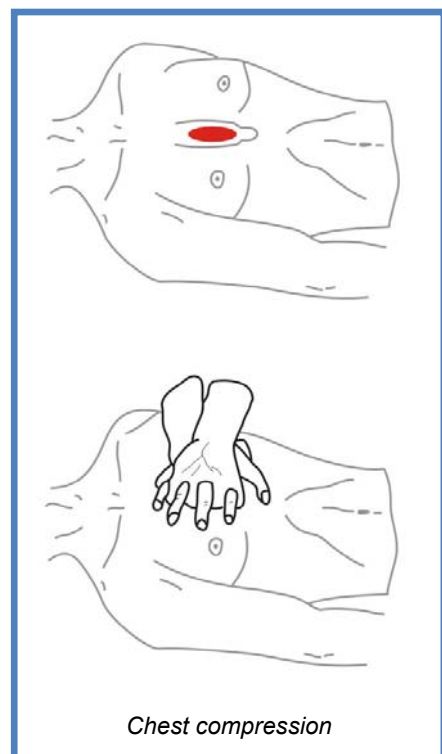
In the children between 1–15 years of age, the cardiac arrest is usually secondary, because of asphyxia. The sequence of steps is similar to the adult CPR; however a slightly modified approach is used to recover respiration as soon as possible.

### ***The main differences between adult and paediatric CPR***

ILCOR recommends that lay rescuers, who usually learn only single rescuer techniques, should be taught to use a ratio of 30 compressions to 2 ventilations, which is the same as the adult guidelines and enables anyone trained in basic life support techniques to resuscitate children with minimal additional information. Only, when there are two or more rescuers specially trained in resuscitation (usually healthcare professionals), they should use a ratio 15:2. The modification to age definitions enables a simplification of the advice on chest compression. Advice for determining the landmarks for infant compression is now the same as for older children. Infant compression technique remains the same: two-finger compression for single rescuers and two-thumb, encircling technique for two or more rescuers, but for older children there is no difference between the one- or two-hand techniques. The emphasis is on achieving an adequate depth of compression with minimal interruptions, using one or two hands according to the rescuer preference.

### ***The paediatric CPR algorithm***

1. Check the victim for response
2. Shout for help
3. Turn the victim onto his back
4. Open the airway
5. Check normal breathing
6. If absent, give 5 rescue breaths. Identify effectiveness by seeing that the child's chest has risen and fallen in a similar fashion to the movement produced by a normal breath.
7. If still unresponsive, start chest compressions. To perform chest compression in children over 1 year of age, place the heel of one hand over the lower third of the sternum. Lift the fingers to ensure that pressure is not applied over the child's ribs. Position yourself vertically above the victim's chest and, with your arm straight, compress the sternum to depress it by approximately one third of the depth of the chest. In larger children or for small rescuers, this is achieved most easily by using both hands with the fingers interlocked.
8. The depth of compression is approximately one-third of antero-posterior diameter of the chest.



9. Combine chest compressions with rescue breathing. The ratio is 30:2 (the same ratio as in adults), except if there are 2 rescuers well trained in paediatric CPR (see above).
10. After 1 minute of basic life support (rescue breaths and chest compressions) emergency medical services (ambulance) should be phoned.
11. CPR is again fully continued until qualified help arrives and take over or the child starts breathing normally, or rescuer is absolutely exhausted.

## **DEALING WITH TRAPPED CASUALTIES**

Accident scenes are dangerous places and one should protect himself in many ways. Technical first aid is an important part of initial action. High visibility jackets and warning triangles should be used. An ignition of the crashed car should be switched off, protect the crashed vehicle from further movement. Check the condition and number of victims, activate integrate rescue service and start first aid. Use surgical gloves for manipulating with victims if possible. See <http://www.roadandtravel.com>

### ***The risk of spine injury***

There is always a suspicion of head and spine trauma. Spine with its bone structures protects spinal cord against injury. Spinal trauma, mainly unstable vertebral fractures, can cause spinal cord injury during manipulation and dislocation by the rescuer. That is why we manipulate with the car crash victim only if there is another life-threatening situation like thread of fire, coma or serious trauma.

### ***Pulling casualties from a car***

Level of consciousness should be noted. If the victim is e.g. only drunken and is able to response, careful whole-body examination is made and, in case of need, we allow him to leave the car on his own.

If the victim is unconscious, we have to open his airway. His head is maintained in strictly neutral position to minimize cervical spinal cord injury. If the victim starts to breathe spontaneously and there is no need for emergency hauling out of the car, we should wait for a professional help.

In the case that breathing of the victim is not effective, one should initiate emergency hauling out of the car and start CPR immediately. The best way of pulling out is to use more people. One person is responsible for the victim's head while the others try to extract his body. Rautek's manoeuvre is usually applied: The first step is to free up the victim's feet if they are

stuck, and approach the person from behind, slipping arms of the rescuer under victim's armpits. With both hands grab the victim uninjured forearm, so that the body of the victim is supported by rescuer chest. Move the victim slowly and pull him from the car maintaining as much as possible a straight line between his head and body, forming a sort of block. A thread of fire is a situation that justify pulling out an injured person as soon as possible without waiting for a help. See <http://www.roadandtravel.com>

## **FOREIGN BODY AIRWAY OBSTRUCTION**

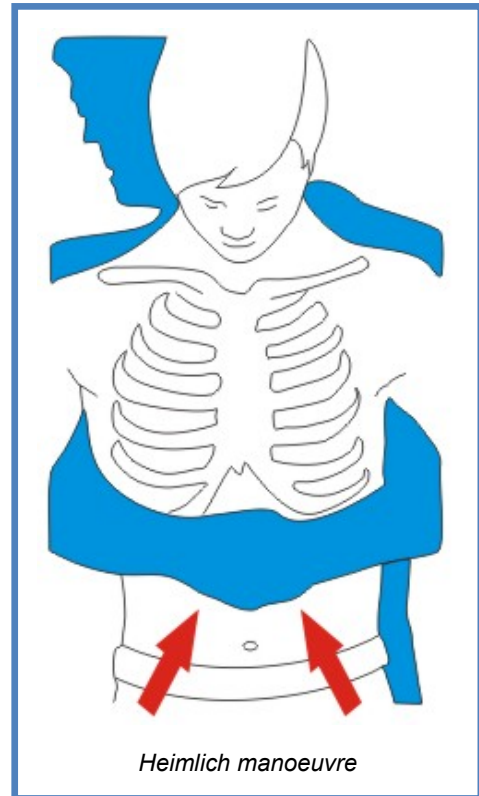
Foreign body airway obstruction is an acute, life-threatening situation occurring in both children and adults. The adults often aspirate food particles, mainly if they are drunk, while children most commonly aspirate a part of their toys or nuts. The vocal cords are the narrowest part of airway in adults, while in children it is just below. Distally to that narrowest part, the airways are getting broader (the internal diameter of trachea is about 20 mm in an adult). A foreign body obstruction is usually even worsened by concurrent laryngeal spasm.

Foreign body obstruction (FBP) treatment varies according to the severity of obstruction. The symptoms of FBO with a partial obstruction are cough and stridor within inspiration. If the victim is able to breathe and cough, no further action is performed because it can make situation worse. If the obstruction is complete, the victim cannot breathe or cough and after short time is getting unconscious. Emergency medical services should be contacted immediately. All manoeuvres are based on the principle of intra-thoracic pressure rise so that foreign body is expelled by the stream of expired gas.

1. Series of back blows are the safest approach. Both abdominal thrust and chest compressions could lead to a serious injury of intra-abdominal organs. Therefore back blows are indicated as a method of choice in pregnant women, extremely obese people and infants. Apply up to five back blows as follows:
  - a. Stand to the side and slightly behind the victim.
  - b. Support the chest with one hand and lean the victim well forwards so that when the obstructing object is dislodged it comes out of the mouth rather than goes further down the airway.
  - c. Give up to five sharp blows between the shoulder blades with the heel of your other hand
2. Heimlich manoeuvre consists of forceful pressure on upper abdomen which pushes diaphragm upwards rapidly. If the victim is still conscious, we stand behind him and put both arms round the upper part of his abdomen and pull our hands sharply upwards and

downwards. This is repeated up to 5 times. Even if the foreign body is expelled, the patient should be always examined by a physician because of risk for intra-abdominal organ damage.

- a. Stand behind the victim and put both arms round the upper part of his abdomen.
  - b. Lean the victim forwards.
  - c. Clench your fist and place it between the umbilicus and xiphisternum.
  - d. Grasp this hand with your other hand and pull sharply inwards and upwards.
  - e. Repeat up to five time
3. The same effect is achieved by chest compression. We stand behind the victim and put both arms round his chest and press him against our chest. This is repeated up to 5 times.



4. **If the victim is already unconscious, full basic life support with CPR is initiated.** In terminal stadium, laryngospasm sometimes relieves and foreign body is expelled.

#### ***Foreign body obstruction in infants***

The infants are placed face down over rescuer's forearm with head and neck supported. Forceful back blows are delivered. **In unconscious infant, emergency CPR is started.**

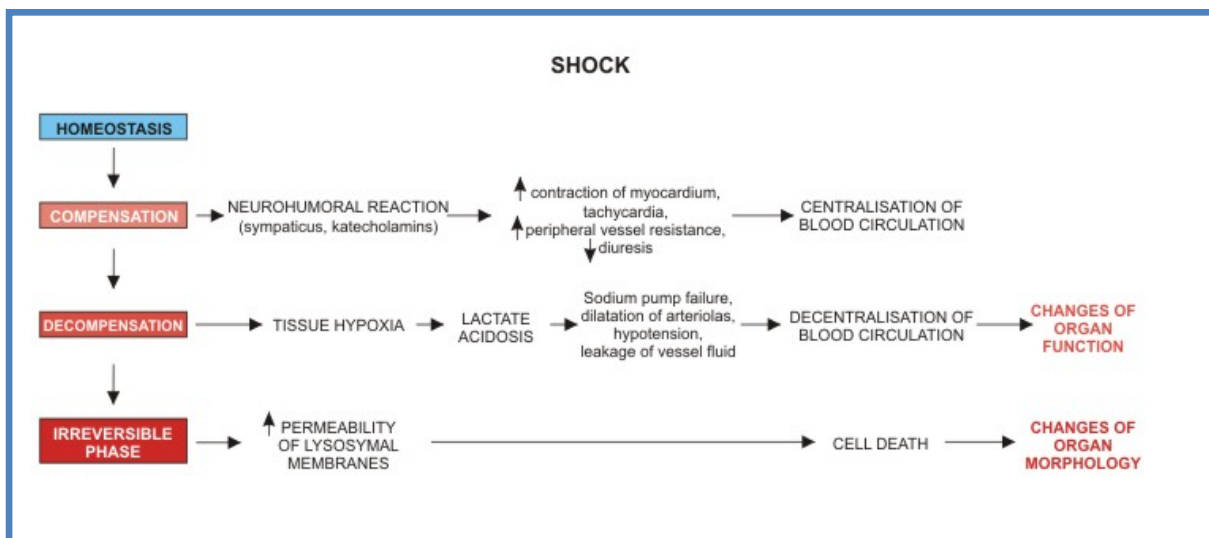
For more details of CPR see also

<http://www.lf3.cuni.cz/en/departments/anesteziologie/vyuka/studijni-materialy/resuscitation/>

# SHOCK

Shock is a serious, life-threatening medical condition resulting from acute disturbance between supply of oxygenated blood to the tissues (perfusion) and need of oxygen in the tissues. Medical shock should not be confused with the emotional state of shock, as the two are not related. Medical shock is a life-threatening medical emergency and one of the most common causes of death for critically ill people. Shock can have a variety of forms, all with similar outcomes, but all relate to a problem with the body's circulatory system.

Circulatory system consists of three parts: the heart, blood vessels and blood. Disturbance can occur in any of these parts and according to the origin the shock can be divided into hypovolaemic shock (lack of circulating volume because of bleeding or loss of intravenous fluid like in cases of extensive burn injury), obstructive shock (obstruction in blood flow caused usually by massive pulmonary embolism, tension pneumothorax or cardiac tamponade), cardiogenic shock (the failure of the heart to pump effectively), distributive shock caused by excessive vasodilatation usually caused by spinal cord trauma and mixed forms (septic shock, anaphylactic shock).



## HYPOVOLEMIC SHOCK

This is the most common type of shock. Common causes of hypovolemia can be bleeding, severe burns or excessive dehydration like in ileus, diarrhoea, vomiting, or overheating. A low blood volume can result in multiple organ failure, kidney damage and failure, brain



damage, coma and death. The compensatory mechanism is centralisation of circulation, the arteriolar and precapillary sphincters constrict to divert blood to the heart, lungs and brain. Epinephrine and norepinephrine are released. Norepinephrine causes predominately vasoconstriction of the kidneys, gastrointestinal tract, and other organs to divert blood to the heart, lungs and brain. Epinephrine predominately causes an increase in heart rate. The lack of blood to the renal system causes the characteristic low urine production. Should the cause of the crisis not be successfully treated, the shock will proceed to the progressive stage and the compensatory mechanisms begin to fail. Due to the decreased perfusion of the cells, sodium ions build up within while potassium ions leak out. As anaerobic metabolism continues, increasing the body's metabolic acidosis, precapillary sphincters fail, but postcapillary sphincters are still intact causing blood accumulating and clotting (sludging) in the capillaries. Due to this, the hydrostatic pressure will increase and, combined with histamine release, this will lead to leakage of fluid and protein into the surrounding tissues. As this fluid is lost, the blood concentration and viscosity increase, causing sludging and micro-thrombi formation in the micro-circulation. The prolonged vasoconstriction will also cause the vital organs to be compromised due to reduced perfusion. At refractory (irreversible) stage, the vital organs have failed and the shock can no longer be reversed. Brain damage and cell death occur resulting finally in death of the victim.

### ***Signs and symptoms of hypovolemic shock***

- Hypotension due to decrease in circulatory volume.
- A rapid, weak, thready pulse due to decreased blood flow combined with tachycardia.
- Cool, clammy skin due to vasoconstriction and release of catecholamines.
- Rapid and shallow respirations due to sympathetic nervous system stimulation and acidosis.
- Hypothermia due to decreased perfusion and evaporation of sweat.
- Thirst and dry mouth, due to fluid depletion.
- Fatigue due to inadequate oxygenation.
- Cold and pale or mottled skin (cutis marmorata), especially extremities, due to insufficient perfusion of the skin.
- Anxiety, restlessness, altered mental state due to decreased cerebral perfusion and subsequent hypoxia is late signs.

### ***Treatment***

The management of shock requires immediate intervention, even before a diagnosis is made. Re-establishing perfusion to the organs is the primary goal. Aggressive therapy is

necessary to restore and maintain the blood circulating volume and adequate blood pressure ensuring oxygenation and maintaining effective cardiac function. Secondary complications (hypothermia, position trauma, aspiration) must be prevented as soon as possible (to stress the time factor in therapy of shock, the terms golden hour or platinum 30 min are used).

In haemorrhagic shock (caused by bleeding), it is necessary to immediately control the bleeding if possible and restore the circulating volume by giving infusions of electrolyte solutions (e.g. Hartmann or Ringer solution). Blood transfusions are necessary for loss of large volume of blood (e.g. >1500 ml in adults), but can be avoided in smaller and slower haemorrhage. Low haemoglobin concentration is better tolerated than low circulating volume. Hypovolaemia due to burns, diarrhoea, vomiting, etc. is treated with infusions of solutions that balance the nature of the fluid lost. Regardless of the cause, the restoration of the circulating volume is priority. As soon as the airway is maintained and oxygen administered, the next step is to commence replacement of fluids via the intravenous route.

### **CARDIOGENIC SHOCK**

In spite of medical progress, the mortality of cardiogenic shock remains high. The main goals of the treatment of cardiogenic shock are the re-establishment of circulation to the myocardium, minimising heart muscle damage and improving the heart's effectiveness as a pump. Inotropic agents, which enhance the heart's pumping capabilities, are used to improve the contractility and correct the hypotension before definitive treatment. This is most often performed by percutaneous coronary intervention and insertion of a stent in the culprit coronary lesion or sometimes by cardiac bypass.

### **SEPTIC SHOCK**

This is caused because bacteria and/or their toxins cause vasodilatation and endothelial lesions that will lead to leakage of fluid and protein into the surrounding tissues and toxic or bacterial damage to various organs including lungs and myocardium. Signs of sepsis are heart rate > 90 beats per minute (tachycardia), body temperature < 36°C or > 38°C (hypothermia or fever), respiratory rate > 20 breaths per minute and changes in blood gases, white blood cell count and other laboratory results. Patients are defined as having septic shock if they have sepsis plus hypotension after aggressive fluid resuscitation (typically upwards of 6 litres or 40 ml/kg of crystalloid). Therapy consists of surgical treatment of the site of infection (if possible), antibiotic therapy and drugs to support circulation, ventilation and other organ functions. Mortality rate is high.

## **OBSTRUCTIVE SHOCK**

Signs depend on the exact reason of obstruction. Therapy consists of removing the obstruction.

## **NEUROGENIC SHOCK**

Neurogenic shock is the most rare form of shock. It is caused by trauma to the spinal cord resulting in the sudden loss of autonomic and motor reflexes below the injury level. Without stimulation by sympathetic nervous system the vessel walls relax uncontrolled, resulting in a sudden decrease in peripheral vascular resistance, leading to vasodilatation and hypotension. Appropriate positioning and vasoconstricting drugs are used.

## **ANAPHYLACTIC SHOCK**

Anaphylaxis is a severe, whole-body allergic reaction. According to the severity, allergic reactions involve skin reaction (urtica, Quincke's oedema), gastrointestinal reaction (nausea, diarrhoea), bronchospasm and the most severe circulatory reaction – anaphylactic shock. This reaction is sudden, severe, and involves the whole body. Tissues in different parts of the body release histamine and other substances. Anaphylaxis can occur in response to any allergen. Common causes include drugs, food and insect bites/stings.

Symptoms develop rapidly, often within seconds or minutes. Signs include: abnormal heart rhythm (arrhythmia), low blood pressure, mental confusion, rapid pulse, skin colour that is blue from lack of oxygen or pale from shock, swelling (angioedema) in the throat that may be severe enough to block the airway, swelling of the eyes or face, weakness, wheezing.

Anaphylactic shock is an emergency condition requiring immediate professional medical attention. Call 155 or 112 immediately, check vital signs (airway, breathing, and circulation from Basic Life Support) in all suspected anaphylactic reactions, cardiopulmonary resuscitation should be started, if needed. People with known severe allergic reactions may carry an Epi-Pen containing epinephrine or other allergy kit, and should be helped if necessary. Epinephrine should be given by injection in the thigh muscle right away. This opens the airways and raises the blood pressure by tightening blood vessels. Treatment for shock includes intravenous fluids and medications that support the actions of the heart and circulatory system.

Anaphylaxis is a severe disorder that can be life threatening without prompt treatment. However, symptoms usually get better with the right therapy, so it is important to act promptly.

For details refer to standard intensive care and emergency care textbooks.

# ASEPSIS, ANTISEPSIS, MEANS AND TYPES OF STERILIZATION, AND DISINFECTION

## DEFINITIONS

**Asepsis** is the practice to reduce or eliminate contaminants (such as bacteria, viruses, fungi and parasites) from entering the operative field in surgery or medicine with the aim to prevent infection. Asepsis is the absence of infectious organisms. Asepsis is achieved by using aseptic techniques.

**Antisepsis** is the decontamination of living tissues such as human skin and, especially, at site of surgical wounds. Antisepsis is the removal of transient microorganisms from the skin and the suppression of the resident flora. It may be achieved by removal of section or tissues, serving as a substrate. It means by derivation (wound drainage), mechanically (necrectomia, excision) or chemically (use of antiseptics).

**Disinfection** means a reduction in the number of pathogenic organisms on objects or materials, so the risk of infectious disease is minimized. Disinfection is the destruction of all microorganisms with the exception of endospores and viruses. Disinfection is divided into preventive (materials, water) and repressive (neutralization of bacteria in the outbreak of infectious disease).

**Sterilization** is the precise removal of all microbes from a surface or content. It is the process of annihilation of all living microorganisms e.g. viruses, bacteria, prions, fungi, or their spores or parasites.

## HISTORY

Hippocrates first espoused the concept of asepsis. The heat sterilization of medical instruments has been used in Ancient Rome, but declined throughout Middle Ages. It resulted in increased morbidity and mortality after surgery.

The history of asepsis goes back to 1847 when Semmelweis identified surgeons' hands as route of spread of puerperal infection. In 1865 Lister introduced the first wound asepsis with the use of carbolic acid spray.



*Listerian operation showing the carbolic acid spray in practise*

Aseptic working method is based on a maximum effort to prevent nosocomial infections (infections caused by microorganisms present in hospital). Its aim is to prevent microbial contamination of wounds or other sites of the body. Using sterile instruments and fluids can ensure this during the invasive medical and nursing procedures only. Staff undergo through epidemiological filter changing the clothing and footwear completely. Sterile clothing, including gloves, masks, and caps, which are all disposable, must be used during operations.

### **TYPES OF STERILIZATION**

Do not forget that for all sterilization methods cleaning of materials are crucial. Proper cleaning is achieved by decontamination and then by physical scrubbing. This should be done with detergents (Cresol, Persteril) and hot water.

## 1. Physical sterilisation

### Heat and steam sterilization



A method for heat sterilization is the autoclaving. Bergmann invented the first autoclave in 1880. Now autoclaves commonly use steam heated to 121° or 134°C under the pressure 2 or 3 atmospheres. To achieve sterility, a holding time of at least 20 minutes at 121°C (2 atm) or 10 minutes at 134°C (3 atm) is required. Steam sterilization is used for materials, which endure temperatures up to 140°C (iron, glass, rubber articles, porcelain, textile). All materials are sterilized in containers or paper covers. For effective sterilization, steam needs to penetrate the autoclave load uniformly, so an autoclave must not be overcrowded, and the lid of containers must be left ajar.

To ensure the autoclaving process was able to cause sterilisation, most autoclaves have meters and chart that record or display relevant information such as temperature and pressure as a function of time.

For indication of sterilization the staff places an indicator tape inside the autoclave prior to autoclaving. The tape will change the colour when the appropriate conditions have been met. Some types of paper cover have built-in indicators on them (Lukasterik®).



### Dry heat sterilization

The standard setting for a hot air oven is at least two hours at 160°C or one hour at 160°C with forced air circulation (or 20 minutes at 180°C). Dry heat has the advantage that it can be used on heat-stable items that are adversely affected by steam (it does not cause rusting of steel objects).

### Radiation sterilization

Methods exist to sterilize using radiation such as electron beams, X-rays, gamma rays, or subatomic particles.

- **Gamma rays** are emitting by radioisotope Cobalt-60. Gamma rays are very penetrating and are commonly used for sterilization of disposable medical equipment, such as

syringes, needles, cannulas, and intravenous sets. The sterilization dose is 25 kGy. Gamma radiation requires bulky shielding.

- **X-rays** are less penetrating than gamma rays and require longer exposure times, but need less shielding.
- **Electron beam** is also commonly used for medical device sterilization. Electron beams use an on-off technology and provide a much higher dosing rate than gamma or X-rays. A limitation is that electron beams are less penetrating than either gamma or X-rays.
- **Ultraviolet light irradiation** (UV), from a germicidal lamp is useful only for sterilization of surfaces and some transparent objects. The most effective is radiation with a length of 260 nm. UV irradiation is routinely used to sterilize the operating rooms between uses.

## **2. Chemical sterilization**

### **Ethylene oxide (EO)**

EO gas is commonly used for the sterilization of objects that are sensitive to temperatures exceeding 60°C such as plastics, optics and electrics. EO penetrates well, moving through paper, cloth and some plastic films and is highly effective. Ethylene oxide treatment is generally carried out between 30° and 60°C with relative humidity above 30% and a gas concentration between 200 and 800 mg/l for at least 3 hours. Ethylene oxide is the most common sterilization method, used for over 70% of total sterilization, and for 50% of all disposable medical devices. It is highly flammable. There are two methods of EO sterilization: the gas chamber method and the micro-dose method. The micro-dose method minimizes the use of gas. The method of sterilization is alkylation of enzyme or protein groups. As a biological indicator for EO sterilization is used *Bacillus subtilis*, a very resistant organism. If sterilization fails, incubation at 37°C causes a fluorescent change within two hours. Fluorescence is caused by EO resistant enzyme.

### **Formaldehyde**

Formaldehyde is used as a gaseous sterilizing agent together with steam at 60°–80 °C under pressure of 90 kPA. It is prepared onsite by depolymerisation of solid Para formaldehyde. The gas does not penetrate, it effects only surface. Many vaccines, such as the original Salk polio vaccine, are sterilized with formaldehyde.

### **Low Temperature Plasma**

Low temperature plasma sterilization chambers use hydrogen peroxide vapour (56%) in high frequency electromagnetic field to sterilize heat-sensitive equipment such as rigid endoscopes. The sterilization process is 54 minutes at 45° to 50°C. The Sterrad® has limitation with processing certain materials such as paper, linens, gauze and cotton.



### **STORAGE OF STERILE MATERIAL**

The material is stored at the temperature 15°–20°C and humidity 40–60%. The material has special cover (Lukasterik®, container). The expiry date depends on the cover – for a container is 6 days (if the container is opened, then only 24 hours), for a double cover is 6 months and for a double cover in a special store cabinet is 1 year.



### **DISINFECTANTS AND ANTISEPTICS**

**Disinfectants** are solutions that destroy pathogenic organisms on objects and materials. They have a bactericidal effect, but the bacterial endospore is very resistant, and some bacteria and viruses are able to develop resistance.

**Antiseptics** are agents that reduce or kill germs chemically and are applied to skin and wounds.

### **TYPES OF DISINFECTANTS**

**Phenolics** – phenol – the oldest known disinfectant first used by Lister.

**Phenol** is a standard for comparison to the other disinfectants. The corresponding rating system is called „Phenol coefficient“. The disinfectant to be tested is compared with phenol on a standard microbe (*Salmonella typhi* or *Staphylococcus aureus*). Disinfectants that are more effective than phenol have a coefficient more than 1. Disinfectants that are less effective have a coefficient less than 1.



**Oxidizing agents** destroy the cell membrane of a microorganism and thus cause the lysis and death of a cell. The strong oxidizers are chlorines and oxides. In clinical use there is hydroxide peroxide, per-acetic acid, chlorine dioxide.

**Quaternary ammonium compounds (Quats)** acts as low-level disinfectants. They are effective against bacteria but do not kill *Pseudomonas aeruginosa* and bacterial spores.

**Quats** include benzalkonium chloride (BAC), cetylpyridium chloride (Cetrim ®, CPC). They are used for skin disinfection.

**Alcohols and aldehydes** (ethanol, isopropanol, glutaraldehyd) are usually used as antiseptics.

**Alcohols** – ethanol (60–90%), 1-propanol (60–70%) and 2-propanol/isopropanol (70–80%) are used to disinfect the skin before injections.

**Boric acid** is used against yeast infections of vagina and as an eye washer. It is commonly used as 3% solution.

**Iodine** is used for skin and wound disinfection. It is usually water-based solution that contains povidone-iodine (Betadine ®). It is far better tolerated than previous alcohol-based solutions. The great advantage of iodine antiseptics is the widest scope of antimicrobial activity, killing even endospores.

## **SUMMARY**

The definition of terms asepsis, antisepsis, disinfection and sterilization is of crucial importance. The start of asepsis goes back to 19th century together with names like Semmelweis, Lister and Bergmann.

There are two types of sterilization: physical (heat and radiation sterilization) and chemical (ethylene oxide, formaldehyde, low temperature plasma, ozone, per-acetic acid sterilization). The most common form of sterilization is autoclave and ethylene oxide. The sterile material is stored under special conditions in special covers (containers, craps, paper, textile).

Disinfectants and antiseptics are agents that kill pathogenic organisms either on surfaces of nonsterilised subjects or on a skin. **To improve the preventive care the disposable aids and devices are being used more and more.**

# ANAESTHESIA

Anaesthesia means insensitivity. **General anaesthesia** produces loss of sensations by introducing loss of consciousness during which patients are inactivated of the arousal, even by painful stimulation. **Regional or local anaesthesia** produces loss of sensation from a limited area of a body with preserved consciousness.

Anaesthesia can be induced by physical means (cold, electric current), but far the most used is anaesthesia induced by drugs. Early modern medical anaesthesia dates to experiments with nitrous oxide (laughing gas) by Sir Humphry Davy in England and the dentist Horace Wells in the United States. Ether came into general use as an anaesthetic after a demonstration at the Massachusetts General Hospital in Boston by William T.G. Morton in 16<sup>th</sup> October 1846, followed by chloroform next year. General anaesthetics, administered by inhalation or intravenous injection, cause unconsciousness as well as insensibility to pain and are used for surgical or diagnostic procedures.

History of local anaesthesia dates back to ancient times. The leaves of the coca plant were traditionally used as a stimulant in Peru. It is believed that the local anesthetic effect of coca was also known and used for medical purposes. Cocaine was isolated in 1860 and first used as a local anesthetic in 1884. The search for a less toxic and less addictive substitute led to the development of the amino-ester local anesthetic procaine in 1904. Since then, several synthetic local anesthetic drugs have been developed and put into clinical use, notably lidocaine in 1943, bupivacaine in 1957 and prilocaine in 1959. Intravenous regional anesthesia was first described by August Bier in 1908. This technique is still in use and is remarkably safe when drugs of low systemic toxicity such as prilocaine are used. Spinal anesthesia was first used in 1885 but not introduced into clinical practice until 1899, when August Bier subjected himself to a clinical experiment in which he observed the anesthetic effect, but also the typical side effect of postpunctural headache.

Epidural anesthesia by a caudal approach had been known in the early 20<sup>th</sup> century, but a well-defined technique using lumbar injection was not developed until the 1930s. With the advent of thin flexible catheters, continuous infusion and repeated injections have become possible, making epidural anesthesia a highly successful technique to this day. Beside its many uses for surgery, epidural anesthesia is particularly popular in obstetrics for the treatment of labor pain.

## **GENERAL ANAESTHESIA**

Various agents (gases, vapours of liquid anaesthetic agents, intravenous, intramuscular etc. drugs) can be used to produce general anaesthesia (GA). According to the way of application, GA can be divided into inhalational GA (anaesthesia produced by the respiration of a volatile liquid or gaseous anaesthetic agent), intravenous GA (the anaesthetic agent, e.g. a barbiturate, is administered intravenously to effect. If an intravenous catheter is used, 'topping-up' amounts can also be administered as required) or combination of these ways – balanced anaesthesia, e.g. anaesthesia that balances the depressing effects on the motor, sensory, reflex and mental aspects of nervous system function by the anaesthetic agents.

The philosophy encourages the use of several agents, each designed to affect one of the functions.

- Analgesia: blocking the sensation of pain;
- Hypnosis and amnesia: produces unconsciousness
- Relaxation: decreasing muscle tone;
- Vegetative stability: obtundation of reflexes, preventing exaggerated autonomic reflexes

Various drugs are used to potentiate desirable effect and to affect independently each part of GA according to the general health of the patients and demands of the surgeon. The examples of inhalational general anaesthetics are nitrous oxide, isoflurane, sevoflurane, desflurane, the examples of intravenous general anaesthetics are thiopentone, propofol, ketamine (that can be administered in intramuscular way, too). The examples of analgesics are morphine, fentanyl, sufentanil, alfentanil, remifentanil. The examples of muscle relaxants are suxamethonium, atracurium, cisatracurium, mivacurium, vecuronium and others.

## **REGIONAL ANAESTHESIA**

Regional anaesthesia (RA) is usually produced by administration of local anaesthetic drugs (LA) that block conduction through nerve axons. The local anaesthetic then diffuses into nerves where it inhibits the propagation of nerve impulses through axons. High LA concentrations block all types of nerves, e.g. inhibit all qualities of sensation (pain, touch, temperature etc.) as well as muscle control, low concentrations block only unmyelinated or thin myelinated fibres (sympathetic nerves and pain and cold sensations).

Anaesthesia persists as long as there is a sufficient concentration of local anaesthetic at the affected nerves. Sometimes a vasoconstrictor drug is added to decrease local blood flow, thereby slowing the transport of the local anaesthetic away from the site of injection. Depending on the drug and technique, the anaesthetic effect may persist from less than an hour to several hours. Placement of a catheter for continuous infusion or repeated injection allows conduction anaesthesia to last for days or weeks. This is typically done for pain therapy.

Local anaesthetics can block almost every nerve between the peripheral nerve endings and the central nervous system. The most peripheral technique is *topical anaesthesia* to the skin or other body surface. Small and large peripheral nerves can be anesthetized individually (peripheral nerve block) or in anatomic nerve bundles (plexus anaesthesia). Neuroaxial blocks (subarachnoidal block - spinal anaesthesia and epidural anaesthesia) are applied near the spinal cord where the peripheral nervous system merges into the central nervous system.

Clinical techniques include:

- **Surface anaesthesia** – application of local anaesthetic spray, solution or cream to a mucous membrane (e.g. eye, bronchi, urethra) or the skin (e.g. EMLA Cream) The effect is short lasting and is limited to the area of contact.
- **Infiltration anaesthesia** – injection of local anaesthetic into the tissue to be anaesthetised.
- **Field block** – subcutaneous injection of a local anaesthetic in an area bordering on the field to be anaesthetised.
- **Peripheral nerve block** – injection of local anaesthetic in the vicinity of a peripheral nerve to anaesthetise that nerve's area of innervation.
- **Plexus anaesthesia** – injection of local anaesthetic in the vicinity of a nerve plexus, often inside a tissue compartment that limits the diffusion of the drug away from the intended site of action. The anaesthetic effect extends to the innervation areas of several or all nerves stemming from the plexus.
- **Epidural anaesthesia** – a local anaesthetic is injected into the epidural space where it acts primarily on the spinal nerve roots. Depending on the site of injection and the volume injected, the *anesthetized* area varies from limited areas of the abdomen or chest to large regions of the body.
- **Spinal anaesthesia (subarachnoidal block)** – a local anaesthetic is injected into the cerebrospinal fluid, usually at the lumbar spine (in the lower back), where it acts on

spinal nerve roots. The spinal cord terminates in adults at the first lumbar vertebra level. The resulting anaesthesia usually extends from the legs to the abdomen or chest.

- ***Intravenous regional anaesthesia (Bier's block)*** – blood circulation of a limb is interrupted using a tourniquet (a device similar to a blood pressure cuff), then a large volume of local anaesthetic is injected into a *peripheral* vein. The drug fills the limb's venous system and diffuses into tissues where peripheral nerves and nerve endings are anesthetized. The anaesthetic effect is limited to the area that is excluded from blood circulation and resolves quickly once circulation is restored.

For all types of smaller surgeries, injuries treatment, and similar procedures attainable from the body surface and limited for the particular area the simplest local anaesthesia called infiltration may be used.

Adverse effects depend on the local anaesthetic agent, method, and site of administration. The most common are hematoma, infection, nerve injury, systemic toxic reaction and very rare allergic reaction. Details are discussed in depth in the pharmacology and anaesthesia text book.

### ***Patients' safety***

Modern anaesthesia seems to be a safe procedure; estimated risk of death related to anaesthesia only is about 1:185 000, but anaesthesia can contribute to other surgery – related death. Probability of death within 30 days after surgery is 1:177 – 1:200 (0.56 %) after scheduled surgery and 1:34 – 1:40 (2.94 %) after acute surgery.

Patients scheduled for surgery usually undergo preoperative evaluation. An anaesthetist visits the patient a day before surgery to evaluate a patient's general condition and to obtain an informed consent for anaesthesia. Anaesthetic visit includes gathering history of previous anaesthetics and any other medical problems, physical examination, control of laboratory tests (minimal are blood count and urine analysis) and consultations prior to surgery. The extent of medical and laboratory tests depends on complicating diseases and type of surgery.

### ***ASA score***

ASA stands for American Society of Anesthesiologists. In 1963 the ASA adopted a five–category physical status classification system for assessing a patient before surgery. These are:

- ASA 1: a normal healthy patient.
- ASA 2: a patient with mild systemic disease.

- ASA 3: a patient with severe systemic disease.
- ASA 4: a patient with severe systemic disease that is a constant threat to life.
- ASA 5: a moribund patient who is not expected to survive either with or without the operation.

If the surgery is an emergency, the letter “E” (emergency) follows the physical status, for example “3E”. The risk of mortality increases with increasing ASA score starting with 0.06% in ASA1 to 51% in ASA5. The benefit of surgery must always outweigh the risk of serious complications.

### ***Premedication***

Premedication means a drug treatment given to a patient before anaesthesia. These drugs are typically sedatives or analgesics. Hypnotic and sedative drugs (benzodiazepines, zolpidem, zopiclon etc) are usually administered orally a night before surgery, benzodiazepines, opioids and anticholinergic drugs (to suppress salivation and bradycardia) are administered either intramuscularly or subcutaneously 30 min before surgery. Another possibility is intravenous route or oral premedication used mainly in children.

### ***Immediate preparation before elective procedure***

Patients’ consent and pre-anaesthetic medication (premedication, chronic medication etc.) are controlled. Patients should have their dentures, jewels, prosthesis etc. removed to avoid their damage and/or problems with airways. The use of cosmetic should be avoided. To decrease the risk of aspiration of gastric content, patients should starve from solid food 6 hours and from clear fluid 2–4 hours before surgery.

### ***Monitoring***

Patients must be monitored continuously during anaesthesia and surgery to ensure the patient's safety. This generally includes monitoring of heart rate (via ECG or pulse oximetry), oxygen saturation (via pulse oximetry), non-invasive blood pressure and inspired and expired gases (for oxygen, carbon dioxide, nitrous oxide, and volatile agents) in case of GA. For major surgery, monitoring may also include temperature, urine output, invasive blood measurements (arterial blood pressure, central venous pressure, pulmonary artery pressure and pulmonary artery occlusion pressure),



*Anaesthetic machine*

cerebral activity (via EEG analysis), neuromuscular function (via peripheral nerve stimulation monitoring), and cardiac output. All measured parameters are recorded in an anaesthesia record. The anaesthesia record is the medical and legal documentation of events during anaesthesia. It reflects a detailed and continuous account of drugs, fluids, and blood products administered and procedures undertaken, and also includes the observation of cardiovascular responses, estimated blood loss, urinary body fluids and data from physiologic monitors. The anaesthesia record may be written manually on paper; however, an electronic record increasingly replaces the paper record.

For details refer to standard anaesthesia textbooks.

# EXAMINATION OF THE PATIENT IN SURGERY

Similarly as in other medical specialities, every patient should be examined by following steps and procedures.

## **1. TAKING MEDICAL HISTORY OF A PATIENT**

The medical history or anamnesis of a patient is information gathered by a surgeon. This is based on asking specific questions, given to the patient or to the other persons (usually family members) who know the patient and are able to give competent information, with the aim to obtain data contributing for diagnostics and for medical care. Symptoms are complaints reported by the patient, whereas clinical signs are assessed by direct clinical examination.

A surgeon typically asks questions to obtain the following information about the patient:

- Identification: The name and age.
- The main or presenting complaint: the current health problem and its time course. It is necessary to know what brings the patient to the surgeon. Furthermore, the surgeon focuses on getting information regarding duration of patient's problems (acute or chronic), whether it starts suddenly or not, whether there was a trigger moment (for example trauma and its mechanism; eating of specific food), if it starts after particular action – for example sportive activity – or spontaneously.
- Past medical history: including major illnesses, any previous surgery, any previous infection disease, any current illness, acute or chronic like diabetes mellitus, heart disease, hypertension. Abusus: tobacco, alcohol, others drugs.
- Family history: Health status of the family members (parents, grandparents, children). In some diseases the family history is very important (e. g. cancer, congenital defects).
- Childhood diseases.
- Social history: including marital status, occupation, housing, exposure to environmental pathogens etc.
- Regular medications: including those prescribed by doctors, and others obtained over the counter.
- Allergies.
- Sex life: gynaecological history in females etc.



## **2. PHYSICAL EXAMINATION OF A PATIENT**

Physical examination is the process by which a surgeon uses his senses to investigate the body of a patient for signs of disease. It is necessary to start the examination systematically from the head ending at the lower extremities.

### ▪ **Inspection**

It is necessary to examine the stripped patient. The surgeon is focusing on body features and symmetry, skin colour, frequency of respiration, movement of the abdomen and each side of the chest during respiration, hair distribution, abnormal contour, scars and striae, swelling, presence of the wound or Indry.

### ▪ **Palpation**

The hands of the surgeon do this examination. The palpation is used to determine various deformities, their size, their shape, resistance, fluctuation, firmness, swelling, muscle tone, movement of the joints, and pathological movement (e. g. in fractures). Palpation has its essential importance in evaluation of acute abdomen and signs of peritoneal irritation.

### ▪ **Percussion**

Percussion, a method of tapping on a surface, is used to determine the condition of underlying structures. It is usually used to evaluate the thorax or abdomen. Two types of percussion examination are distinguished: direct and indirect. Direct percussion uses only one or two fingers; indirect percussion uses the middle flexor finger. A dull sound shows the presence of a solid mass under the surface, a more sonorous sound indicates a cavity containing air. With help of percussion the diagnosis of emphysema or pneumothorax can be made.

### ▪ **Auscultation**

Auscultation, a method of listening of the body internal sounds, usually uses a stethoscope. It requires clinical experience. This type of physical examination is possible to use for examination of the heart, the lungs, and the gastrointestinal system. When examining the heart by auscultation, there are important signs such as frequency, abnormal sounds like heart murmurs, gallops, and other extra sounds. When examining the lungs, there is important to focus on presence of wheezes and crackles. In gastrointestinal tract auscultation helps to identify type of peristalsis.

### ▪ **Per rectum – digital rectal examination**

Digital rectal examination is an internal examination of the rectum. The patient is lying on the hip, thus anus is accessible. The surgeon inserts finger into the rectum and palpates the insides. This type of examination is useful especially for assessment of rectal tumour or other tumours in the small pelvis, it is also a directed examination of prostate gland.

**Measurement of patient's body temperature, weight, height, pulse, and blood pressure belong to physical examination.**

### **3. OTHER CLINICAL EXAMINATION**

In surgery other clinical examinations may be used to assess proper clinical diagnosis. Examples of such employed methods are: biochemical analysis of blood and urine, electrocardiogram, histological examination of the tissue samples, microbiological examination, endoscopical examination, sonography, X-ray examination, CT (computed tomography), MR (magnetic resonance), examination using radioisotopes etc.

#### ***Some tips for practice***

When conducting a patient interview, you should take the following steps:

- a. Place yourself close to the patient. Position yourself, when practical, so the patient can see your face. If at all possible, position yourself so that the sun or bright lights are not at your back. The glare makes it difficult for the patient to look at you.
- b. Identify yourself and reassure the patient. Maintain a calm, professional manner. Speak to the patient in your normal voice.
- c. Learn your patient's name. Once you learn the patient's name, you should use it during the rest of your interview. Children will expect you to use their first name. For military adults, use the appropriate rank. If civilian, use "Mr." or "Ms." unless they introduce themselves by their first name.
- d. Learn your patient's age. Age information will be needed for reports and communications with the medical facility. You should ask adolescents their age to be certain that you are dealing with a minor. With minors, always ask how you can contact their parent or guardian. Sometimes this question upsets children because it intensifies their fear of being sick or injured. Be prepared to offer comfort and assure children that someone will contact their parents or guardians.
- e. Seek out what is wrong. During this part of the interview, you are seeking information about the patient's symptoms and what the patient feels or senses (such as pain or nausea). Also, find out what the patient's chief complaint is. Patients may give you several complaints, so ask what is bothering them most. Unless there is a spinal injury that has interrupted nerve pathways, most injured individuals will be able to tell you of painful areas.

f. Ask the PQRST questions if the patient is experiencing pain or breathing difficulties.

**P** = Provocation – What brought this on?

**Q** = Quality – What does it feel like?

**R** = Region – Where is it located?

**R** = Referral – Does it go anywhere (e.g., “into my shoulder”)?

**R** = Recurrence – Has this happened before?

**R** = Relief – Does anything make it feel better?

**S** = Severity – How bad is it on a scale of 1 to 10?

**T** = Time – When did it begin?

g. Obtain the patient’s history by asking the AMPLE questions.

**A** = Allergies – Are you allergic to any medication or anything else?

**M** = Medications – Are you currently taking any medication?

**P** = Previous medical history – Have you been having any medical problems? Have you been feeling ill? Have you been seen by a physician recently?

**L** = Last meal – When did you eat or drink last? (Keep in mind, food could cause the symptoms or aggravate a medical problem. Also, if the patient requires surgery, the hospital staff will need to know when the patient has eaten last.)

**E** = Events – What events led to today’s problem (e.g., the patient passed out and then got into a car crash)?

#### **4. OBJECTIVE EXAMINATION**

The objective examination is a comprehensive, hands–on survey of the patient’s body. During this examination, check the patient’s vital signs and observe the signs and symptoms of injuries or the effects of illness. When you begin your examination of the patient, you should heed the following rules:

1. Obtain the patient’s consent (if the patient is alert).
2. Tell the patient what you are going to do and explain him/ her why it is necessary to do that.

# BASIC GUIDE OF MEDICAL DOCUMENTATION IN SURGERY

Documentation systems in the health care field have seen increased demand due to the increasing liability in that industry. This is especially true when considering the fact that larger and larger numbers of individuals are being processed by the health care systems.

**The importance of the medical documentation cannot be underestimated. It is the most important source of information of the patient.**

**Every country has particular law and instructions on how to keep, to protect and to save medical documentation. It is a duty of medical doctors and staff to learn and to follow these rules.**

**Chart** is a survey displaying a review of patient problem(s), objective diagnosis, considerations, patient–selection criteria, treatment in abstract, and outcome. It is commonly used in the outpatient practice.

**Record** is detailed report of patient current problem, medical history, contemporary medication taken, allergies, current objective health condition including laboratory findings, diagnosis, considerations, patient–selection criteria and reasons for planned option of surgical approach, pre–op prepare, pre–op pharmaceuticals, surgery documentation, post–op treatment, post–op course and healing with daily logging, results and outcome, suggestions and recommendation for the following period. The patient has to be clearly identified in the medical record. All separable parts of documentation must be clearly labelled in a way, which avoids any confusing. It is usually used for inpatient care purposes.

**Documentation** contains complete medical data, also invoice’s details and cost data for financing of the whole care. The term “documentation” may be used for any type of medical data register mentioned above.

***Informed consent:***

Due to forensic purposes a signed informed consent of the patient must be included in any type of documentation (chart, record etc.). In this document a patient personally undersigns her/his agreement and understanding of described suggested treatment, expected outcome, possible risks and complications. With regard to under age persons and/or individuals non-sui juris the form must signed by patient's legal guardian.

**Practical process:** Before the surgery, the surgeon definitely reviews suggested treatment and surgical approach to the patient. The surgeon discusses risks and benefits of the operation and answers questions. Based on this explanation he obtains the person's permission to perform the operation, called informed consent. The patient reads and signs a form documenting consent. In non-sui iuris patients (under age children, irresponsible persons) or in cases of emergency surgery in which the person is unable to provide informed consent, doctors must contact the liable relatives or patient's legal guardian. Rarely, emergency life-threatening surgery must proceed before the parents or legal guardian may be contacted.

The doctor and a witness, usually a nurse, sign the informed consent at the same time.

In the Czech law the consent is described, in particular, in Section 23, paragraph 2, Coll No. 20/1966 Act (Act on Care for Public Health). Together but it is also defined in the Convention on Biomedicine. Due to that it is an international Convention on Human Rights under Article 10 of the Constitution that is directly applicable and takes precedence over the law.

Article 5 of the Convention, which is a basic rule for consent, sounds as follows: Any intervention in the field of the health care may be performed only on condition that the particular person gave the free and informed consent for that. This person must be properly informed about the purpose and nature of intervention, as well as its consequences and risks. The person concerned may, at any time freely withdraw his/her consent.

If the operation or other intervention is not covered by agreement, its correct implementation does not relieve a physician from liability. It governs even if the procedure is successful. Object of protection is not the patient's health in this case, but his right to free decision-making.

The terms of consent are the real interpretative problem.

Consent must be free and informed. Consent must be given in advance. The patient must be advised of the nature and consequences of surgery and the risks associated with it. With

regard to treatment options, there is no need to mention all, including those which have significant adverse consequences, are obsolete or impracticable in the circumstances, are only available abroad, etc.

Interesting problems arise in connection with the question of what the risk is worth mentioning, and what is so unlikely that it need not be mentioned. International case law has established various criteria (for example, the risk of less than 1% is not already mentioned), however none of these criteria can be applied universally. The most stringent demands are put on the lessons about the risks of cosmetic interventions, there may exist a duty to inform about the risk of per thousand fractions. So called „reasonable person standard“ is used for the legal solution to the problem of adequate guidance in most countries with developed medical law. It follows that the legal assessment of the existence of consent is not relevant whether the doctor information "sent", but whether the patient "received and processed". This places considerable demands on physician communication skills. It is logical that other means will be teaching the patient, who is also a physician with medical education, and other lessons learned patient with very low intelligence (again applies subjective reasonable person standard). The goal of informed consent is not to educate from the patients some experts in the diseases which are affected. Its aim that must be fulfilled, however, is to give to the patient an adequate basis for responsible decision on treatment.

***Special kind of documentation:***

**Surgical documentation (surgical protocol or operation report) is a separated description of operation itself. It must content:**

1. Patient's name, medical record number, date and time of operation
2. Name of chief surgeon, co-surgeons, and/or assistants, nurses, anaesthetist at surgery involved in the case
3. Detailed description of used approach.
4. Kind of special device if any was used
5. Clinical findings during the procedure
6. Clinical findings increased the level of difficulty of the surgery
7. Any intra-operative complication
8. Patient's condition at the end of surgery
9. Estimated blood loss
10. Health insurance codes for the billing statement

**Photographs** serve as comparison of pre- and postoperative status. Along with they illustrate pre-operative findings.

The doctor and the nurse must document everything that she/he has been done during the care process from the moment of first meeting till the final parting. **The doctor and staff must conduct the documentation in all respects so everyone next can carry on the care of the patient.**

***Do not forget:***

**Documentation serves not only for the run of perfect care for the patient but as well as your possibility of protection in a connection with liability litigation.**

**Every state (country) may have own specific regulations, instructions, and rules for medical documentation. Coming to a new facility it is necessary to gain, to learn and to use the correct information in this aspect.**

# COMMON SURGICAL PROBLEMS

## A. NOSOLOGIC UNITS (TUMOURS, CYSTS, ULCERS, SINUSES AND FISTULAS, NECROSIS, GANGRENE)

**Tumour** is the name used for a swelling or lesion formed by an abnormal growth of cells (termed neoplastic). Tumours may be benign, pre-malignant or malignant (cancer). A pathologist determines the nature of the tumour after examination of the tumour tissues from a biopsy or a surgical excision specimen.

In practice a **benign tumour** does not grow in an unlimited, aggressive manner, does not invade surrounding tissues, and does not metastasize.

Other symptoms depend on the type and location of the tumour. Some tumours produce no symptoms, but symptoms that often accompany tumours, mainly malign, include: fever, chills, night sweats, weight loss, loss of appetite, fatigue, malaise, bleeding or occult blood loss causing anemia, pressure causing pain or dysfunction, cosmetic changes, itching, ie pruritus, 'hormonal syndromes' resulting from hormones secreted by the tumour, obstruction, e.g., of the intestines, compression of blood vessels or vital organs.

In order to make a clear diagnosis a biopsy is often performed to determine if the tumour is benign or malignant. Most patients with tumours undergo CT scans or MRI to determine the exact location of the tumour and its extent. More recently, positron emission tomography (PET) scans have been used to visualize certain tumours types.

Treatment also varies based on the type of tumour, whether it is benign or malignant, and its location. If the tumour is benign and does not disturb the proper functioning of the organ, no treatment is needed. Sometimes benign tumours may be removed for cosmetic reasons, however. Benign tumours of the brain may be removed because of their location or harmful effect on the surrounding normal brain tissue.

If the tumour is malignant, it means that it is a systemic disease; management of the treatment belongs to the hands of oncologists. It usually includes surgery, radiation, chemotherapy, or a combination of these methods.

The surgeon then at the request may make surgical removal of tumour, possibly also removal of lymphatic nodes or another intervention. After healing the patient returned for



further treatment (radiation, chemotherapy, etc.) back to the oncology department. Therapeutic procedure is determined on the basis of specifying the stage of the tumour by the identification of tumour size and surrounding tissues involvement. In addition to stage tumour is classified according its characteristics. The most often used classification is called according to described basic features = **TNM (tumour, nodus, metastasis)**.

**T: primary tumour**

T0: no signs of primary tumour

Tx: primary tumour can not be assessed

Tis: carcinoma in situ

T1–4: according to the size and a local extension of tumour

**N: nodes – metastases to regional lymph nodes**

N0: no metastasis to local lymph nodes

Nx: metastases in lymph nodes can not be assessed

N1–3 according to extent of metastatic involvement of local nodes

**M: distant metastases**

M0: no distant metastasis

Mx: distant metastases can not be assessed

M1 presence of distant metastases, also metastases to distant lymph nodes

In addition to these characteristics this classification can be used for further specification

**V: invasion into the veins**

V0: no invasion into vein

V1: microscopic invasion into the vein

V2: macroscopic invasion of a vein

**C: method of diagnostic detection**

C1: Standard procedure (common imaging methods, endoscopy)

C2: special procedures (magnetic resonance imaging, nuclear medicine, biopsy)

C3: surgical exploration with biopsy

C4: definitive surgery and histopathological examination of preparation

C5: autopsy

**R: residual tumour**

R0: no residues

Rx: it is not possible to assess

R1: microscopic residual tumour

R2: macroscopic tumour (in resected tissue with the edge without finding of the tumour)

**G: histopathological evaluation**

G1: well differentiated

G2: moderately differentiated

G3: rare differentiated

G4: non – differentiated

**Cyst** is a closed sac–like structure. Cysts are common and can occur anywhere in the body in people of any age. Cysts usually contain a gaseous, liquid, or semisolid substance. Cysts vary in size. The outer wall of a cyst is called the capsule.

Cysts can arise through a variety of processes in the body, including: "wear and tear" or simple obstructions to the flow of fluid, infections, tumours, chronic inflammatory conditions, inherited conditions, and defects in developing organs in the embryo.

Here are some of the more well–known types of cysts: cysts in the breast (fibrocystic breast disease), ovarian cysts, dermoid cysts, cysts within the thyroid gland, Baker cyst (popliteal) behind the knee, ganglion cysts of the joints and tendons, cysts of the glands within the eyelid, termed chalazions, sebaceous cysts of the small glands in the skin, polycystic kidney disease.

The majority of cysts are benign, but some may produce symptoms due to their size and/or location. Rarely, cysts can be associated with malignant tumours (cancers) or serious infections. Diagnostics is usually based on palpation, X–ray, ultrasound, computer tomography CT, and MRI.

The treatment for a cyst depends upon the cause of the cyst along with its location. Cysts may be surgically removed. If there is any suspicion that a cyst is cancerous, a biopsy is taken of the cyst wall (capsule) to rule out malignancy.

**Ulcers** are defects that develop as a solution of tissue in the skin, mucous membranes, or eye. Although they have many causes (bacterial, viral or fungal infection, cancer – both 'primary' and 'secondary, venous stasis, arterial Insufficiency, diabetes, loss of mobility), they

are marked by: loss of integrity of the area, secondary infection of the site by bacteria, fungus or virus, generalized weakness of the patient, delayed or none healing.

The most frequent clinical examples are peptic ulcer (of the stomach, esophageal cardium or duodenum), pressure sore (decubitus), crural ulcer (due to venous insufficiency or other causes), arterial insufficiency ulcer, ulcerative colitis (of the colon) etc.

Treatment usually starts as a conservative one; in more serious and chronic cases the surgical intervention is necessary. It consists of debridement (removal of foreign bodies and nonvital tissues from the wound) and necrectomy (removal of dead tissue), following by the coverage of the defect by skin graft or flap.

**Sinus** is a sac or cavity in any organ or tissue or an abnormal cavity or passage caused by the destruction of tissue. By the other meaning in surgery the term is used for a chronically infected tract such as a passage between an infected space and the skin.

**Fistula** is an abnormal connection between an organ, vessel, or intestine and another structure. Fistulas are usually the result of injury or unwanted outcome of the, even as a wanted outcome (for example arteriovenous shunt) surgery. It can also result from infection or inflammation. It is a tract connecting two epithelialised surfaces.

Fistulas may occur in many parts of the body. Some of these are: arteriovenous (between an artery and vein), biliary (created during gallbladder surgery, connecting bile ducts to the surface of the skin), cervical (either an abnormal opening into the cervix or in the neck), craniosinus (between the space inside the skull and a nasal sinus), enterovaginal (between the bowel and vagina), faecal or anal (the feces is discharged through an opening other than the anus), gastric (from the stomach to the surface of the skin), pre or retroperitoneal (between the uterus and peritoneal cavity), pulmonary arteriovenous (in a lung, the pulmonary artery and vein are connected, allowing the blood to bypass the oxygenation process in the lung (pulmonary arteriovenous fistula), umbilical (connection between the navel and gut).

Types of fistulas include:

- Blind (open on one end only, but connects to two structures)
- Complete (has both external and internal openings)
- Horseshoe (connecting the anus to the surface of the skin after going around the rectum)

- Incomplete (a tube with an external skin opening and does not connect to any internal structure)

Clinical examples are Crohn's disease and ulcerative colitis, hidradenitis suppurativa, surgical complications, postirradiation complication, trauma.

Treatment of fistulae varies depending on the cause and extent of the fistula, but often involves surgical intervention combined with antibiotic therapy.

**Necrosis** (in Greek Νεκρός = "dead") is the name given to unnatural death of cells and living tissue. It begins with cell swelling, chromatin digestion, and disruption of the plasma membrane and organelle membranes. Late necrosis is characterized by extensive DNA hydrolysis, vacuolation of the endoplasmic reticulum, organelle breakdown, and cell lysis. The release of intracellular content after plasma membrane rupture is the cause of inflammation in necrosis.

In contrast to apoptosis, clean up of cell debris by phagocytes of the immune system is generally more difficult, as the disorderly death generally does not send cell signals, which tell nearby phagocytes to engulf the dying cell. This lack of signalling makes it harder for the immune system to locate and recycle dead cells, which have died through necrosis than if the cell, had undergone apoptosis.

There are many causes of necrosis including prolonged exposure to injury, infection, cancer, infarction, poisons, and inflammation.

**Gangrene** derives from the Latin word "gangraena" and from the Greek gangraina (γάγγραινα), which means "putrefaction of tissues". It is a complication of necrosis characterized by the decay of body tissues, which become black and malodorous. It is caused by infection or ischemia, such as from thrombosis (blocked blood vessel). It is usually the result of critically insufficient blood supply (e.g., peripheral vascular disease) and is often associated with diabetes and long-term smoking. This condition is most common in the lower extremities. The best treatment for gangrene is revascularization (i.e. restoration of blood flow) of the affected organ, which can reverse some of the effects of necrosis and allow healing. Other treatments include debridement and local care, or surgical amputation of nonhealed or irreversibly damaged acral part. The method of treatment is generally determined depending on location of affected tissue and extent of tissue loss.

There three types:

**1) Dry gangrene**

Dry gangrene begins at the distal part of the limb due to ischemia and often occurs in the toes and feet of elderly patients due to arteriosclerosis. Dry gangrene spreads slowly until it reaches the point where the blood supply is inadequate to keep tissue viable. Macroscopically, the affected part is dry, shrunken and dark black, resembling mummified flesh. The dark colouration is due to liberation of haemoglobin from hemolyzed red blood cells, which are acted upon by hydrogen sulfide (H<sub>2</sub>S) produced by the bacteria, resulting in formation of black iron sulfide that remains in the tissues. The line of separation usually brings about complete separation with eventual falling off of the gangrenous tissue if it is not removed surgically.

If the blood flow is interrupted for a reason other than severe bacterial infection, the result is a case of dry gangrene. People with impaired peripheral blood flow, such as diabetics, are at greater risk of contracting dry gangrene. The early signs of dry gangrene are a dull ache and sensation of coldness in the affected area along with pallor of the flesh. If caught early, the process can sometimes be reversed by vascular surgery. However, if necrosis sets in, the affected tissue must be removed just as with wet gangrene.

**2) Wet gangrene**

Wet gangrene occurs in naturally moist tissue and organs such as the mouth, bowel, lungs, cervix, and vulva. Bedsores occurring on body parts such as the sacrum, buttocks and heels—although not necessarily moist areas—are also categorized as wet gangrene infections. In wet gangrene, the tissue is infected by saprogenic microorganisms (*Bac. perfringes*, *fusiformis*, *putrificans*, etc.), which cause tissue to swell and emit a faetid smell. Wet gangrene usually develops rapidly due to blockage of venous and/or arterial blood flow. The affected part is saturated with stagnant blood, which promotes the rapid growth of bacteria. The toxic products formed by bacteria are absorbed causing systemic manifestation of septicaemia and finally death. Macroscopically, the affected part is edematous, soft, putrid, rotten and dark. The darkness in wet gangrene occurs due to the same mechanism as in dry gangrene.

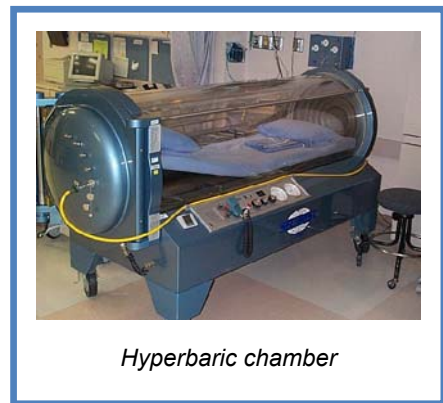
**3) Gas gangrene**

Gas gangrene is a bacterial infection that produces gas within tissues. It is a deadly form of gangrene usually caused by *Clostridium perfringens* bacteria. Infection spreads rapidly as the gases produced by bacteria expand and infiltrate healthy tissue in the vicinity. Because of its ability to quickly spread to surrounding tissues, gas gangrene should be treated as a medical emergency. Gas gangrene is caused by a bacteria exotoxin-producing clostridial species, which are mostly found in soil and other anaerobes (e.g.

Bacteroides and anaerobic streptococci). These environmental bacteria may enter the muscle through a wound and subsequently proliferate in necrotic tissue and secrete powerful toxins. These toxins destroy nearby tissue, generating gas at the same time. Gas gangrene can cause necrosis, gas production, and sepsis. Progression to toxemia and shock is often very rapid.

Treatment is usually surgical debridement, and excision even amputation of involved extremity is necessary in many cases. Antibiotics alone are not effective because they do not penetrate ischemic muscles sufficiently.

Hyperbaroxia can be successfully used in the treatment with re-stay in hyperbaric chamber. Hyperbaric oxygen therapy is a treatment method, using the ability of blood to carry the greater amount of oxygen at a higher atmospheric pressure than under normal conditions. This can be used with very good results in all conditions associated with impaired blood supply of organs. Hyperbaroxia also has an irreplaceable role in the treatment of decompression disease, air embolism, gas gangrene or some intoxication.



*Hyperbaric chamber*

### ***Therapeutic indications of hyperbaric oxygen therapy***

#### **Absolute indications**

Decompression syndrome (for divers and pilots)

Air embolism

Acute traumatic ischemia

Intoxication

- *Smoke gases – CO*
- *combat chemicals*
- *cyanide, tetrachlorem, hydrogen sulphide*

Brain hypoxia (Apalic syndrome, conditions after extralong KPCR, intoxication, injuries)

Crush syndrome and compartment syndrome

Head injury with brain oedema

Infection with Clostridia:

- *Myonecrosis (gas gangrene)*
- *cellulitis (anaerobic toxemia)*
- *Haemorrhagic shock (in which case you can not use the classical method of treatment)*

## **Relative indications**

### ORTHOPEDICS / SURGERY

Non clostridial infection:

Advanced soft tissue bacterial gangrene

Necrosis of fascia

Nonclostridial myonecrosis

Actinomycosis

Chronic osteomyelitis, resistant to conventional therapy

Radiation necrosis of bones and soft tissue

Ulceral and necrotic defects in the leg vascular insufficiency: blood vessels

arteriosclerosis, diabetic gangrene, B rger disease, pressure sores, crural ulcers,  
toxic and allergic angiopathy (vasculitis)

Burns, scalds

Reimplantation of traumatically amputated limbs

Healing of skin grafts with impaired nutrition and blood supply

Pyoderma gangrenosum

Polytraumatic injuries

### ENT

Suddenly arising perceptual disorders of hearing

Acoustic trauma (shooting, intense noise)

Failure of the internal ear, Meni r disease

Neurological vascular disorders

### INTERNAL MEDICINE

Cardiogenic shock complicating AIM

Chronic ICHS including angina pectoris

Adjuvant in operations on the heart

Methemoglobinemia

### GASTROENTEROLOGY

Necrotizing enterocolitis

Pneumatosis cystoides intestinalis

### NEUROLOGY

CVE ischemic etiology

Spinal cord injury and other spinal cord lesions

Sclerosis Multiplex

Migraine

### OPHTHALMOLOGY

Closure of a. centralis retinae

Thrombosis of v. centralis retinae

Diabetic retinopathy

Cataract, neuritis n. opticus

Retinitis pigmentosa

Degeneration of macula

### UROLOGY

Furnier idiopathic gangrene of external genitalia

### ***Contraindications of hyperbaric oxygen therapy***

#### **Absolute contraindications**

Open or aired pneumothorax

#### **Relative contraindications**

Untreated malignant disease

Claustrophobia diagnostically certified

Pregnancy

If in history

- *Spontaneous pneumothorax*
- *state after chest operation*
- *state after operation of secondary and internal ear*

Epilepsy

Lung injury

Emphysema with high CO<sub>2</sub> pressure

Hyperfunction of thyroid gland

Acute viral infection UBW with a high fever

In co-administration of drugs: Adrimycin (doxorubicin), cis-platinum, Antabus (disulfiram)

The above contraindications are relative. In an absolute indication for HO (e.g., severe CO poisoning, gas gangrene, air embolism) it does not take account of these contraindications.



## **B. PARALLEL DISEASES AND PROBLEMS (METABOLIC, CARDIOVASCULAR, VENTILATION, PSYCHOLOGICAL, AND PSYCHIATRIC)**

Always have bad impact into the surgery, post-op course and outcome. Metabolic disorders are caused by problems with chemical processes in the body. Very frequent diabetes mellitus is often connected with poor healing, inclination to infection, and post-op decompensation of basic illness.

Cardiovascular diseases include coronary heart disease (heart attacks), cerebrovascular disease, raised blood pressure (hypertension), peripheral artery disease, rheumatic heart disease, congenital heart disease and heart failure. They have higher risk of tromboembolism, heart problems related to stress, and vascular supply of surgical wound.

Ventilation problems represent hypoxia and respiratory infection.

Cerebrovascular disease does not only represent an increase of somatic risks but also the deterioration of cooperation with patient.

Psychological problems are often underestimated. But they bring psychological risks and adverse outcomes from the side of patient dependent factors: multiple or serious psychological problems, unrealistic expectations, external reasons for surgery, or surgeon-dependent factors: lack of empathy for postoperative problems, too much hurry with evaluations or too little preoperative preparation, or surgeon-patient interaction: poor communication or personality conflict. In the short term, postsurgical discomfort and functional problems may cause dissatisfaction. Neuroticism may also have a negative effect on the early postsurgical phase but not on the long-term outcome. Depression is a relatively common finding following any surgical procedure. During this time, additional support is needed from the family and the medical personnel. In cosmetic surgery and bariatric surgery these problems are much more frequent.

## **C. SPECIFIC ASPECTS (CHILDHOOD, OLD AGE)**

### ***Age***

Adequate preparation can help a **child** feel less anxious about the anesthesia induction and surgery and get through the recovery period faster. The key is in providing information at a child's level of understanding, correcting misconceptions, and dispelling fears and feelings of guilt. It is necessary a child understands the physical problem that requires the surgery and becomes familiar with the hospital and some of the procedures he or she will undergo.

Children of all ages cope much better if they have some concrete idea of what's going to happen and why it's necessary. The close cooperation with family is always recommendable. Hospitals have changed enormously. The stay is shorter and parents may accompany a child practically the whole time except while the surgeon is operating. Sometimes there are some myths around the idea of surgery. Let a child know that the medical problem is not the result of anything he or she may have done or may have failed to do, and that the operation is not a punishment, but simply the way to "fix" the problem. A child's level of anxiety prior to surgery is predictive of whether they will experience post-surgical delirium and maladaptive behavioural changes, including anxiety, nighttime crying, and bedwetting, they are more emotional, more impulsive, and less social.

***Elderly patients*** do not tolerate well postoperative starvation, prolonged pain, sepsis or immobility. They should be given a high surgical priority and more postoperative intensive care. In particular, fluid intake and output immediately before and after surgery needs to be managed better to avoid possible adverse effects. Return back to the home environment as soon as possible is more than beneficial.

# INFLAMMATION AND INFECTION IN SURGERY (WOUND, LOCAL, SYSTEMIC, GENERAL), PREVENTION OF TETANUS, NOSOCOMIAL INFECTION

## INFLAMMATION

**Definition:** Inflammation: is the complex biological response of vascular tissues to harmful stimuli, such as pathogens, damaged cells, or irritants. It is protective attempt by the organism to remove the injurious stimuli as well as initiate the healing process for the tissue.

Inflammation can be classified as acute or chronic. It can be caused by mechanical trauma (e.g. surgical incision), infection (due to bacteria, viruses, fungi or protozoa), chemical and physical agents (such as heat, cold, radiation), ischaemia or hypersensitivity. Mechanical trauma is the most common cause.

### **1. Acute inflammation**

It is the initial response of the body to harmful stimuli and is achieved by the increased movement of plasma and leukocytes from the blood into the injured tissues. A cascade of biochemical events propagates and matures the inflammatory response, involving the local vascular system, the immune system, and various cells within the injured tissue.

It is the inflammatory process of up to one week in duration.

Cardinal signs are calor (heat), rubor (redness), tumour (swelling), dolor (pain), and functio laesa (loss of function).

The development of inflammation can be described as follows: it is initiated by tissue damage or the introduction of microorganisms through the epithelial membrane, which causes an immediate vascular response – a capillary vasoconstriction followed by vasodilatation and a production of exudate (composed of a fluid and cells from the capillaries, protein rich).

The outcome of inflammation can vary. It can lead to a) resolution, b) suppuration, c) spread of inflammation through the tissues, bloodstream or lymphatic system, d) chronic

inflammation, e) fibrosis with scarring, or f) in extreme cases due to multiple organ failure to death.

## **2. Chronic inflammation**

Leads to a progressive shift in the type of cells which are present at the site of inflammation and is characterised by simultaneous destruction and healing of the tissue from the inflammatory process.

It is prolonged inflammatory process taking more than 6 weeks in duration.

Chronic inflammation can develop as a failure of resolution of acute inflammation (e.g. chronic abscess) or it can start as a chronic process from the beginning (e.g. TB, syphilis, leprosy or liver cirrhosis). Chronically inflamed tissue is characterised by the infiltration of mononuclear immune cells (monocytes, macrophages, lymphocytes, and plasma cells), tissue destruction, and attempts at healing, which include angiogenesis and fibrosis. The process results mostly in the formation of granulation tissue, fibrosis or partial regeneration, which can occur in combination with varying extent.

The definitive outcome of any inflammation depends on multiple factors such as an age of a patient, a degree of blood supply, condition of the host immune system, infection dose, a route of introduction, virulence or presence of endotoxins and exotoxins.

## **INFECTION**

**Definition:** Infection is multiplication, spread, and detrimental colonization of a host organism by a foreign species, utilizing the host's resources. The infecting organism, or pathogen, interferes with the normal functioning of the host and can lead to chronic wounds, gangrene, loss of an infected limb, and even death. The host's response to infection is inflammation. Colloquially, a pathogen is usually considered a microscopic organism though the definition is broader, including faeces, parasites, fungi, viruses, prions, and viroids.

Infections are caused mostly by pathogenic bacteria (Gram positive or negative bacteria – both aerobic and anaerobic: most important ones: Staphylococcus pyogenes aureus, Pseudomonas, Streptococcus, Escherichia coli, Proteus, Clostridium; mycotic infections, Candida. The granulomas are products of tuberculosis and syphilis. Also the viruses belong to causative agents.

Severity of infection is determined by virulence of the pathogen, its number and the host response. Risk factors for development of infection include poor perfusion, malnutrition, immunosuppression, inadequate surgical technique, and presence of dead tissue or foreign material.

The most common type of surgical infection is infection originated from direct contact or per continuitatem, also by spreading through lymph vessels or blood vessels. Usually the infection is caused by multiple pathogens; occasionally it is a monoinfection. The symptomatology is often typical for the respective pathogen – for instance, Staphylococci cause abscesses and Streptococci cause cellulitis. Both can give rise to a wound infection, which can be also caused by *Pseudomonas aeruginosa*, *E. coli*, etc. as mentioned above.

The microorganisms can spread from an infected wound through the lymphatic system (which is called lymphangitis or lymphadenitis) or can enter directly the bloodstream and develop bacteraemia, septicaemia or pyemia.

**Types:**

1. Superficial – erysipelas (Streptococci), erysipeloid (*Erysipelothrix rhusiopathiae*), cellulitis, lymphangitis
2. Localized infection: abscess of sweat glands – hidradenitis, folliculitis, furuncle, carbuncle (Staphylococci are the most common)
3. Deep infection of soft tissues – abscess with a membrane and cavity, pyoderma fistulans, gas gangrene
4. Infection in pre-existing body cavities – empyema (e.g. pleura, joints), subphrenical abscess

An infection usually comes from primarily open or contaminated wounds, foreign bodies or it is of iatrogenic origin (catheterization of bladder, surgical wounds).

The treatment of any infection is in general following: evacuation of collected pus, removal of foreign body, wound debridement and surgical revision with a wide wound opening and drainage. It is also advisable to immobilise an infected wound (lymphangitis in particular), to use antiseptics and an appropriate antibiotic treatment.

The complications of wound infection include chronic inflammation and scarring, and as a worst-case scenario it can lead to septic shock (see the chapter Shock).

The prevention of infection comprises strict asepsis during any surgical wound care and antibiotic prophylaxis before surgery when indicated. For instance bowel surgery requires a

short-term antibiotic prophylaxis during operation and/or before an insertion of any implant to the body. It is usually sufficient a one-dose antibiotic prophylaxis.

### **Abscess**

It is a localized collection of pus, which is liquid. It contains exudates, melted dead cells as well as bacteria and damaged tissue. An abscess is easily diagnosed and does require incision and drainage, while does not usually need antibiotics unless there is present cellulitis. Inadequate drainage or dependence on antibiotics may lead to *chronic abscesses* (associated with mycobacteria and actinomycetes), *sinuses* (a blind tract leading from an epithelial surface lined by granulation tissue) or *fistula* formation (abnormal communication between two epithelial surfaces).

### **Cellulitis**

It is a spreading inflammation of connective tissue and it is typical infection caused by  $\beta$ -haemolytic streptococci group A. The condition is always presented with redness, oedema and localized tenderness. The treatment requires an antibiotic administration (usually penicillin) and immobilization of a limb. It does not require surgical treatment unless it is accompanied with collection of liquid i.e. abscess, which needs drainage.

### **Lymphangitis and lymphadenitis**

Lymphangitis is a non-suppurative infection of lymphatic vessels that drain an area of cellulitis. Lymphadenitis is an infection of regional lymph nodes. Lymphangitis is always presented with red streaks under the skin, which are associated with primary lymphadenopathy. An acute inflammation usually subsides after several days on treatment, but occasionally can lead to systemic inflammation. We should treat primarily the original site of infection, administer antibiotics, recommend a rest and do a surgical intervention if needed.

***Phlegmona diffusa*** is a more or less extensive inflammation of the cutaneous and subcutaneous tissues presenting symptoms partaking of the nature of both deep erysipelas and flat carbuncles, and usually accompanied by varying constitutional disturbance. Suppuration at several points takes place, and sloughing may ensue. Recovery usually finally results, but a fatal issue is possible.

### **Bacteraemia**

It is a presence of bacteria in bloodstream. It is transient and usually without clinical symptoms. Bacteraemia happens quite often but bacteria are damaged by the host immune system, which eliminates them and prevents from harmful effect.

## **Septicaemia**

It is a spread of bacteria and/or their toxins to the bloodstream, and contrary to bacteraemia, causes a severe clinical condition, which might be even life threatening. In the past, it was caused typically by streptococci and pneumococci; today a more common cause of sepsis is a Gram negative bug which is associated with infections of digestive or urinary systems or coming from infected foreign bodies (catheters, endoprosthesis, etc.). Septicaemia is clinically presented with shivering, an increase of temperature and general restlessness, exanthema and small capillary bleeding. The treatment requires surgical intervention in the infection site (wound, biliary system, abdominal cavity with peritonitis, etc) and a proper medical treatment. When the condition is not successfully treated, it leads to toxic shock.

### **Specific types of infection**

Gas gangrene – an anaerobic infection caused by *Clostridium perfringens*.

Necrotising fasciitis and synergistic spreading gangrene (Fournier's gangrene) – caused by mixture of streptococci, staphylococci, coliforms and anaerobes

Pseudomembranous colitis – *Clostridium difficile* infection

Gramnegative infection

Actinomycosis

Mycotic infection

## **TETANUS AND PREVENTION**

Tetanus is a rare infection caused by *Clostridium tetani*, an anaerobic Gram-positive rod that produces a neurotoxin. It affects peripheral nerves and travel to the spinal cord where it blocks inhibitory spinal reflexes. *Clostridium* is found widely in the environment, e.g. in soil and faeces, and its port of entry is usually a wound (most dangerous can be deep wounds made with a foreign body, necrosis).

An incubation period is 4–14 days and tetanus is then presented with spasms in a cranio-caudal direction. Clinically we can see typical symptoms such as trismus, risus sardonicus and opisthotonus (a severe hyperextension of the neck and the back due to spasm). A patient dies for asphyxia due to convulsion of breathing muscles and laryngospasm. Consciousness is not altered during the whole period. The mortality rate can reach up to 60%.

In the prevention of tetanus, proper surgical wound care and active and passive immunization play the most important role.

### ***Active immunization = vaccination***

It is provided by tetanus toxoid ALTEANA ® 0.5 mg administered intramuscularly (to the deltoid muscle).

- a) Regular – all children should be immunized and this is repeated after 6 weeks and 6 months after the initial dose. Booster doses should be given at 10–year intervals.
- b) Irregular – after any injury or wound puncture, new trauma

### ***Passive immunization***

It is provided by anti–tetanus immunoglobulin – TEGA 2 mls (250 Units) administered intramuscularly.

All patients with a new trauma should get a booster dose unless it has been given to them within the last 5 years.

The contaminated and penetrating wounds should be debrided and prophylactic penicillin administered. The tetanus toxoid booster dose should be given only to the previously immunized patient. If a patient has not been yet immunized he/she should be given a human anti–tetanus immunoglobulin.

**Remember: Any vaccination should be properly recorded !!! Patient must obtain a warrant of vaccination, or at least proper document.**

## **NOSOCOMIAL INFECTION**

Definition: Infection acquired in the hospital setting.

Before 1988 the infection was only considered nosocomial if it started 48–72 hours after admission to the hospital. Nowadays, nosocomial infections also include wound infections within 30 days after surgery, in case of indwelling catheter 7 days, joint prosthesis within 1 year.

Principles of the origin and existence of nosocomial infection:

- High susceptibility of the organism
- Reduced immunity (also artificially)
- The abolition of barriers

Agents may have low resistance to survival, but high resistance to antibiotics and disinfecting means.

The most frequent ones are urinary tract infection (42%) wound infection after surgery (22%), pneumonia (11%), septicaemia and others.



The origin of nosocomial infection can be endogenous or exogenous.

1. **Endogenous** – caused mostly by bacteria, which are present in a body before patient's hospitalization. Due to medical intervention they can break the natural barriers. Microorganisms can also colonize the patient without any harmful effect during hospitalization and cause an infection later on.
  - Patients on ICU – gram–negative bacteria (Enterobacter, Pseudomonas), pneumonia, micro–aspiration of the unconscious patient
2. **Exogenous** – caused by bacteria or viruses, which may survive for a long time in hospital and transmitted from the staff (contaminated hands), from inhalators, liquid soap, contaminated endoscopes, showers, etc.

Typical examples of nosocomial infection causing a lot of problems are:

- Clostridium difficile – nosocomial diarrhoea (pseudomembranous colitis) can be endogenous or exogenous
- Wound infection caused by MRSA (Methicillin–resistant Staphylococcus aureus)
- Calicivirus and rotavirus epidemics

The number of nosocomial infections is increasing due to a lot of factors such as prolonged hospitalization, invasive diagnostic and treatment methods, ageing of patients and having more patients on immunosuppression. Nosocomial infections cause substantial morbidity and mortality, make the hospital stay longer and increase a direct patient–care cost.

The fight against the infection is primarily medical, microbiological, but also it is hygiene and social problem. All precautions should be done during the whole hospitalization of any patient.

***The most serious are infections caused by resistant micro – organisms.***

MRSA: high incidence in the U.S., resistant to beta–lactams, MAK, TET, sensitive. to VAN, TEI, improper MRSA – sensitive. to AM / INH, wound colonization, oral cavity, nose, etc.

VISA, GISA, VRSA, GRSA, VRE (vancomycin–resistant Enterococci)

ESBLY (extended spectrum beta–lactamase, especially in Klebsiella, E. coli) resistant to beta – lactams except penems, IMC, colonization and infection of wounds, etc.

multi–G–bacteria (Pseudomonas, Acinetobacter, Serratia)

IMC, the UPV airways, catheters

candida resistant (C. krusei, C. glabra)

**Remember: It is necessary to report all nosocomial infections!!! Every facility must have a register of nosocomial infection and must follow the incidence of this unwanted complication.**

## **HISTORY OF SURGICAL CLOTHING**

In contrast to the uniforms long required of nurses, surgeons did not wear any kind of specialized garments until well into the 20<sup>th</sup> century. Surgical procedures were conducted in an "operating theatre" – an amphitheatre – or auditorium–type room with a raised table at centre stage and several rows of seats to allow students and other spectators to observe the case in progress. The surgeon wore his street clothes, with perhaps a butcher's apron to protect his clothing from blood stains, and he operated barehanded with non–sterile instruments and supplies. (Gut and silk sutures were sold as open strands with reusable, hand–threaded needles; packing gauze was made of sweepings from the floors of cotton mills.) In contrast to today's concept of surgery as a profession that emphasizes cleanliness and conscientiousness, at the beginning of the 20<sup>th</sup> century the mark of a busy and successful surgeon was the profusion of blood and fluids on his clothes.

With the "Spanish flu" pandemic of 1918 and the growing medical interest in Lister's antiseptic theory, some surgeons began wearing cotton gauze masks in surgery – however, this was not to protect the patient from intra–operative infection, but to protect the surgeon from the patient's diseases. Around the same time, operating theatre staff began wearing heavy rubber gloves to protect their hands from the solutions used to clean the room and equipment, a practice surgeons grudgingly adopted.

By the 1940s, advances in surgical antisepsis (now called aseptic technique) and the science of wound infection led to the adoption of antiseptic drapes and gowns for operating room ("OR") use. Instruments, supplies and dressings were routinely sterilized by exposure to either high–pressure steam or ethylene oxide (EtO) gas.

Originally, OR attire was white to emphasize cleanliness. However, the combination of bright operating lights and an all–white environment led to eyestrain for the surgeon and staff, and additionally, many people found the sight of bright red blood splashes on a white gown or drape rather off–putting. By the 1950s and 1960s, most hospitals had abandoned white OR apparel in favour of various shades of green, which provided a high–contrast environment and reduced eye fatigue.

By the 1970s, surgical attire had largely reached its modern state: a short-sleeve V-necked shirt and drawstring pants or a short-sleeve calf-length dress, made of green cotton or cotton/polyester blend. Over this was worn a tie-back or bouffant-style cloth cap, a gauze or synthetic textile mask, a cloth or synthetic surgical gown, latex gloves and supportive closed-toe shoes. This uniform was originally known as "surgical greens" because of its colour, but came to be called "scrubs" because it was worn in a "scrubbed" environment.

### ***Modern scrubs***

Today, any medical uniform consisting of a short-sleeve shirt and pants are known as "scrubs". Scrubs may also include a waist-length long-sleeved jacket with no lapels and stockinet cuffs, known as a "warm-up jacket". Nearly all-patient care personnel in the United States wear some form of scrubs while on duty, as do some staffers in doctors' offices. These types of scrubs can come in any colour or pattern. Scrubs featuring cartoon characters and cheerful prints are common in pediatricians' offices and children's hospitals, while prints for various holidays can be seen throughout the year. Some hospitals use scrub colour as a way of quickly identifying a staff member's department, e.g. light blue for Surgery, pink or lavender for Labour and Delivery, dark green or dark blue for Emergency, and so forth. A few hospitals extend this convention to non-staff and visitors in order to make these people clearly identifiable. (For example, visitors may wear yellow scrubs, while staffers wear blue.) Scrubs may have the hospital's name or logo imprinted on them (commonly on pockets or at knees), or they can come in custom colours, e.g. a university hospital may have scrubs in the school's colours.

Scrubs worn in surgery, in contrast, are almost always coloured solid light green, light blue or a light green-blue shade. Surgical scrubs are rarely owned by the wearer; due to concerns about home laundering and sterility issues, these scrubs are hospital-owned or hospital-leased through a commercial linen service.

Scrubs are also commonly used as the basis for "doctor" or "nurse" costumes.



*Surgical gown*

Scrubs are not as universal in hospitals outside of the United States, for example in most of Europe Nurses and Midwives mostly wear a uniform of tunic and trousers or a dress. Doctors tend to wear smart clothes with a white coat except for surgery.

### **Scrub caps**

Scrub hats (scrub caps) have graduated from being functional to being a personalizable accessory both in the OR and outside. Before the antiseptic focus of the 40's, hats were not considered essential to surgery. In the forties and fifties, as a hygienic focus swept the industry, hats became standard wear to help protect patients from contaminants of hair. Full-face hats were even designed for men with beards. These hats have been, and continue to be distributed by GPOs (Group Purchasing Organizations) who supply hospitals with most equipment.

In the medical fashion 'revolution' of the seventies, more and more medical professionals began personalizing their scrubs by either sewing their own hats or buying premade hats made of eclectic fabric. Several styles were popular, including the 'bouffant', a utilitarian hairnet-like hat, and the 'milkmaid', a bonnet-like wrap around hat. Another revolution occurred recently fortifying the fashion focus of the medical scrub industry. The blue sky scrubs 'Pony' hat was invented in Texas for fashion conscious medical personnel. The hat holds up long hair and is made in several styles.



Scrub caps

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Even the use of clothing is individual to certain extent according the provisions of particular state. In the Czech Republic special clothing is prescribed for operating room and the other for need of inpatient or outpatient department. The cap and mask (at present almost everywhere single-use) and also special shoes belong to mandatory different color clothes of operating theatre. The same equipment is necessary for the workplace, where are used the invasive diagnostic-therapeutic procedures (eg. ARD) or it is a highly infectious area (department of microbiology, treatment of infectious diseases). For other medical facilities is also prescribed protective complete clothing and shoes.

# WOUND TYPES, THEIR CHARACTERISTICS, AND WOUND HEALING

## 1. TYPES OF WOUNDS

**A. Open wounds** can be classified according to the object that caused the wound. The types of open wound are:

- **Incisions or incised wounds**, caused by a clean, sharp-edged object such as a knife, a razor or a glass splinter.
- **Lacerations**, irregular wounds caused by a blunt impact to soft tissue that lies over hard tissue (e.g. laceration of the skin covering the skull) or tearing of skin and other tissues. Lacerations may show bridging, as connective tissue or blood vessels are flattened against the underlying hard surface.
- **Abrasions** (grazes) or excoriation are quite superficial wounds in which the top layers of the skin (the epidermis, upper corium) are scraped off. Abrasions are often caused by a sliding fall onto a rough surface.
- **Puncture wounds**, caused by an object puncturing the skin, such as a nail or needle.
- Cutting wounds (vulnus sectum) originates by the hit of cutting object to the body, it has smooth edges, sharp angles, is of the same depth throughout its course or wedgelike constricts. The edges of the wound are according to the shape of instruments, which hit the surface of the body.
- Bite (vulnus morsum) is due to bite of humans or animals. Depending on the type of teeth and the pressing force there is a bruising wound, puncture wound, or laceration. Very often it is the combined type of injury or loss injury. Bite wounds are often contaminated and heal with difficulties.
- Firearm wounds (vulnus sclopetarium) have the score, shooting channel and shot. The wound, which has a score and shot (projectile passed through the body), is called a bullet hole. These wounds are primarily infected, because the projectile enters deeply into the tissues of organisms.

- According to affected tissue can be distinguished penetrating, blunt and perforating wounds.
- **Penetration wounds** go from the surface and enter the cavities or organs of the body. In blunt or non-penetrating trauma, there may be an impact, but the skin is not necessarily broken. The penetrating object may remain in the tissues, come back out the way it entered, or pass through the tissues and exit from another area. Perforating trauma is associated with an **entrance wound** and with larger **exit wound**. It can be caused by a foreign object or by fragments of a broken bone. Penetrating trauma can be serious because it can damage internal organs and presents a risk of shock and infection.

**B. Closed wounds** may be dangerous as open wounds. The types of closed wounds are:

- **Contusions** are caused by blunt force trauma that damages tissues under the skin.
- **Crushing injuries** are caused by a great or extreme amount of blunt force applied over a long period of time. Often they are lethal not only due to primary damage itself but also due to secondary process, called crush syndrome. It is a serious medical condition characterized by major shock and renal failure following a crushing injury to skeletal muscle. It appears after the release of the crushing pressure. The mechanism is release of muscle breakdown products – notably myoglobin, potassium and phosphorus into the bloodstream.

## **2. WOUND HEALING**

All types of acute tissue disorders and damage (for example injuries, surgical wound, myocardial infarction) all undergo a similar reparative process. How the body repairs damaged tissue and what factors influence the wound healing process it is necessary to know for the check of post-op course.

### ***Phases of Wound Healing***

The entire wound healing process is a complex series of events that begins at the moment of injury and can continue for months to years. The wound healing process has 3 phases. They are the inflammatory phase, the proliferative phase, and the maturational phase.

#### **I. Inflammatory Phase (2–5 days)**

In the inflammatory phase, bacteria and debris are phagocytized and removed, and factors are released that cause the migration and division of cells involved in the proliferative phase.

### **A) Hemostasis**

- Vasoconstriction
- Platelet aggregation
- Thromboplastin makes clot

### **B) Inflammation**

- Vasodilation
- Phagocytosis

## **II. Proliferative Phase (2 days to 3 weeks)**

The proliferative phase is characterized by angiogenesis, collagen deposition, granulation tissue formation, epithelialization, and wound contraction. In angiogenesis, new blood vessels grow from endothelial cells. In fibroplasia and granulation tissue formation, fibroblasts grow and form a new, provisional extracellular matrix (ECM) by excreting collagen and fibronectin. In epithelialization, epithelial cells crawl across the wound bed to cover it. In contraction, the wound is made smaller by the action of myofibroblasts, which establish a grip on the wound edges and contract themselves using a mechanism similar to that in smooth muscle cells. When the cells' roles are close to complete, unneeded cells undergo apoptosis.

### **A) Granulation**

- Fibroblasts lay bed of collagen
- Fills defect and produces new capillaries

### **B) Contraction**

- Wound edges pull together to reduce defect

### **C) Epithelialization**

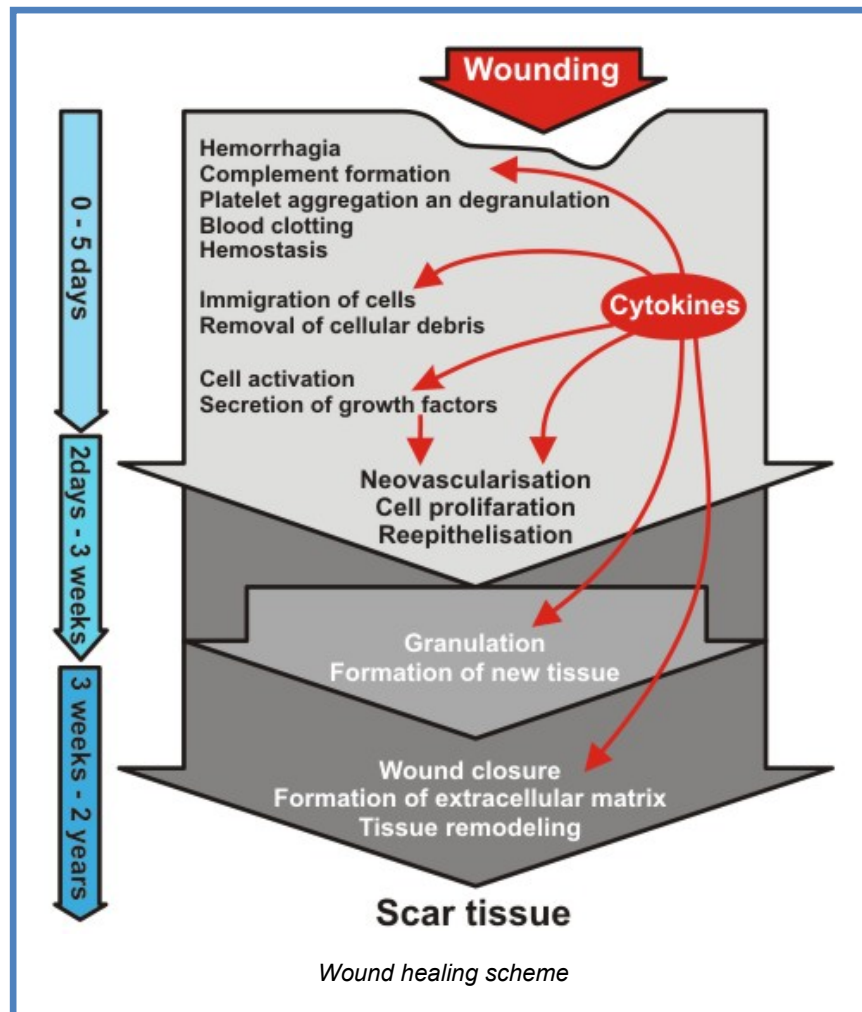
- Crosses moist surface
- Cell travel about 3 cm from point of origin in all directions

## **III. Remodeling Phase (3 weeks –2 years)**

In the maturation and remodelling phase, collagen is remodelled and realigned along tension lines and cells that are no longer needed are removed by apoptosis.

- New collagen forms which increases tensile strength to wounds
- Scar tissue is only 80 percent as strong as original tissue

However, this process is not only complex but fragile, and susceptible to interruption or failure leading to the formation of chronic non-healing wounds. Delayed wound healing often occurs in seriously ill patients, mainly with metabolic disorders (diabetes mellitus) or arteriovenous diseases, exhausted patients (malignant tumours, severe injuries and polytrauma, infection), and in the elderly.



## Healing by

### Primary Intention:

- When wound edges are directly next to one another
- Little tissue loss
- Minimal scarring occurs
- No infection
- Wound closure may be performed with sutures immediately or very early



- Delayed primary closure (Tertiary Intention): the wound is initially left open, cleaned, debrided and observed for necessary period, then it is possible to make a closure or a skin grafting (burns).

**Secondary Intention:**

- The wound is kept widely open and allowed to create a granulating tissue at the bed
- Large tissue loss (at least skin shell)
- Broader, often instable, scar
- Frequently infected
- Wound care must be performed daily to suppress infection, to support wound debris removal and granulation tissue formation

***Specificity***

**Delayed suture** (per tertiam intention) means a wound is primarily left open. After cleaning, the removal of devitalized tissue and follow up during the necessary period, it is possible to make the closure by suture or if necessary by skin grafting.

# PREOPERATIVE PREPARATION OF THE PATIENT

Preoperative care is the preparation and management of a patient prior to surgery. It includes both physical and psychological preparation.

Patients who are physically and psychologically prepared for surgery tend to have better surgical outcomes. Preoperative care is extremely important prior to any invasive procedure, regardless of whether the procedure is minimally invasive or a form of major surgery.

Various preparations are made in the days and weeks before surgery. It is often recommended that physical conditioning and nutrition be improved as much as possible, because good general health helps a person recover from the stress of surgery.

Eliminating or minimizing tobacco and alcohol use before undergoing surgery that involves general anaesthesia can increase safety. Recent tobacco use makes abnormal heart rhythms more likely to develop during general anaesthesia and impairs lung function. Excessive alcohol consumption can damage the liver, causing heavy bleeding during surgery and unpredictably increasing or decreasing the effect of the drugs used for general anaesthesia. Alcohol consumption should be decreased gradually, however, because a sudden decrease before undergoing general anaesthesia can cause harmful effects, such as fever and abnormalities of blood pressure or heart rhythm.

Assuming a larger blood loss a patient may wish taking and preservation of own blood. Using of own blood (autologous transfusion) eliminates the risk of infection and the majority of reaction after transfusion. Certain amount of blood can be taken repeatedly (if necessary) and it is possible to keep it up to the operation. The body will replace the missing blood within 1 week after sampling.

The doctor performs a physical examination and takes a medical history, which includes the person's previous problems, recent symptoms, past medical conditions including allergies, use of tobacco and alcohol. The person is also asked to list all pharmaceuticals currently being taken. Non-prescription as well as prescription drugs must be disclosed, or serious health problems could result. For example, the use of aspirin (some trade names ECOTRIN, ASPERGUM), which a person may consider too trivial to mention, can increase bleeding during surgery.

Tests performed before surgery (preoperative testing) may include blood and urine tests, and an electrocardiogram. Further examination depends on parallel diseases, for example in patients with cardiopulmonary disorders X-rays, and pulmonary function tests are also necessary. These tests determine how well the vital organs are functioning. If organs are functioning poorly, the stress of surgery or anaesthesia can cause problems. Preoperative tests may also reveal an unapparent temporary illness, such as an infection, which would require the postponement of surgery.

When admitting a patient to the hospital the surgeon reviews suggested treatment and surgical approach to the patient. They consider the risks and benefits of operation together and surgeon answers the patient questions. Based on this explanation a patient gives the permission to the surgeon to perform the operation. This permission is called informed consent. The patient reads and signs a form documenting consent. In non sui iuris person (children under 18 years of age, irresponsible person deprived of legal capacity) or in emergency situation in which the person is unable to provide informed consent, doctors must contact the liable relatives or legal guardian. Rarely in the life-saving interventions, is the operation performed before contacting the family or legal guardians. Preoperative explanation meets the patient's need for information regarding the surgical experience, which in turn may alleviate most of his or her fears. Patients who are well informed about what they can expect after surgery, and who have the opportunity to express their goals and opinions, often cope better with postoperative pain and decreased mobility.

The anaesthesiologist may meet the person before the day of surgery to review test results and identify any medical conditions that might affect the choice of aesthetic. The safest and most effective types of anaesthesia may be discussed as well.

Because some of the drugs given during surgery may cause vomiting, the person should generally not eat or drink anything for at least 6 hours beforehand. Specific guidelines should be given and vary depending on the kind of surgery. The person should ask the doctor which of his regularly prescribed drugs should be taken before surgery. People undergoing surgery involving the intestines are given laxatives and desinfection for a day or two before the operation; eventually the clysmas may be administered repeatedly.

Because the device that monitors the level of oxygen in the blood is attached to a finger and reacts to the colour of nail bed, nail polish and artificial nails should be removed before going to the hospital. Proper bath or shower of the whole body is necessary. To reduce the preoperative anxiety hypnotics are regularly used in the evening before the day of surgery (Diazepam®, Hypnogen® etc.)

## **THE DAY OF SURGERY**

Before most operations, a person removes all clothing, jewellery, hearing aids, dentures, and contact lenses or eyeglasses and puts on a hospital gown. The person is taken to a specially designated room (the holding area) for final preparations before surgery. The skin that will be cut (operative site) is scrubbed with an antiseptic, which removes bacteria, helping to prevent infection. A nurse or health care assistant may shave the operative site. A plastic tube (catheter) is inserted in one of the veins of the hand or arm, through which fluids and drugs are given. A drug may be given intravenously for sedation. Approximately 30–60 minutes before the surgery a premedication is given to the patient. It usually consists of parasympatolytics (Atropin ®), analgesics (Dolsin ®), and drugs with anxiolytic, sedative, and antihistaminic effect. In special cases with risk of tromboembolism the low molecular heparins as well as intravenous administration of liquids may be applied during several hours before the surgery. When a patient with infection or in risk acquires the infection is operated he/she must get the therapeutic or prophylactic antibiotic treatment. The intravenous administration starts one hour prior the surgery and continues by the need.

Antibiotic prophylaxis use means an administration of antibiotics as a protection against possible infection in non–infectious patients.

## **PRINCIPLES OF PROPER PROPHYLAXIS ARE:**

Antibiotic is always administered before the operation, using of non–toxic antibiotics, bactericidal (or bacteriostatic able to achieve bactericidal effects in a given quantity), it is not long – 24, maximum 48 hours.

Prophylactic use is used for reasons of parallel illnesses and with aspect to the surgery. The overall problems include heart diseases with high and medium risk (bacterial endocarditis, prostheses of heart valves, congenital malformations with cyanosis, condition after the heart transplantation, hypertrophic cardiomyopathy, acquired valve defects, mitral valve prolapse with regurgitation), impaired immune system (i.e., patients after cancer treatment, HIV positive, after organ transplantation, decompensated diabetes mellitus), rheumatoid arthritis treated by steroids, patients on dialysis programme. Basis of prophylaxis consists of a group of penicillin antibiotics: Amoxicillin 2 g 1 hour before surgery (ampicillin 2 g i.m., intravenously 30 min before surgery).

In patients allergic to penicillin antibiotics: Klindamycin 600 mg 1 hour before the surgery (Klindamycin 600 mg i.m. 30 min before operation). The second group is indications of antibiotic prophylaxis are the surgical reasons, which mean the use in such surgeries; their

severity or scope may be in the postoperative period complicated by bacterial infections. This is for example the extirpation of bone cysts, implantation of foreign bodies, more complex operations in a contaminated site (oral cavity, intestine, and lung).

For the prophylaxis penicillin antibiotics, cephalosporins of first generation and lincosamids are used the most frequently.

### **IN THE OPERATING ROOM**

Finally a patient is taken on the special trolley to the operating tract.

At this point, the person may still be awake, although groggy, or may already be asleep. The person is moved to the operating table, over, which are specially, designed surgical lights. Doctors, nurses, and other personnel who will be near or touching the operative site thoroughly scrub their hands with antiseptic soap, which minimizes the number of bacteria and viruses in the operating room. For surgery, they also wear scrub suits, caps, masks, shoe covers, sterile gowns, and sterile gloves.

Anaesthesia – regional, or general – is given.

The operating room provides a sterile environment in which the operating team can perform surgery.

The operating team consists of the chief surgeon, who directs the surgery; one or more assistant surgeons, who help the chief surgeon; the anaesthesiologist, who controls the supply of aesthetic and monitors the person closely; the scrub nurse, who passes instruments to the surgeon; and the circulating nurse, who provides extra equipment to the operating team.

The operating room gives a space for surgical performances. It typically contains the surgical table, the operating lamp, an instrument table, coagulation, suction, anesthesiological machine, and a monitor that displays vital signs. Aesthetic gases are piped into the aesthetic machine. A catheter attached to a suction machine removes excess blood and other fluids, which can prevent surgeons from seeing the tissues clearly. Intravenous fluids, started before the person enters the operating room, are continued.

Prepare of operating field continues when patient has been under the regional or general anaesthesia. The special disinfection agents are used (Betadine ® etc.) to make widely the

final cleaning. Then the sterile sheets limit the requisite area for the surgical approach. In cases when the local infiltrative anaesthesia is used, this the moment of its application. And the surgery may start... If the patient is under the local anaesthesia do not forget to inform him/her intermittently about the intended next steps of the surgery course.

When it is finished, the polluted area is again washed, usually using the sterile inert solutions. The dressing covers the wound and patient is waked up. Then he/she is transferred on the trolley back to the post-op ward.

### ***Review of Special Steps and Staff Tips for Pre-operative Management of the Patient***

The purpose of the pre-operative evaluation is to identify the problems, which may increase the operative risk and predispose to postoperative problems.

## **PRE-OPERATIVE ASSESSMENT**

Whenever possible, pre-operative assessment should be performed prior to admission.

1. Full history: present, past illnesses, operations, and allergies, bleeding tendencies
2. Examination:
  - Local – concerning the present operation
  - General – thorough examination of all systems, especially the cardiovascular and respiratory.
3. Laboratory tests: full blood count (FBC), blood haemoglobin, blood sugar, liver function tests (bilirubin, hepatic transaminases), erythrocyte sedimentation rate, C-reactive protein, and clotting screen.

E.g.: haemoglobin level—decreased in anaemia, increased in polycythaemia and dehydration. White cell count is increased if there is infection. Neutrophilia results from bacterial infection, lymphocytosis from viral infection and eosinophilia from allergy. White cell count is decreased in overwhelming infection. C-reactive protein is elevated in inflammatory conditions, infection and tissue injury.

4. Radiographs: CXR (chest X-ray) – in all patients with cancer, cardiac, respiratory and renal disease. CXR can show signs of chronic lung disease, cardiomegaly and cardiac failure.
5. ECG: in all patients over the age of 40 and those with cardiac, respiratory and renal disease.

Young fit patients may require no investigations before a minor elective operation; specialized tests need surgical patients with other medical problems.

**Classification of pre-operative state** was defined by American Society of Anaesthesiologists – **ASA grading**. It attempts to quantify the risks of anaesthetizing patients with various clinical conditions.

- Class 1: healthy patient
- Class 2: mild or medium systemic disease, no functional limitations
- Class 3: severe systemic disease with limitations of activity
- Class 4: severe systemic disease that is a constant threat to life
- Class 5: moribund patient with unfavourable prognosis, the surgery is the last option of the treatment

### **PREOPERATIVE CARE**

1. General care – same for any type of operation.
2. Special care – focused on age, current disease, other medical problems of surgical patients.

Both general and special care is influenced by type of the operation.

3. Local care

#### ***General care***

1. Obtain informed consent. It is important to talk to every patient before the operation, explain all forms of possible treatment available for the condition, the nature of the operation, risks and the results. Obtain the signature of the patient, parent or legal guardian. Confirm the site of operation. Mark the appropriate side.
2. Anaesthetic premedication
3. Physiotherapy – breathing exercises, exercises influencing blood circulation. DVT prophylaxis (deep venous thrombosis prophylaxis) – compression stockings, subcutaneous low molecular weight heparin
4. Cross-match of blood if major operation with expected blood loss
5. Nil by mouth 6 hours pre-op
6. Intravenous administration of fluids
7. Medication planning (e.g. insulin, steroids, antibiotics...)

### **Local care**

Skin preparation: patient should take a bath, operation site should be shaved, and preparation of the skin itself consists in application of skin antiseptics. Operation field is rubbed on with swabs 2–3 times; operation field is lined with sterile sheets.

### **Special care**

Special care is focused on medical problems in surgical patients and correction of abnormalities resulting from current disease.

Special care is needed in

1. Patients at extremes of life in elderly, newborns and infants. Smaller dose of narcotics, sedatives and analgesics are needed.
2. Obese patients. Obesity often results in poor healing, higher incidence of respiratory problems. DELAY ELECTIVE SURGERY UNTIL THE PATIENT LOOSES WEIGHT.
3. Patients with allergy. Unsuspected reactions may occur (sensitivity to surgical dressing...)
4. Patients with malnutrition, vitamin deficiency, immunosuppression...
5. Patients using drugs e.g. anticoagulant therapy, insulin.... Adjust anticoagulant therapy, conversion from warfarin to heparin over the peri-operative period.

### **Medical problems in surgical patients**

Cardiac, respiratory, renal, hepatic, haematological, endocrine

#### **1. Cardiovascular problems**

Cardiology opinion is necessary in patients with angina, cardiac failure, arrhythmias, valve heart disease, hypertension, cerebrovascular disease. Elective surgery should be delayed 6 months after myocardial infarction, better to say till full cardiopulmonary compensation. Cardiac failure should be stabilised at least 1 month before surgery. Mild hypertension without renal or cardiac complications does not significantly affect surgical risk. Control blood pressure (BP) at 160/95. Check potassium level (K+) in serum of patients on diuretics. Patients with valve heart disease and prosthetic valves need prophylactic antibiotics. Chronic anticoagulant therapy should be converted to heparin. Discontinue warfarin 3–4 days preoperatively and start heparin or low-molecular weight heparin.

#### **2. Respiratory disease**

This is a major cause of postoperative problems in elderly. Preoperative tests should include CXR. In major operations lung function tests, spirometry, and sputum culture. Peri-operative management: stop smoking. Preoperative physiotherapy, breathing exercises, antibiotics, nebulisation, avoid narcotic analgesics, postoperative physiotherapy, and early mobilisation.



### **3. Renal disease**

Impairment of renal function shows raised urea or creatinin. It is necessary to refer to nephrologist. Important is adequate pre-operative hydration. Caution with nephrotoxic drugs like for example gentamicin.

### **4. Hepatic disease**

There is high incidence of morbidity and mortality by cirrhosis due to anaemia, electrolyte disturbances, abnormal clotting, malnutrition, abnormal drug metabolism, portal hypertension. Defective synthesis of clotting factors and thrombocytopenia (hypersplenism) may result in excessive bleeding.

Hepatitis: little risk in hepatitis A in the past, hepatitis B, C may be carried permanently. Check HbsAg, liver function tests LFT's (bilirubin, hepatic transaminases, albumin, and alkaline phosphatase), clotting screen-platelet count, protrombin time (PT), tromboplastin time.

Coagulation defect and protein deficiency should be corrected. Avoid hepatotoxic drugs and drugs metabolised by liver.

### **5. Endocrine disease**

Diabetes mellitus affects many systems. Principles of management of diabetes in peri-operative period depend on whether they are insulin dependent, on oral hypoglycaemics or controlled by diet.

In insulin dependent patients depot insulin is replaced with short-timed insulin in intravenous infusion (glucose level should be between 4-10 mmol/l). Check glucose level regularly.

Patients using oral hypoglycaemics should be converted to insulin in major surgery. In minor surgery omit oral hypoglycaemic agent. Regular check of glycaemia is necessary.

### **Instruction to nurses**

1. The site of the operating field should be shaved.
2. Removals of all items, which are not firmly, fasten to the body, for example dentures, jewellery, etc.
3. Pre-op diet means nil orally for patient from 12 midnight on day before surgery. Bowel preparation for surgery of colon.
4. Exceptionally catheters, cannulation of central vein in major surgery, introduction of nasogastric tube.
5. Premedication.
6. Prophylactic antibiotics.

# **THE SURGICAL TEAM. OPERATING THEATRE AND OPERATING THEATRE EQUIPMENT. OPERATING THEATRE MANAGEMENT**

The surgery is a procedure, realised by the team of doctors, nurses, and additional staff.

The surgical team is a unit providing the continuum of care beginning with preoperative care, and extending through peri-operative (during the surgery) procedures, and postoperative recovery, however during surgery it is led by one surgeon performing the most critical work himself while directing his team to assist with.

Each specialist of the team, whether surgeon, anaesthesiologist or nurse; has special training. It may be different according to the regulations and rules of particular country.

## **THE SURGEON:**

After completing the medical school a surgeon receives further specialized training. In the Czech Republic it lasts at least 5 years. He starts with the assisting to the senior surgeons, later he provides surgery under their supervision, and finally he performs operations independently. There exists a list of obligatory surgeries one has had to do during the training as well as special courses, stays at different subspecialties etc. When the candidate matches all specified conditions this time finishes with oral and practical examination. Based on this training and examination, both with the responsibility of Institute of Postgraduate Education in the Health Care and Ministry of Health, surgeon applies and obtains the license for practice from Medical Chamber.

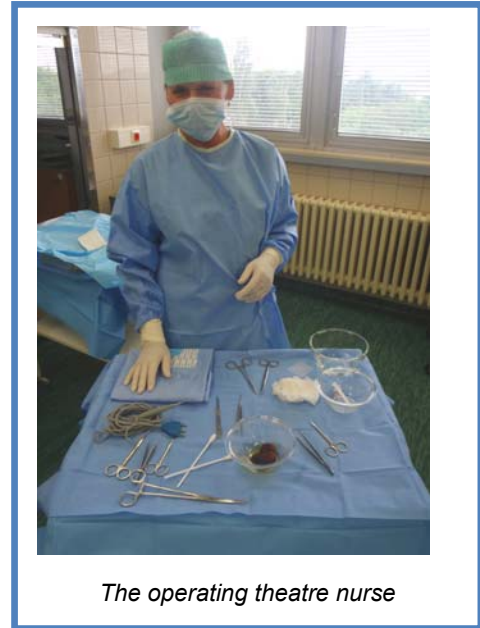
## **THE ANAESTHESIOLOGIST:**

An anaesthesiologist has to complete five years of post-medical school training in anaesthesia. Similarly like in surgery anaesthesiologist starts with observing, then she/he continues with simpler procedures with supervision, and finally she/he is independent specialist. Anaesthesiologists usually further specialize in certain surgery specialties, such as paediatric anaesthesia, cardio surgical anaesthesia etc. The anaesthesiologist is involved in all three phases of surgery: preoperative, intra-operative, and postoperative management.

## THE OPERATING THEATRES

### NURSE/CIRCULATING NURSE:

Nurses pass an education and training in the specialized schools. College must complete the medical focus (Higher School Health), or a bachelor s degree with a medical focus. In that time they are ready to take care for patients under the supervision and direction of doctors. Later, getting further education, they can specialize (paediatric nurse, anaesthetist nurse, operating room nurse etc.) The operating room nurse takes care of material and instruments during surgery and also she/ he may assist the surgeon. Operating room nurses may be specialised in various surgical branches.



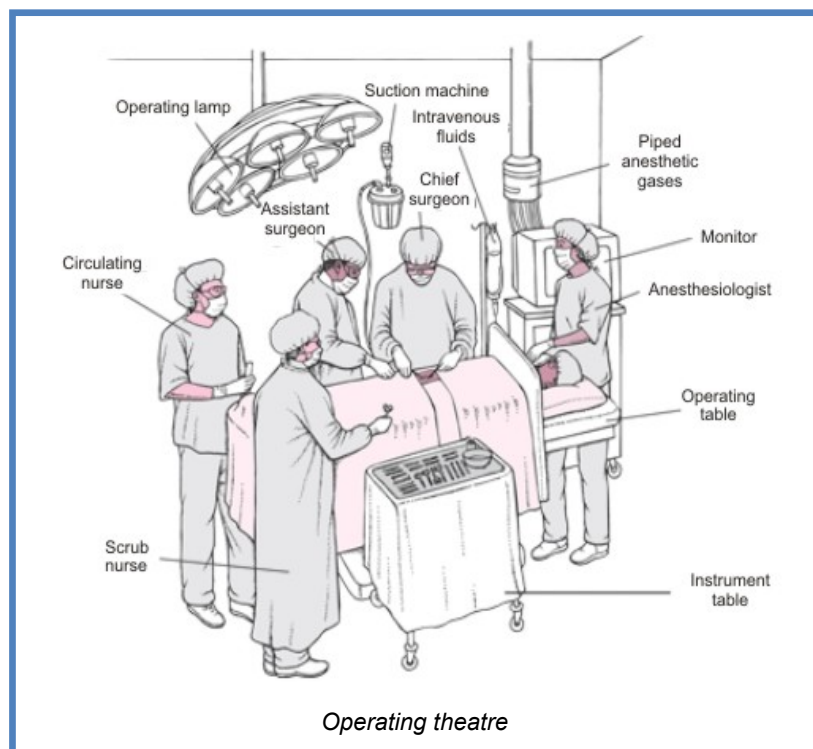
### THE SPECIALIZED NURSE ANAESTHETIST:

The nurse anaesthetist takes care of the patient before, during, and after surgical procedures. The nurse constantly monitors every important function of the patient's body and assists the anaesthesiologist to ensure maximum safety and comfort for the patient.

## OPERATING THEATRE

An **operating theatre**, **operating room**, or a **surgery suite**, also called surgery centre, is the unit of a facility where surgical procedures are performed.

An operating room is designed and equipped to provide care to patients with a range of conditions, or it may be designed and equipped to provide care to



wide spectrum of patients or, on the contrary, it is supposed for highly specialized operations. Operating rooms are sterile environments. Based on level of infection at the surgical site they can be divided to the aseptic (so called clean), semi aseptic (semi clean) and septic (dirty). Also they can differ according to necessary equipment for particular speciality (i.e. plastic surgery, ophthalmology, otorhinolaryngology, neurosurgery, cardiosurgery etc.) or to type of surgery (emergency, acute, elective etc.).



The surgery suite unit is closed, consisting of entry lobby, hygiene filter (cloakrooms with bathrooms and WC), inner lobbies, recovery and scrub rooms, operating theatres, additional auxiliary rooms like doctor's office and nurse's office, personnel restrooms, handy warehouse etc.

All personnel wear protective or special clothing called scrubs. They also wear special shoes or shoe covers, masks, caps, eye shields, and other aids to prevent the spread of germs in both directions (from staff to patient, and from patient to staff). The operating room is brightly lit and the temperature is semi cool; operating rooms are air-conditioned with microbial filters to help prevent infection.

## **OPERATING THEATRE EQUIPMENT**

An operating room has to have special equipment. This obligatory equipment may be different according to the regulations and rules of particular country. In the Czech Republic the emergency resuscitative devices, including the suction, operating table, surgical lights and device for coagulation are the essential needs. In case of general anaesthesia resuscitative anaesthesia equipment and patient monitoring equipment are necessary.

The patient is brought to the operating room on a trolley or wheelchair or bed with wheels (called a gurney). Then he is transferred to the operating table, which is stright and narrow and which has safety straps to keep him or her positioned correctly. The table can be positioned according to the convinience of the surgeon, certain operation and the patient.

The monitoring equipment and anaesthesiological machine are usually situated by the head of the patient. The anaesthesiologist commonly sits or stands by the apparatus, checks the patient's condition and carries on the anesthesiological treatment.

## ***Anaesthesia and Resuscitative Equipment***

1. Ventilator (also called a respirator) – assists with or controls pulmonary ventilation. Ventilators consist of a flexible breathing circuit, gas supply, heating/humidification mechanism, monitors, and alarms. They are microprocessor – controlled and programmable with regard to regulation of the volume, pressure, and flow of respiration.
2. Infusion pump – device that delivers fluids intravenously through a catheter. Infusion pumps employ automatic, programmable pumping mechanisms to deliver continuous pharmaceuticals and liquids like infusions or blood transfusion or plasma transfusion to the patient.



*Infusion pump*

## ***Life Support and Emergency Resuscitative Equipment***

Crash cart – also called resuscitation cart or code cart. A crash cart is a portable cart containing emergency resuscitation equipment for patients with signs of the failure of vital functions. The emergency equipment includes a defibrillator, airway intubation aids, resuscitation bag/mask, and pharmaceuticals. Crash carts are strategically located in the operating room for immediate accessibility.

## ***Patient Monitoring Equipment***

- Acute care physiologic monitoring system comprehensive patient monitoring systems that can be configured to continuously measure and display various parameters via electrodes and sensors connected to the patient. Parameters monitored may include the electrical activity of the heart via an ECG, respiratory (breathing) rate, blood pressure (non–invasive and invasive), body temperature, cardiac output, arterial haemoglobin oxygen saturation (blood oxygen level), and end–tidal carbon dioxide.
- Pulse oximeter–monitors the arterial haemoglobin oxygen saturation (oxygen level) of the patient's blood with a sensor clipped over the finger or toe.

## ***Other Operating Theatre Equipment***

Disposable equipment includes urinary catheters to drain urine during surgery, catheters used for arterial and central venous lines to monitor blood pressure during surgery or withdraw blood samples), endotracheal tubes, and monitoring electrodes.

### **Diagnostic equipment**

The use of diagnostic equipment may be required in the operating theatre. Mobile X ray units are used for bedside radiography. Handheld portable clinical laboratory devices, called point-of-care analyzers, are used for blood analysis.

*In highly special branches there are necessary some very special devices like for example in cardiosurgery:*

Heart-lung bypass machine, also called a cardiopulmonary bypass pump – takes over for the heart and lungs during some surgeries, like valve diseases, aneurysm, bypass, transplantation, tumours. Its task a) is substitution of heart and lung function during the surgery, b) control of circulation and oxygenation of blood, c) allowance to regulate the temperature – the heart activity is replaced by a rotary pump and pulmonary function by oxygenating unit.

The principle of **extracorporeal circulation**: venous blood of the patient is drained using the pump by the venous cannula from the right atrium or by two cannulas introduced into the upper and lower vena cava to the oxygenating unit with reservoir. Here blood is arterialised and it is forced by the pump into the arterial bloodstream using the cannula introduced into the ascendent aorta. A principle of hemodilution is applied with the whole system of extracorporeal circulation filled by crystalloids in such volume that after mixing with blood hematocrit fell down. Dilute blood penetrates into the capillary network of the body with less resistance and thus improves tissue perfusion.

**Intra-aortic balloon pump** – a device that helps reduce the heart's workload and helps blood flow to the coronary arteries for patients with unstable angina, myocardial infarction, or those awaiting organ transplants. Intra-aortic balloon pumps use a balloon placed in the patient's aorta. The balloon is on the end of a catheter that is connected to the pump's console, which displays heart rate, pressure, and electrocardiogram (ECG) readings. The patient's ECG is used to time the inflation and deflation of the balloon.

In some special branches several special devices may be need for example in neurosurgery or traumatology further monitoring can be done:

**Intracranial pressure monitor** – measures the pressure of fluid in the brain in patients with head trauma or other conditions affecting the brain (such as tumours, oedema, or haemorrhage). Intracranial pressure monitors are connected to sensors inserted into the brain through a cannula or bur hole. These devices signal elevated pressure and record or

display pressure trends. Intracranial pressure monitoring may be a capability included in a physiologic monitor.

**According to the description above it is clear the run and operation of surgical suite is very expensive.**

Therefore the **Operating Theatre Management** is very important. Operational Operating Theatre Management focuses on maximizing operational efficiency at the facility, i.e. to maximize the number of surgical cases that can be done on a given day while minimizing the required resources and related costs.

### **Governing Principles of Operating Room Management**

- 1) Ensure patient safety and the highest quality of care
- 2) Provide surgeons with appropriate access to the OR
- 3) Maximize the efficiency of operating room utilization, staff, and materials to reduce costs
- 4) Decrease patient delays
- 5) Enhance satisfaction among patients, staff, and physicians.

M. Haas

# TECHNOLOGIES IN SURGERY

20<sup>th</sup> century and 21<sup>st</sup> century are characteristic with rapid progress in all branches of human activities including the medicine. Many new devices have during this time been developed to help doctors with establishing their diagnoses or healing patients.

## 1. MICROSCOPE AND MICROSURGERY

Zacharias Jansen set together the first microscope in 1590 in the Netherlands. In 1610, on the basis of Jansen design Galileo Galilei was interested in microscopy. Anton van Leeuwenhoek invented first microscope with a magnification of 200 times in 1676. It was simple microscope with a singular lens.

The work of a British geologist Robert Hook *Micrographia* was an important turn in the development of microscopy. In the book published in London in 1665 he described the construction of the microscope with a separate lens, eyepiece and a lighting device. In addition, there was included a lot of views obtained using the microscope, which were first documented device options in scientific research.

The company Carl Zeiss was the first who started factory production of microscopes (1847).

Modern microscope has more than a single lens. It is called compound light microscope. The light transmits the image to the observer's eye.

The modern microscopes are made up of modules. Modules provide the required functions which can be used for wide range of purposes. The operation field is illuminated by fiber optic cables. To the microscope can be equipped with video camera and the operation field can be seen on a television display.

Optical microscopy normally achieves magnification 50× to 1000×. The maximum theoretical magnification is about 2000× and already hampered by physical barriers due to limit of the length of light waves. The device has two binoculars, one for the surgeon and one for the assistance, each binocular is independent.



*Operating microscope*



### ***Compound microscope***

- Has one beam path, but it may split into two parts (one for each observers eye – binocular vision)
- High resolution but no depth perception

### ***Stereo microscope***

- Uses two separate light beams to get true 3–D image of observed object
- Ideal for surgery but has limited resolution

### ***Magnifying glasses***

- are personalized for each surgeon. Two types of glasses exist, according to lenses Kepler type and Galileo type. The glasses can be equipped with CCD camera and the operation field can be displayed on monitor.

For use in surgery it was necessary to develop:

### ***Instruments***

- The tips of the instruments are fine enough to handle small vessels, nerves and the suture. Instruments handles are not made very small so they can be easily manipulated.

### ***Suture***

- It was the only limiting factor for microsurgery before 1960s because there was no such a thin suture material to perform microsurgery. Commonly used sutures are 9–0, 10–0, and 11–0.

## **MICROSURGERY**

Microsurgery is surgical technique, which is currently used in many surgical specialties (plastic surgery, otorhinolaryngology, neurosurgery, maxillofacial surgery, urology, ophthalmology etc.). Microsurgery requires an operating microscope or magnifying glasses, special instruments and suture.

### ***History***

The history of microsurgery began in 1960s. The first micro vascular surgery was described by neurosurgeon J. Jacobson. Using microscope he performed anastomosis of vessels of 1.4 mm in diameter (today's routine anastomosed vessels are about 1.0 mm in diameter). The first revascularization (the process of restoring the function of an affected organ) was performed by hand surgeons Kleinert and Kasdan in 1963. It was the revascularization of a

partial digital amputation. The first human microsurgical transplantation was performed in 1968 by J. Cobbett.

### ***Free tissue transfer***

- A surgical reconstructive procedure. Donor tissue is disconnected from its feeding artery and vein and is transferred to recipient place, where anastomosis of artery and vein with the recipient bloodstream is made using microsurgical technique.
- Common donor autologous regions include rectus abdominis muscle, latissimus dorsi muscle, fibula etc. It is an autologous material unlike the organ transplantation, that replace the functional loss but it has an allogenic origin and thus it is determined by the life immunosuppression.
- Autologous free flaps are used for reconstruction of breast after cancer resection, traumatic tissue loss, congenital tissue absence etc.

### ***Replantation***

- Reattachment of a completely detached body part (fingers and thumbs are most common)
- Involves restoring blood flow, restoring the bony skeleton and connecting tendons and nerves as required
- functional demands of the amputated specimen is paramount in guiding which amputated pieces should and should not be replanted, also important is the patient ability to cooperate with the long rehabilitation process
- only a piece or a portion may be necessary to obtain a certain functional result, or in the case of multiply amputated fingers, a finger or fingers may be transposed to a more useful location to obtain a more functional result

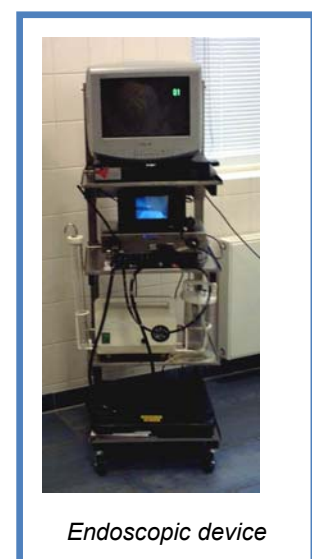
## **2. ENDOSCOPE AND ENDOSCOPY**

### ***Endoscope***

- rigid or flexible tube
- A light delivery system to illuminate the inspected object
- A light source (normally outside the body)
- Lens system
- Additional channels for instruments or manipulators

### ***Endoscopy***

Endoscopy is a minimally invasive diagnostic medical procedure



*Endoscopic device*

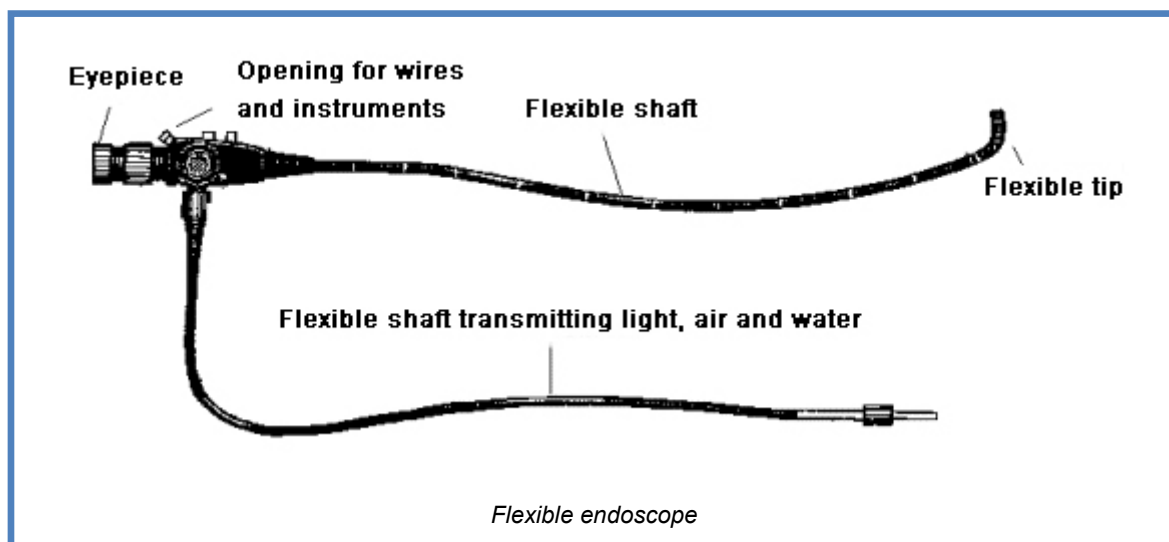
that is used to assess the interior surfaces of an organ by inserting a tube into the body. Endoscopy also enables taking biopsies and retrieval of foreign objects. Most of the examinations are performed under neurosedation or with topical anesthesia. There are two types of endoscopes: rigid and flexible.

### ***Rigid endoscopy***

- **Sigmoideoscopy** : probably the most commonly used rigid endoscopy, 25 or 30 cm long, examination usually carried out in left lateral position
- **Oesophagoscopy**: useful for removing of foreign bodies from oesophagus, in other indications has been superseded by the flexible instruments
- **Cystoscopy**: was useful for retrograde catheterization of vesica urinaria, widely superseded by the flexible scope
- **Laparoscopy**: widely used in general surgery, particularly for minimally invasive surgery (e.g. cholecystectomy, appendicectomy)
- useful for diagnosis of the pathological process and taking of biopsy

### ***Flexible endoscopy***

- **Gastroscopy**: used with intravenous sedation and a pharyngeal local anesthetic spray, a clear view can be obtained of the oesophagus, stomach, duodenum and the ampulla of Vater, has many uses (GI bleeding tracing, injection of oesophageal varices etc.)
- **Colonoscopy**: allow to inspect the whole of the colon after adequate bowel preparation, polyps can be removed by a wire snare or diathermy, biopsies can be carried out using the grasp
- **Bronchoscopy**: narrow fiber optic bronchoscopes can be passed under local anesthetic, mainly used for diagnostic purposes
- **Other flexible endoscopes**: cystoscopes, sigmoideoscopes, choledochoscopes, arterioscopes etc.



### **Complications:**

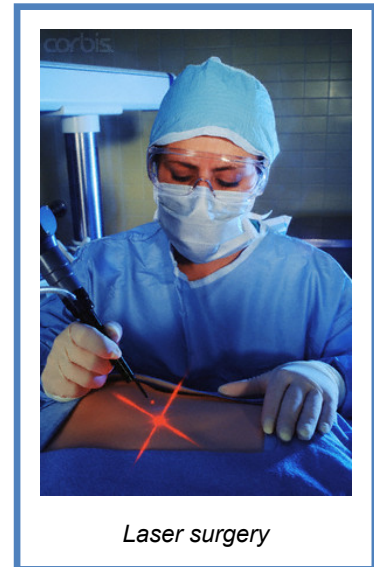
- Perforation, haemorrhage at the site of biopsy taking or surgical procedure, pulmonary aspiration, infection

## **3. LASER AND LASER SURGERY**

### ***Lasers***

They are "scalpels of light" that may offer a new alternative for some surgical procedures. Lasers can be used to cut, burn, or destroy abnormal or diseased tissue; shrink or destroy lesions or tumours; sculpt tissue; and seal blood vessels. Lasers may help surgeons perform some procedures more effectively than other traditional methods. Because lasers cause minimal bleeding, the operative area may be more clearly viewed by the surgeon. Lasers may also provide access to parts of the body that may not have been as easily reached manually.

The first working laser was introduced in 1960. The device was initially used to treat diseases and disorders of the eye, whose transparent tissues gave ophthalmic surgeons a clear view of how the narrow, concentrated beam was being directed. Dermatologic surgeons also helped pioneer laser surgery, and developed and improved upon many early techniques and more refined surgical procedures.



### ***The three types of lasers most often used in medical treatment are the:***

- Carbon dioxide (CO<sub>2</sub>) laser. Primarily a surgical tool, this device converts light energy to heat strong enough to minimize bleeding while it cuts through or vaporizes tissue.
- Neodymium: yttrium–aluminum–garnet (Nd: YAG) laser. Capable of penetrating tissue more deeply than other lasers, the Nd: YAG makes blood clot quickly and can enable surgeons to see and work on parts of the body that could otherwise be reached only through open (invasive) surgery.
- Argon laser. This laser provides the limited penetration needed for eye surgery and superficial skin disorders. In a special procedure known as photodynamic therapy (PDT), this laser uses light–sensitive dyes to shrink or dissolve tumours.

Routine uses of lasers include erasing birthmarks, skin discoloration, and skin changes due to aging, and removing benign, precancerous, or cancerous tissues or tumours. The rule is tissue taking for the histological examination.

Most laser surgeries can be performed on an outpatient basis, and patients are usually permitted to leave the hospital or medical office when their vital signs have stabilized.

Like traditional surgery, laser surgery can be complicated by hemorrhage, infection, perforation of an organ or tissue etc. Laser surgery can also involve risks that are not associated with traditional surgical procedures. Being careless or not practicing safe surgical techniques can severely burn the patient, destroy healthy tissue or damage eyes etc. These injuries can be permanent, thus it is necessary to keep the rules for safety manipulation with lasers and to use the protective aids like for example eye shields while undergoing or performing laser surgery.



*Nd: YAG laser*

#### **4. ROBOTIC SURGERY**

In the world of science and technology the robot is defined as independently working machine performing intended tasks. Among machines robot like belong: manipulator – a machine not having its own intelligence, which is typically remote controlled.

- Droid is any intelligent and automatic robot.
- Android is a robot similar to humans;
- Kyborg (cybernetic organism) is a robot or android having implanted brain of live being (this being had to exist before, a machine with a biological brain is not a kyborg)

From this it is clear that the surgery has not a robot in the sense of the word, but the remote controlled machine without intelligence – manipulator with surgical instruments.

Robotic surgery use robots for surgical operation. Major potential advantages of robotic surgery are precision and miniaturization. First robot was used in



*Surgeon console*

1985 to place needle for a brain biopsy. In 1988 was robot used to perform prostatic surgery. In 1999 the world's first robotics surgery was performed as a coronary artery bypass graft at beating heart.

The surgeon's hand movements are scaled and filtered to eliminate hand tremor then translated into micro movements of the proprietary instruments. The camera used in the system provides a true stereoscopic picture transmitted to a surgeon's console. Robots enter the body through small (usually about 1cm) entry incisions, through which surgeons use long-handled instruments to operate on tissue within the body. As will be seen, robots do not actually replace humans but rather improve their ability to operate through the small incisions.

Surgical robots comprise four main components: a surgeon's console, a patient-side robotic cart with 4 arms manipulated by the surgeon, a high-definition 3-D vision system and detachable instruments. Surgical instruments are mounted on the robotic arms.

- Surgeon console
  - Not in touch with patient, surgeon can view 3-D image of the surgical field, surgeon controls robot's arms with system's master interface
- Patient-side cart
  - Contains the robotic arms that directly contact the patient, consist of two or three instrument arms and one endoscope arm
- Detached instruments
  - Today's instruments allow the robotic arms to maneuver in ways that simulate fine human movements
  - The device memorizes the position of the robotic arm before the instrument is replaced so that the second one can be reset to the exact same position as the first
  - Robots can perform about seven independent movements and surgeon can control the amount of force applied, robots has ability to filter out hand tremors and scale movements
- 3-D vision system
  - High resolution real-time magnification with elimination of background noise



*Patient-side cart*

- The endoscope is programmed to regulate the temperature of the endoscope to prevent fogging during the operation

## **5. TISSUE ENGINEERING**

It is an interdisciplinary field that applies the principles of engineering and life sciences toward the development of biological substitutes that restore, maintain, or improve tissue function or a whole organ. Tissue engineering utilizes living cells as engineering materials (living fibroblasts in skin replacement or repair, cartilage repaired with living chondrocytes etc.).

Living cells are extracted from liquid tissue with centrifugation or apheresis. Solid tissue has to be digested by enzymes and then cells are extracted in the same way as from liquid tissue.



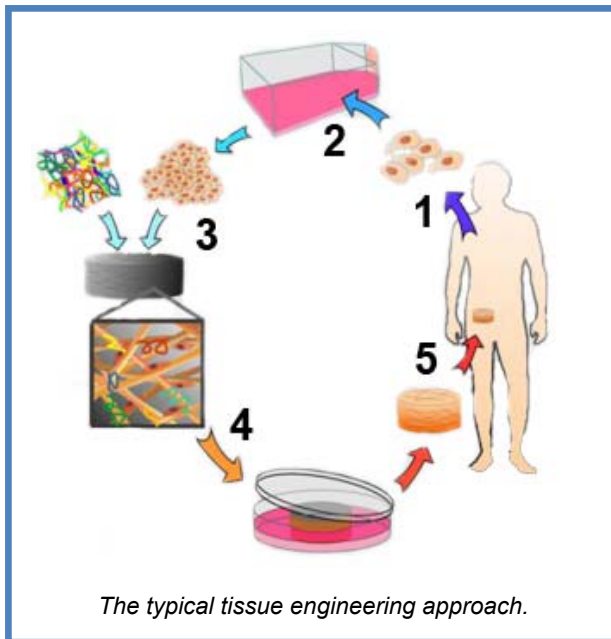
*The first 3-D realistic construct 'grown' from individual cells*

### ***Types of cells:***

- Autologous: cells obtained from the same individual to which they will be reimplanted
- Allogenic: cells obtained from individual of the same species
- Isogenic: cells obtained from genetically identical organism (twins, clones etc.)
- Xenogenic: cells obtained from individual of another species
- Primary cells: obtained from an organism
- Secondary cells: obtained from a tissue bank
- Stem cells: undifferentiated cells with ability to transform in any type of specialized cells

Cells have to be implanted into an artificial structure–carrier capable of supporting 3–D tissue formation. These structures have to meet some goals such as high porosity and an adequate pore size. It has to be constructed from natural materials and it also has to be biodegradable so there is no need to surgical removal of the structure.

Creation of functional tissues in vitro requires extensive culturing to promote survival, growth and inducement of functionality. The basic requirements for cell culture are oxygen, pH, temperature, nutrients, humidity and osmotic pressure maintenance. Sometimes growth hormones and specific metabolites and nutrients or chemical or physical stimuli are required.



1. Remove cells
2. Expand number in culture
3. Seed onto an appropriate scaffold with suitable growth factors and cytokines
4. Place into culture
5. Re-implant engineered tissue to repair the damaged site

### Examples of engineered tissues:

#### Bioartificial liver device

- several research efforts have produced hepatic assist devices utilizing living hepatocytes

#### Artificial pancreas

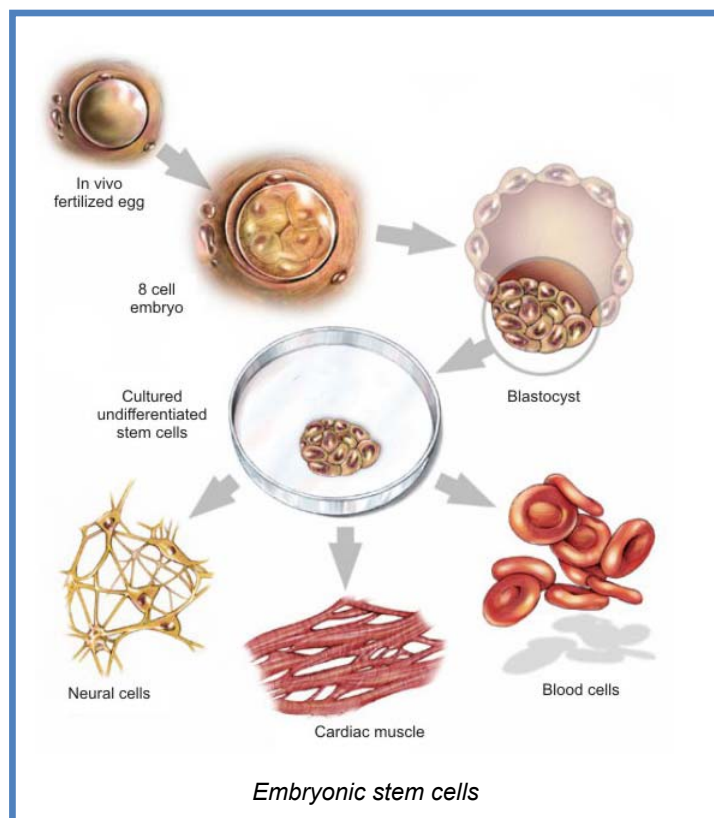
- research involves using islet cells to produce and regulate insulin, particularly in cases of diabetes

#### Cartilage

- lab-grown tissue was successfully used to repair knee cartilage

### Stem cells

Stem cells are primary undifferentiated cells. Their basic and characteristic attribute is self-renewal and also an ability to differentiate into diverse cellular types. We distinguish embryonic and adult stem cells.

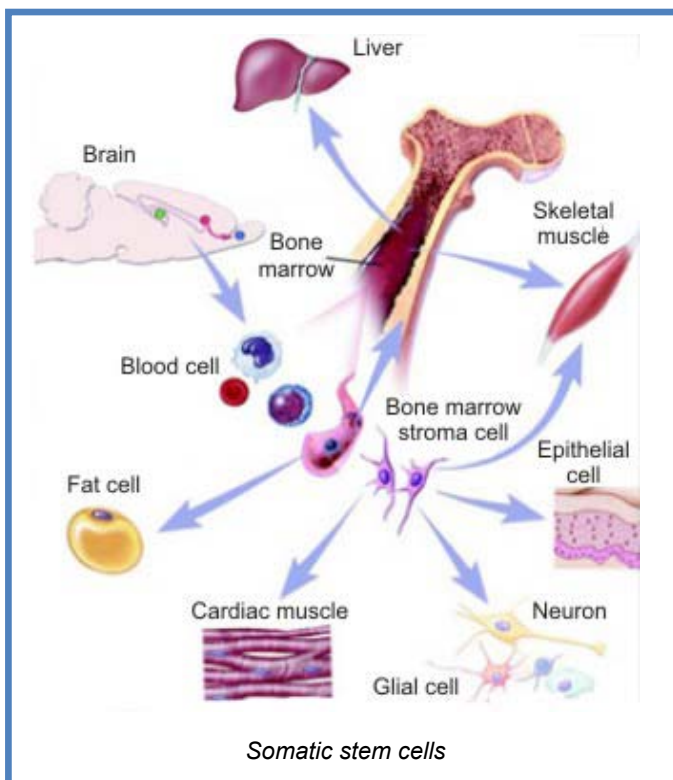




**Embryonic stem cells** can differentiate into almost all types of human cells. They are obtained from donors of redundant embryos originated by IVF and donated to research purposes. This type of cells is currently connected with many ethical and political problems. They substantially limit the research and use of this material in many countries.

**Adult or somatic stem cells** are found among already differentiated cells within the tissues and organs. These stem cells can transform in main specialized cell type of finding place. The basic function of adult stem cells in the organism is to maintain and to repair the tissue of the location. Just this fact became a subject of multiyear research and finally also a material for practical use in diverse medical areas. Typical example of such an area is haematology. Stem cells however progressively find their use also in other domains of medicine.

Many diverse tissues such as bone marrow, fat, skin, vessels or muscle can serve as a source of multipotent stem cells. However the potential of these tissues can be considerably limited, partly by low amount of cells as well as by problems resulting from harvest, like pain or morbidity of donors.



New researches found adipose tissue as a very suitable source of stem cells. Cells harvested from this material have the ability of osteogenic, chondrogenic, adipogenic and neurogenic differentiation. Adipose tissue generally fulfills the conditions of ideal source. It is easily accessible in demanded amount and the harvest presents a tolerable load for patient. Adipose tissue derived stem cells (ATSCs) brought new possibilities in many areas of medicine. The chondrogenic differentiation of these cells is experimentally used in orthopaedics to restore a damaged

cartilage. The newest studies found, that ATSCs can also differentiate into cells producing insulin, somatostatin or glucagon. This offers new possibilities in treating diabetes. Its specific use finds this material also in neurology, cardiology or dental surgery.

In plastic surgery this autologous material may serve for the reconstruction of different types of soft tissue defects resulting from congenital faults, injuries, and tumour resections.

These cells also produce many growth factors, which have an essential importance in wound healing. ATSCs facilitate a formation of granulation tissue and angiogenesis. Therefore they are used to improve the perfusion and healing in post radiation cases, chronic, diabetic and other long healing wounds.

# HAEMORRHAGE, PHYSIOLOGICAL AND SURGICAL HEMOSTASIS

**Bleeding**, in medicine **haemorrhage** is the loss of blood from the circulatory system. Bleeding can occur internally, where blood leaks from blood vessels inside the body or externally, either through a natural opening such as the vagina, mouth or anus, or through a break in the tissue with contact to the body surface. The complete loss of blood is referred to an exsanguination, and desanguination is a massive blood loss. Loss of 10–15% of total blood volume can be endured without clinical sequelae in a healthy person, and blood donation typically takes 8–10% of the donor's blood volume.

The term hemorrhage comes from the Greek haima – blood, rheimai – to break forth – a free and forceful escape of blood.

Bleeding can be caused by injury or can occur spontaneously. Spontaneous bleeding is most commonly caused by problems with gastrointestinal or urogenital tract.

## **EXTERNAL HEMORRHAGE**

Symptoms:

Blood coming from an open wound, haematoma, bruising, shock, paleness, clammy skin, dizziness, rapid pulse, low blood pressure, shortness of breath, weakness, confusion or decreasing alertness.

Initial first aid – direct pressure will stop most external bleeding from open wounds.

## **BLEEDING THROUGH BODY OPENINGS**

### ***Hematemesis***

It is the act of vomiting blood. The blood may have been swallowed after nosebleed or tonsillectomy (brown colour like coffee – grounds) or arises from bleeding in oesophagus, stomach, or duodenum (looks bright red). The most common causes are gastric or duodenal ulcers or varicose oesophageal veins.

### ***Haemoptysis***

Hemoptysis is coughing up of blood, which is in the sputum (bright red or dark red). It could be due to infection or lung cancer.

### ***Hematuria***

It is the presence of blood in urine (appears red, pink or tea coloured). It is a result of injury or disease.

### ***Melaena or rectorrhagia***

It is blood in the stool. Melaena appears like black tar, coming from the bleeding of upper part of GIT (gastric or duodenal ulcer). If it is pure bright red blood, thus it is a signal of bleeding from lower part of GIT (rectum, sigmoidum, colon), which may be mainly caused by haemorrhoids, tumours, fissura ani or injury.

### ***Vaginal bleeding***

Abnormally stronger may indicate gynaecological problem for example the spontaneous abortion.

## **HAEMORRHAGE AS A POSTOPERATIVE COMPLICATION**

Bleeding after surgery may be arterial or venous. Arterial blood is bright red and spurts in time with the pulse. Venous blood is darker and flows steadily. Damage to minor vessels can produce only an oozing. From the large veins there can be a massive blood loss (1 litre in 5 minutes).

### ***Types:***

1. Primary haemorrhage – occurs during surgery and continues.
2. Reactionary haemorrhage – occurs in the first 24 hours. It usually results from a slipped ligature or the removal of primary clot due to cough or increased blood pressure.
3. Secondary haemorrhage – occurs about 7–14 days after surgery due to infection, which erodes the vessel.

Clinical features are pain in the wound, swelling in the wound, haematoma and surrounding bruising, increased amount of blood in the drainage bottle, blood on the dressing.

The patient is cold and clammy with an increasing pulse rate. The blood pressure can fall down, but in young patient can maintain near normal level for some time. The key to blood loss is trend of pulse and blood pressure. The pulse and blood pressure should be recorded every 15–30 minutes.

### ***Treatment***

1. Apply pressure to obvious external bleeding point
2. Stop the suction drainage
3. Establish intravenous infusion
4. Replace lost blood volume with Haemaccel ® or Gelofusin ® until the whole blood transfusion is available.
5. Carry out the coagulation screen, if necessary clotting factors may be replaced with fresh frozen plasma.
6. Arrange for the patient return to the operating theatre for revision of the wound and stop of the bleeding source.
7. Catheterise the patient and measure urine volume.

## **HAEMOSTASIS**

Haemostasis is the complex interaction among vessels, platelets, coagulation factors, coagulation inhibitors and fibrinolytic proteins to maintain the blood within the vascular compartment. The haemostatic system preserves intravascular integrity by achieving balance between haemorrhage and thrombosis.

### ***Physiological haemostasis***

Physiological haemostasis controls blood fluidity and rapidly induces haemostatic plug formation in order to stop or limit bleeding. Physiological haemostasis protects the integrity of the vascular system after tissue injury. It was first described by Abu al Quasim al Zahrawi. He also described a method how to stop the bleeding by local pressure and cauterisation.

The components of normal haemostasis include: blood vessels, platelets, plasma coagulation factors and their inhibitors and the fibrinolytic system.

Haemostasis includes three phases of the haemostatic process: primary haemostasis, coagulation and fibrinolysis.

1. Primary haemostasis is the result of complex interactions among the vascular wall, platelets and adhesive proteins. It takes several seconds.
2. Secondary haemostasis (coagulation) involves a complex cascade of coagulation factors, resulting in the transformation of fibrinogen into polymerized fibrin, which makes a base of the clot. It takes several minutes.

3. Fibrinolysis controls fibrin dissolution as the clot attracts and stimulates the growth of fibroblasts and smooth muscle cells within the vessel wall. It lasts from hours till days.

The test of bleeding time and clotting should be provided before every surgery.

### ***Disorders of haemostasis***

Disorders of haemostasis can be divided into:

1. Platelet disorders – idiopathic thrombocytopenic purpura
2. Disorders of coagulation – haemophilia and trombophilia

The patients with haemostatic disorders should be carefully prepared for surgery with platelet or plasmatic coagulation factor transfer before surgery.

### ***Surgical haemostasis***

The important task for each surgery is to stop the bleeding. The aim is to minimize blood loss and prevent wound haematoma. For small diffuse bleeding compression or contusion with tweezers or clamps are used. The other possibility to stop diffuse bleeding is electric coagulation. Small vessels are ligated with resorbable material. For



*Electrocoagulation device*

greater veins and arteries the double ligation or Z–ligation (cross–stitch) of nonresorbable material may be used. In some cases (endoscopy, neurosurgery, microsurgery) titanium clips are used instead of ligature. These clips are left in the tissue forever.

To facilitate the performance of surgery and improvement of overview of the operational field it is possible to reduce capillary bleeding by different ways. In certain operations of heavily vascularised areas, especially the face and neck, it is an infiltration of tissues by solution with addition of the adrenaline sodium in rate 1 ml of adrenaline (effective substance Epinephrine hydrochloride 1.2 mg) to 250 ml of saline solution, or local anesthetics.

Another possibility is to reduce the flow through the operated area by the compression of blood vessels and to create so called bloodless environment. It is possible of course in areas, which may be set aside a circulation without the risk, i.e. the extremities. Surgery of the extremities is usually carried out in a bloodless field. Hand bulb cuff is placed in the upper part of the extremity, with the pressure of 20–30 kPa. There should be released every 90 minutes for at least 10 minutes.

# **SURGICAL MEDICAL SUPPLIES – BANDAGES AND DRESSINGS, SUTURE MATERIALS, BASIC SURGICAL INSTRUMENTS**

## **BANDAGES**

The function of bandage is either to support a device such as a dressing or splint or on its own to provide support to the body. Bandages are available in a wide range of types, from generic cloth strips, to specialised shaped bandages designed for a specific limb or part of the body, although bandages can often be improvised as the situation demands, using clothing, blankets or other material.

In common speech, the word "bandage" is often used to mean a dressing, which is used directly on a wound, whereas a bandage is technically only used to support a dressing, and not directly on a wound. Some specialists however use these two terms almost interchangeably. Sometimes is also used the term covering bandages for dressings.

Bandages can be divided according to a material or function.

## **DRESSINGS**

A dressing is a device used for application to a wound in order to promote healing and/or prevent further harm.

Main purposes of dressings:

- Stem bleeding – helps to seal the wound to expedite the clotting process
- Absorb exudate – soak up blood, plasma and other fluids exuded from the wound, containing it in one place
- Ease pain – some dressings may have a pain relieving effect, and others may have a placebo effect
- Debride the wound – the removal of slough and foreign objects from the wound
- Protection from infection and mechanical damage
- Promote healing – through granulation and epithelialisation

### ***Types of dressings***

Modern dressings include gauzes (which may be impregnated with an agent designed to help sterility or to speed healing), films, gels, foams, hydrocolloids, alginates, hydrogels and polysaccharide pastes, granules and beads. Dressings can be also impregnated with antiseptic chemicals.

In the 1960s, George Winter published his controversial research on moist healing. Previously, the accepted wisdom was that in order to prevent infection of a wound, the wound should be kept as dry as possible. Winter demonstrated that wounds which were kept moist healed faster than those which were left exposed to the air or covered with traditional dressings.

#### ***Dressings should:***

- control the moisture content, so that the wound stays moist;
- protect the wound from infection;
- remove slough;
- maintain the optimum pH and temperature to encourage healing.

An ideal wound dressing is one that is sterile, breathable, and encourages a moist healing environment. This will then reduce the risk of infection; help the wound heal more quickly and reduce scarring.

### ***Types of Bandage – according to their objective***

#### ***Protective dressing***

- Protects wound against secondary infection
- Various sizes
- Can be applied dry or can be soaked in some solution (covered with another dry gauze layer)

#### ***Suction dressing***

- Suck the discharge from the wound
- Dry or damp (damp has stronger sucking effect)

#### ***Compression bandages***

- Usually for the control of bleeding and edema
- Prevent drifting of body fluids in burns
- Treatment of disturbances of venous circulation
- Elastic bandages, elastic plasters and



- Short stretch compression bandage are applied to a limb (usually for treatment of lymphedema or venous ulcers). The bandage is not capable of shortening around the limb after application and is therefore not exerting ever – increasing pressure during inactivity. This dynamic is called resting pressure and is considered safe and comfortable for long–term treatment. Conversely, the stability of the bandage creates a very high resistance to stretch when pressure is applied through internal muscle contraction and joint movement. This force is called working pressure.
- Long Stretch compression bandage due to their long stretch properties, the high compressive power of these bandages can be easily adjusted, however, they also have a very high resting pressure and must be removed at night or if the patient is in a resting position.

#### Fixative

- Provide rest for an individual part of the body after injury or operation or inflammation
- Various splints (Kramer’s splint, plastic splints etc.) and hardening material (plaster of Paris, starch)

#### Supporting bandages

- Support a certain part of body and help it to maintain a required position
- Various splints or plaster of Paris

#### Extension bandages

- Make up for shortened extremities
- Kirschner extension (wire drilled into a bone), leather cuffs

### **Types of Bandage – according to the type**

#### Plastic

- To be applied on the wound
- Form a thin, elastic translucent layer of plastic substance
- Airtight (= disadvantage)

#### Plaster

- Safeguard of the injured part of the body in relaxed position

#### Scarves

- In first aid – fixing gauze to the wound on various parts of the body or for a sling of the upper extremity

#### Slings

- Made of stripes of gauze for dressing of the nose or chin

#### Bandages

- Serve the fixation of sterile gauze pads on the wound

- Elastic and gauze
- Desault sling – fixation of an injured shoulder girdle

#### Splints

- To immobilize parts of the body
- Mostly in first aid
- The braces must be lined with soft padding to prevent pressure sores on the skin

#### Veneer

- to reinforce other types of bandages

#### Starch

- fixes other bandages (Desault bandage)

#### Plaster of Paris

- Used for fixation of injured joints and bones
- Applied directly to the skin without padding or underlaid by cotton wool and gauze
- Must be controlled to check whether there are no manifestation of blood current impairment in the peripheral part of extremity – if cyanosis, swelling or tingling appear, bandage must be loosened

#### ***Frequently used types in general application***

**Roller bandages** come in a variety of lengths and widths to accommodate various parts of the body. Some roller bandages are made of self-adhering material, which is slightly elastic and gauzelike to conform to the body. They are easier to apply and can be used for a variety of injuries. Gauze rollers are more rigid as they are made of cotton and contain no elasticity. Also available are elastic roller bandages. This type of roller bandage is not usually applied to a wound dressing. Rather, they are to be used for injuries requiring compression such as a sprain or contusion.

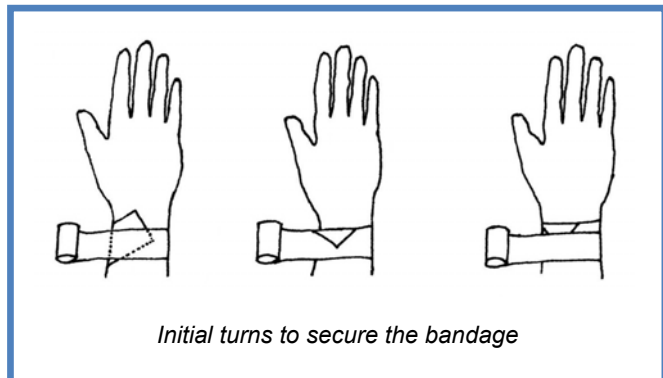
**Triangular bandages** are normally made of cotton and cut in the shape of a triangle. The longest side of the triangular bandage is called the base; the corner directly opposite the middle of the base is called the point; and the other two corners are called ends. This type of bandage can be applied in two ways. Fully opened this type of bandage can be used as an arm sling. The triangular can also be used as a cravat. A binder placed around a patient's body to stabilize an injured arm in a sling, or to hold splints in place. It may be applied evenly over a dressing to supply pressure to a wound as well. Padding may be added to areas that may become uncomfortable.

**Tube bandages** are applied using an applicator, and are woven in a continuous circle. They are used to hold dressings or splints on to limbs, or to provide support to sprains and strains, and it stops the bleed.

**Adhesive tape** is available in various lengths and widths. Adhesive tape is primarily used to secure roller bandages or small dressings in place. Some people are allergic to adhesive. In these instances using paper tape or special hypoallergenic tape would be required.

**Adhesive strips** come in handy for small cuts and abrasions. This item can be used as a combination dressing and bandage.

**GENERAL APPLICATION:** In applying a roller bandage, hold the roll in the right hand so that the loose end is on the bottom; the outside surface of the loose or initial end is next applied to and held on the body part by the left hand. The roll is then passed around the body part by the right hand, which controls



the tension and application of the bandage. Two or three of the initial turns of a roller bandage should overlie each other to properly secure the bandage. In applying the turns of the bandage, it is often necessary to transfer the roll from one hand to the other. Bandages should be applied evenly, firmly, but not too tightly. Excessive pressure may cause interference with the circulation and may lead to disastrous consequences. In bandaging an extremity, it is advisable to leave the fingers or toes exposed so the circulation of these parts may be readily observed. It is likewise safer to apply a large number of turns of a bandage, rather than to depend upon a few turns applied too firmly to secure a compress. In applying a wet bandage, or one that may become wet, you must allow for shrinkage. The turns of a bandage should completely cover the skin, as any uncovered areas of skin may become pinched between the turns, with resulting discomfort. In bandaging any extremity, it is advisable to include the whole member (arm or leg, excepting the fingers or toes) so that uniform pressure may be maintained throughout. It is also desirable in bandaging a limb that the part is placed in the position it will occupy when the dressing is finally completed, as variations in the flexion and extension of the part will cause changes in the pressure of certain parts of the bandage. The initial turns of a bandage on an extremity (including spica bandages of the hip and shoulder) should be applied securely, and, when possible, around the part of the limb that has the smallest circumference. Thus, in bandaging the arm or hand, the initial turns are usually applied around the wrist, and in bandaging the leg or foot, the initial turns are applied immediately above the ankle. The final turns of a completed bandage are usually secured in the same manner as the initial turns, by employing two or more overlying circular turns. As both edges of the final circular turns are exposed, they should be

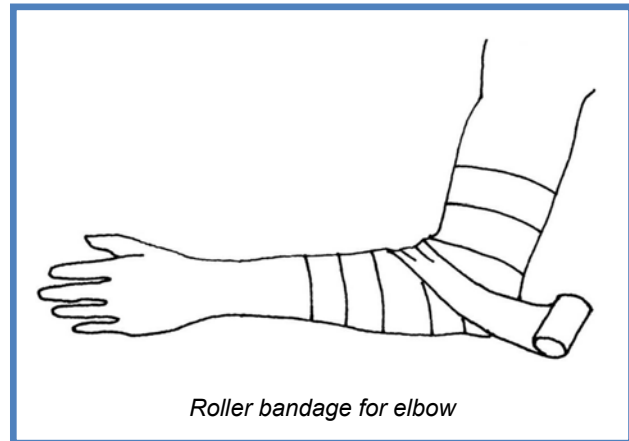
folded under to present a neat, cufflike appearance. The terminal end of the completed bandage is turned under and secured to the final turns by either a safety pin or adhesive tape. When these are not available, the end of the bandage may be split lengthwise for several inches, and the two resulting tails may be secured around the part by tying.

**Examples of bandages:**

**Roller bandages:**

**ROLLER BANDAGE FOR ELBOW**

This type of bandage is used around the elbow joint to retain a compress in the elbow region and to allow a certain amount of movement. Flex the elbow slightly (if you can do so without causing further pain or injury), or anchor a 2- or 3-inch bandage



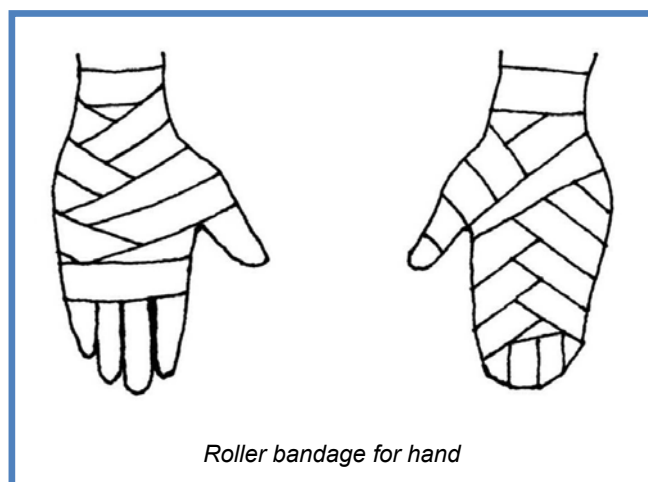
above the elbow and encircle the forearm below the elbow with a circular turn. Continue the bandage upward across the hollow of the elbow to the starting point. Make another circular turn around the upper arm, carry it downward and gradually ascend the arm. Overlap each previous turn about two-thirds of the width of the bandage. Secure the bandage with two circular turns above the elbow, and tie. To secure a dressing on the tip of the elbow, reverse the procedure and cross the bandage in the back

**ROLLER BANDAGE FOR ARM AND LEG**

The spiral reverse bandage must be used to cover wounds of the forearms and lower extremities; only such bandages can keep the dressing flat and even. Make two or three circular turns around the lower and smaller part of the limb to anchor the bandage and start upward, going around making the reverse laps on each turning, overlapping about one-third to one-half the width of the previous turn. Continue as long as each turn lies flat. Continue the spiral and secure the end when completed.

**ROLLER BANDAGE FOR HAND AND WRIST**

For the hand and wrist, the same bandage as for the arm and leg (spiral reverse bandage) is ideal. Anchor the dressing, whether it is on the hand or



wrist, with several turns of a 2- or 3-inch bandage. If on the hand, anchor the dressing with

several turns and continue the bandage diagonally upward and around the wrist and back over the palm. Make as many turns as necessary to secure the compress properly.

#### ROLLER BANDAGE FOR ANKLE AND FOOT

The spiral reverse bandage is also used for dressings of the ankle, as well as for supporting a sprain. While keeping the foot at a right angle, start a 3-inch bandage around the instep for several turns to anchor it. Carry the bandage upward over the instep and around behind the ankle, forward, and again across the instep and down under the arch. Continue the turns, overlapping one-third to one-half the width of the bandage and with an occasional turn around the ankle, until the compress is secured or until adequate support is obtained

#### ROLLER BANDAGE FOR HEEL

The heel is one of the most difficult parts of the body to bandage. Place the free end of the bandage on the outer part of the ankle and bring the bandage under the foot and up. Then carry the bandage over the instep, around the heel, and back over the instep to the starting point. Overlap the lower border of the first loop around the heel and repeat the turn, overlapping the upper border of the loop around the heel. Continue this procedure until the desired number of turns is obtained, and secure with several turns around the lower leg.

#### FOUR-TAILED BANDAGE

A piece of roller bandage may be used to make a four-tailed bandage. The four-tailed bandage is good for bandaging any protruding part of the body because the center portion of the bandage forms a smoothly fitting pocket when the tails are crossed over. This type of bandage is created by splitting the cloth from each end, leaving as large a centre area as necessary. The four-tailed bandage is often used to hold a compress on the chin or on the nose.

#### BARTON BANDAGE

The Barton bandage is frequently used for fractures of the lower jaw and to retain compresses to the chin. The initial end of the roller bandage is applied to the head, just behind the right mastoid process. The bandage is then carried under the bony prominence at the back of the head, upward and forward back of the left ear, obliquely across the top of the head. Next bring the bandage downward in front of the right ear. Pass the bandage obliquely across the top of the head, crossing the first turn in the midline of the head, and then backward and downward to the point of origin behind the right mastoid. Now carry the bandage around the back of the head under the left ear, around the front of the chin, and under the right ear to the point of origin. This procedure is repeated several times, each turn exactly overlaying the preceding turn. Secure the bandage with a pin or strip of adhesive tape at the crossing on top of the head.

### ***Triangular bandages:***

#### TRIANGULAR BANDAGE FOR HEAD

This bandage is used to retain compresses on the forehead or scalp. Fold back the base about 2 inches to make a hem. Place the middle of the base on the forehead, just above the eyebrows, with the hem on the outside. Let the point fall over the head and down over the back of the head. Bring the ends of the triangle around the back of the head above the ears, cross them over the point, carry them around the forehead, and tie in a square knot. Hold the compress firmly with one hand, and, with the other, gently pull down the point until the compress is snug; then bring the point up and tuck it over and in the bandage where it crosses the back part of the head.

#### TRIANGULAR BANDAGE FOR SHOULDER

Cut or tear the point, perpendicular to the base, about 10 inches. Tie the two points loosely around the patient's neck, allowing the base to drape down over the compress on the injured side. Fold the base to the desired width, grasp the end, and fold or roll the sides toward the shoulder to store the excess bandage. Wrap the ends snugly around the upper arm, and tie on the outside surface of the arm.

#### TRIANGULAR BANDAGE FOR CHEST

Cut or tear the point, perpendicular to the base, about 10 inches. Tie the two points loosely around the patient's neck, allowing the bandage to drape down over the chest. Fold the bandage to the desired width, carry the ends around to the back, and secure by tying.

#### TRIANGULAR BANDAGE FOR HIP OR BUTTOCK

Cut or tear the point, perpendicular to the base, about 10 inches. Tie the two points around the thigh on the injured side. Lift the base up to the waistline, fold to the desired width, grasp the ends, fold or roll the sides to store the excess bandage, carry the ends around the waist, and tie on the opposite side of the body.

#### TRIANGULAR BANDAGE FOR SIDE OF CHEST

Cut or tear the point, perpendicular to the base, about 10 inches. Place the bandage, points up, under the arm on the injured side. Tie the two points on top of the shoulder. Fold the base to the desired width, carry the ends around the chest, and tie on the opposite side.

#### TRIANGULAR BANDAGE FOR FOOT OR HAND

This bandage is used to retain large compresses and dressings on the foot or the hand.

*For the foot:* After the compresses are applied, place the foot in the centre of a triangular bandage and carry the point over the ends of the toes and over the upper side of the foot to the ankle. Fold in excess bandage at the side of the foot, cross the ends, and tie in a square knot in front.

*For the hand:* After the dressings are applied, place the base of the triangle well up in the palmar surface of the wrist. Carry the point over the ends of the fingers and back of the hand well up on the wrist. Fold the excess bandage at the side of the hand, cross the ends around the wrist, and tie a square knot in front.

## CRAVAT BANDAGE

A triangular bandage can be folded into a strip for easy application during an emergency. To make a cravat bandage, bring the point of the triangular bandage to the middle of the base and continue to fold until a 2-inch width is obtained. The cravat may be tied, or it may be secured with safety pins.

*Cravat Bandage for Head.* This bandage is useful to control bleeding from wounds of the scalp or forehead. After placing a compress over the wound, place the centre of the cravat over the compress and carry the ends around to the opposite side; cross them, continue to carry them around to the starting point, and tie in a square knot.

*Cravat Bandage for Eye.* After applying a compress to the affected eye, place the centre of the cravat over the compress and on a slant so that the lower end is inclined downward. Bring the lower end around under the ear on the opposite side. Cross the ends in back of the head, bring them forward, and tie them over the compress.

*Cravat Bandage for Temple, Cheek, or Ear.* After a compress is applied to the wound, place the centre of the cravat over it and hold one end over the top of the head. Carry the other end under the jaw and up the opposite side, over the top of the head, and cross the two ends at right angles over the temple on the injured side. Continue one end around over the forehead and the other around the back of the head to meet over the temple on the uninjured side. Tie the ends in a square knot. (This bandage is also called a Modified Barton.)

*Cravat Bandage for Elbow or Knee.* After applying the compress, and if the injury or pain is not too severe, bend the elbow or knee to a right-angle position before applying the bandage. Place the middle of a rather wide cravat over the point of the elbow or knee, and carry the upper end around the upper part of the elbow or knee, bringing it back to the hollow, and the lower end entirely around the lower part, bringing it back to the hollow. See that the bandage is smooth and fits snugly; then tie in a square knot outside of the hollow.

*Cravat Bandage for Arm or Leg.* The width of the cravat you use will depend upon the extent and area of the injury. For a small area, place a compress over the wound, and centre the cravat bandage over the compress. Bring the ends around in back, cross them, and tie over the compress. For a small extremity, it may be necessary to make several turns around to

use all the bandage for tying. If the wound covers a larger area, hold one end of the bandage above the compress and wind the other end spirally downward across the compress until it is secure, then upward and around again, and tie a knot where both ends meet.

*Cravat Bandage for Axilla (Armpit).* This cravat is used to hold a compress in the axilla. It is similar to the bandage used to control bleeding from the axilla. Place the centre of the bandage in the axilla over the compress and carry the ends up over the top of the shoulder and cross them. Continue across the back and chest to the opposite axilla, and tie them. Do not tie too tightly or the axillary artery will be compressed, adversely affecting the circulation of the arm.

## **DRESSINGS**

A dressing is a device used for application to a wound in order to promote healing and/or prevent further harm.

Main purposes of dressings:

- Stem bleeding – helps to seal the wound to expedite the clotting process
- Absorb exudate – soak up blood, plasma and other fluids exuded from the wound, containing it in one place
- Ease pain – some dressings may have a pain relieving effect, and others may have a placebo effect
- Debride the wound – the removal of slough and foreign objects from the wound
- Protection from infection and mechanical damage
- Promote healing – through granulation and epithelialisation

### ***Types of dressings***

Modern dressings include gauzes (which may be impregnated with an agent designed to help sterility or to speed healing), films, gels, foams, hydrocolloids, alginates, hydrogels and polysaccharide pastes, granules and beads. Dressings can be also impregnated with antiseptic chemicals.

In the 1960s, George Winter published his controversial research on moist healing. Previously, the accepted wisdom was that in order to prevent infection of a wound, the wound should be kept as dry as possible. Winter demonstrated that wounds which were kept moist healed faster than those which were left exposed to the air or covered with traditional dressings.



***Dressings should:***

- Control the moisture content, so that the wound stays moist;
- Protect the wound from infection;
- Remove slough;
- Maintain the optimum pH and temperature to encourage healing;

An ideal wound dressing is one that is sterile, breathable, and encourages a moist healing environment. This will then reduce the risk of infection; help the wound heal more quickly and reduce scarring.

**SUTURE MATERIALS**

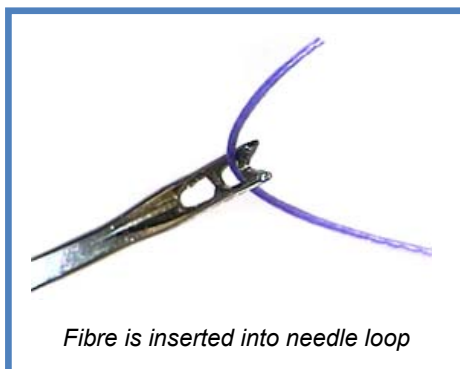
An ideal suture material must have tensile strength to resist breakage, good knot security, and workability in handling, low tissue reactivity, and the ability to resist bacterial infection. Sutures can be divided into two broad groups: absorbable and non absorbable. According to a structure these materials can be also divided to monofilament and braided (polyfilament). Formally existed next classification according the origin currently does not exist any more, as the natural (plant, animal) origin is forbidden.



*Atraumatic suture material (fibre is inserted straight into the needle)*

*Monofilament* sutures cause less reaction than do braided sutures but require more ties to assure an adequate maintenance of the knot compared to braided suture. Monofilament sutures are

usually non-absorbable.



*Fibre is inserted into needle loop*

*Braided* suture usually incites a greater inflammatory response but requires fewer ties to maintain the knot integrity. These include cotton, silk, braided nylon and multifilament Dacron. Until the advent of synthetic fibers, silk was the mainstay of wound closure. It is the most workable and has excellent knot security. Disadvantages: high reactivity and infection due to the

absorption of body fluids by the braided fibers.

### **Examples of suture materials:**

**A. ABSORBABLE:** Those that dissolve, then they are absorbed or digested by the body cells and tissue fluids in which they are embedded during and after the healing processes.

1. Polyglycolic acid (DEXON ®): Widespread absorbable suture material of a synthetic, braided polymer. Dexon has low rate of reactivity and infection rate, and has excellent knot security and tensile strength. A drawback of Dexon is its high friction that binds and snags when wet.
2. Polyglactin 910 (VICRYL ®) is an absorbable, synthetic, braided suture. It is indicated for soft tissue approximation and ligation, and holds its tensile strength for approximately three to four weeks in tissue. Vicryl may also be treated for more rapid breakdown in rapidly healing tissues (Vicryl Rapide).
3. Poliglecaprone 25 (MONOCRYL ®) is generally used for soft-tissue approximation and ligation. It is used frequently for subcuticular dermis closures of the face. It has less of a tendency to exit through the skin after it breaks down, such as Vicryl. Monocryl is the least reactive substance of this group.
4. Polyglyconate (MAXON ®) monofilament synthetic absorbable sutures are prepared from a copolymer of glycolic acid and trimethylene carbonate. It is used e.g. for gynaecology or pediatric cardiovascular surgery.
5. Polyglytone (CAPROSYN ®) monofilament suture delivers a much faster absorption rate than other USP synthetic absorbable sutures – only 56 days.
6. Polydioxanone (PDS ®) is monofilament. It absorbs slowly and there is minimal absorption until about 90 days. However, its in vivo tensile strength reduces more quickly to 70% at 2 weeks, 50% at four weeks and 25% at six weeks. It is widely used for abdominal wall muscle closure where it has replaced nylon/prolene as it does not cause chronic suture sinuses which occur with non-absorbable materials.

**B. NON-ABSORBABLE:** Those suture materials that cannot be absorbed by the body cells or fluids, and must be removed after wound healing is complete or if they are accessible at the body surface they stay at site forever. These materials can be synthetic organic (polyamide, polypropylene, polyester, silk) or anorganic (metal). They are generally used to close skin.

1. Polyamide Nylon (ETHILON ®): Of all the non-absorbable suture materials, monofilament nylon is the most commonly used in surface closures. It has minimal tissue reactivity and resists infections greater when compared to braided suture

materials. It has a high tensile strength that ensures wound security. The disadvantage of nylon is the difficulty in achieving good knot security. Because of this at least 4–5 "throws" (knots) are required to achieve a secure knot.

2. Polymer polypropylene (PROLENE ®) appears to be stronger than nylon and has better overall wound security. However, it has a greater memory (returns to its packaging shape) and is more difficult to work with. Polypropylene is absolutely unresorbable material.
3. Polyester (DACRON ®) is often used in cardiovascular surgery. Its big advantages are minimal tissue reaction, maximal visibility and greater tensile strength. It is easier to work with and holds knots better than nylon or polypropylene. Dacron has greater infection potential than nylon or polypropylene but less than silk or cotton.
4. Silk (MERSILK ®) Strong and handles well but induces strong tissue reaction and has a high infection potential.

**SUTURE SIZES:** The size of suture material is measured by its width or diameter and is vital to proper wound closure. As a guide the following are specific areas of their usage:

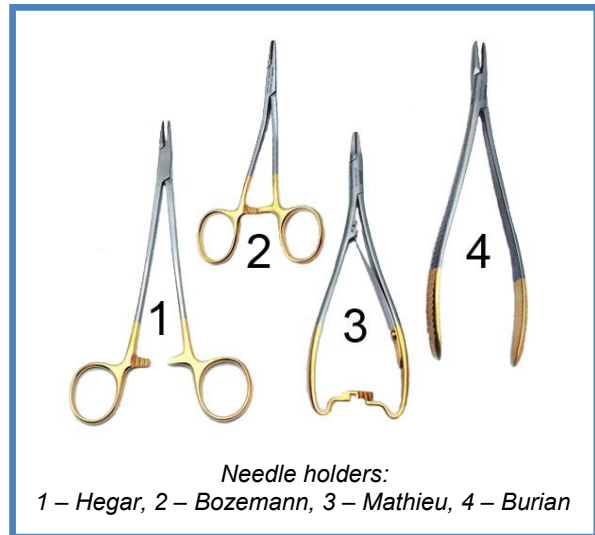
1. 1–0 and 2–0: Used for high stress areas requiring strong retention, i.e. – deep fascia repair
2. 3–0: Used in areas requiring good retention, i.e. – scalp, torso, and hands
3. 4–0: Used in areas requiring minimal retention, i.e. – extremities. It is the most common size utilized for superficial wound closure.
4. 5–0: Used for areas involving the face, nose, ears, eyebrows, and eyelids.
5. 6–0: Used on areas requiring little or no retention. Primarily used for cosmetic effects.

**SURGICAL NEEDLES:** There are a variety of needles for wound closure. Curved needles have two basic configurations; tapered and cutting. For wound and laceration care, the reverse cutting needle is used almost exclusively. It is made in such a way that the outer edge is sharp so as to allow for smooth and atraumatic penetration of tough skin and fascia. Tapered needles are used on soft tissue, such as bowel and subcutaneous tissue, or when the smallest diameter hole is desired.

Creeling may be either a classical when the thread is pulled through the eye of the needle (or is it impressed into it through perforation), or needleful, which transpiercing the tissue hurts less and leaves narrower channel, because the needle has no eye and the thread is sealed in its end.

## **BASIC SURGICAL INSTRUMENTS**

**NEEDLE HOLDERS:** Hinged (locking) instrument used to hold the needle while suturing tissue. Needle holders come in various sizes and shapes, but for most lacerations a standard size 4" will complete the task. For larger, deeper wound closures a larger needle and needle holder may be required.

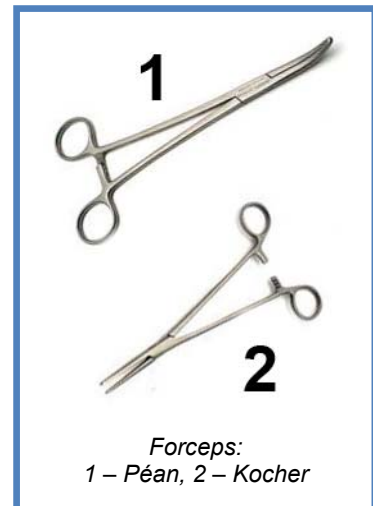


**FORCEPS:** consist of two tines held together at one end with a spring device that holds the tines open. Forceps can be either tissue or dressing forceps. Dressing forceps have smooth or smoothly serrated tips. Tissue forceps have teeth to grip tissue. Many forceps bear the name of the originator of the design, such as Adson tissue forceps.

**Péan's forceps:** a curved or straight clamp for haemostasis

**Kocher forceps:** a strong forceps with sharp points at the tips and transverse serrations along the full length for holding tissues during operation or for compressing bleeding tissue

Grasping and controlling tissue with forceps is essential to proper suture placement. However, whenever force is applied to skin or other tissues, inadvertent damage to cells can occur if an improper instrument or technique is used. Surgeon must be gentle when grasping tissue, and never fully close the jaws on the skin.



**Forceps:** Splitting (Luer, Liston, Cleveland), costotome, grasping (Duval, Babcock, Allis, Collin)

**Tweezers:** anatomical, surgical, adaptation, ophthalmological

**SCISSORS:** There are three types of scissors that are useful in minor wound care.

**Iris scissors:** Iris scissors are predominantly used to assist in wound debridement and revision. These scissors are very sharp and are appropriate in situations that require very

fine control. They are very delicate and are not recommended for cutting sutures. However, when very small sutures require removal they can be use.

**Dissection scissors:** Used for heavier tissue revision as necessary for wound undermining.

**Suture removal scissors:** Standard 6–inch, single blunt–tip, suture scissors are most useful for cutting sutures, adhesive tape, and other dressing materials. Because of their size and bulk, these scissors are very durable and practical.

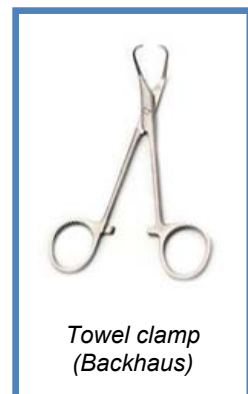


**KNIFE HANDLES AND BLADES:**

The knife handle holds the blade and is used in the debridement and excisions during wound revision. Common blades are the #10 blade

(used for large excisions), #15 blade (small, versatile and well suited for precise debridement and wound revision), and the #11 blade (ideal for incision and drainage of superficial abscesses and the removal of very small sutures). There are special types of knives, calibrating, used for the skin graft harvest – Watson, Humby, or dermatome.

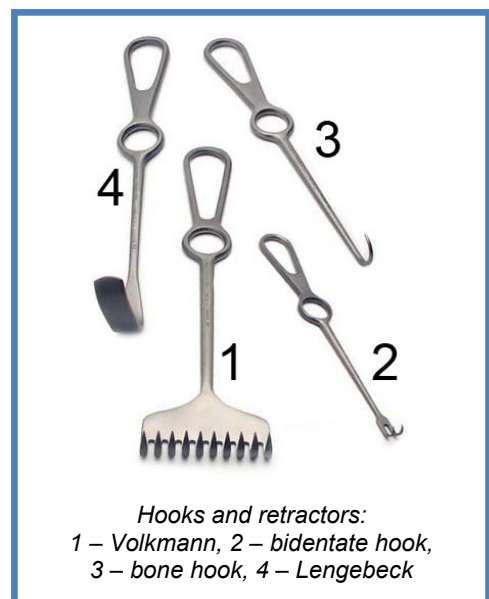
**PROBE:** a slender, flexible instrument designed for introduction into a wound cavity, or sinus tract for purposes of exploration



**TOWEL CLAMPS (Backhaus)** secure drapes to a patient's skin. They may also be used to hold tissue.

**Hooks and retractors:** tools to hold and pull the tissue (sharp – Volkmann, bidentate, tridentate, bone, lid, window – Middeldorf, full – Langenbeck, Kocher called strumal, etc.)

Instruments are usually stored in the sets on special trays or in cartridges; they are also sterilized in most often. Composition of sets may be general (basic), or intended for use in a particular type of operation.



Exceptionally or in contrast very frequently used instruments can be prepared and stored individually in sterile packaging.

# ADMINISTRATION OF MEDICAMENTS

The way of administration has a very important influence on the pharmacokinetic qualities of the drug such as uptake rate, distribution or elimination.

Routes of administration can be divided into:

- **Topical:** local effect, substance is applied directly where its action is desired (epicutaneous, inhalational, eye, ear or nasal drops, vaginal, etc.)
- **Enteral:** desired effect is systemic, substance is given via the digestive tract (oral, via gastric or duodenal feeding tube, into gastrostomy, rectal)
- **Parenteral:** desired effect is systemic, substance is given by other routes than the digestive tract (intravenous, intraarterial, intracardial, intramuscular, subcutaneous, intradermal, intraosseal, intraperitoneal, intrathecal, epidural, intravitreal)
- **Special:** transdermal or transmucosal (systemic effect)

Examples of application:

## **1. PER ORAL** (ONSET OF EFFECT ABOUT 30 MINUTES)

Per oral administration is the most frequent, safe and the cheapest method. However some medicaments are unsuitable for this route because they are not resistant to digestive enzymes or aggressive changes of pH. Some drugs can also irritate the digestive tract and induce a vomit. Using a drug in enterosolvent form, which is not dissolved until it reaches the intestine, could reduce this fact.

## **2. SUBLINGUAL** (ONSET OF EFFECT 1–2 MINUTES)

Absorption from the oral mucosa is very important in the treatment of angina pectoris by nitroglycerine. The biggest advantages of this method are the quick onset of effect and the possibility to break further absorption by spitting out the rest of the drug. Since venous drainage from the mouth is to the superior vena cava, there is a 100% bypass of hepatic first-pass effect

## **3. RECTAL** (ONSET OF EFFECT 10–15 MINUTES)

This method is often used in children, who refused the oral form or when the drug irritates the stomach. Another case is an unconscious patient. The biggest advantage is that the drug is

from 50% absorbed to vena cava inferior so the substantial amount of the medicament evade the liver (first pass effect). However the rectal absorption is often incomplete, irregular and some drugs can irritate the rectal mucosa.

- suppository: a medicated mass adapted for introduction into the rectal, vaginal, or urethral orifice of the body; suppository bases are solid at room temperature but melt or dissolve at body temperature. Commonly used bases are cocoa butter, glycerinated gelatin, hydrogenated vegetable oils, polyethylene glycols of various molecular weights, and fatty acid esters of polyethylene glycol.
- glycerin suppository: a suppository made up of a mixture of glycerin and sodium stearate; used as a rectal evacuant.

#### **4. INHALATION** (ONSET OF EFFECT 2–3 MINUTES)

Inhalation can be used as topical or systemic (parenteral) route of drug administration. The medicament can reach the circulation very quickly because of the large absorption area in lungs. For inhalation can be used gases, fumes, aerosols as well as solids. The main use is general anaesthesia or treatment and prevention of asthma bronchial.

The penetration of the drug into the airways is especially impressed with the particle size:

- size about 40–50  $\mu\text{m}$  – catch in nose, nasopharynx
- size about 30  $\mu\text{m}$  – catch in trachea
- size about 10  $\mu\text{m}$  – catch in bronchi
- less than 5  $\mu\text{m}$  – reach the alveoli

Types of inhalation:

- cold – T 25–36 °C → lowers the blood flow in the mucosa
- indifferent – T 36–37 °C → calmative effect
- warm – T 38–40 °C → increases the blood flow in the mucosa

#### **5. INJECTION**

##### ***A. Intradermal injection***

It is an application of a substance into the skin on the level of dermis mostly for diagnostic purposes (Mantoux test, alergologic tests etc.)

##### **The way of application:**

- usually small amount of drug (0.1 ml)
- after disinfection of the place of puncture stretch the skin and make a puncture under an angle of 15°
- after right application a whitish bud will occur in the place of puncture



**Usual places of intradermal injections:**

- Shoulders in the area of *deltoideus muscle*
- Outer and inner part of *the forearm*
- Upper part of the chest – *pectoralis major muscle*
- Back in the area of shoulder blades – *trapezoid muscle*
- Outer part of thighs – *quadriceps femoris muscle*

**B. Subcutaneous injection (onset of effect 10–20 minutes)**

In a subcutaneous injection the medication is delivered as a bolus into the subcutaneous tissue. This method is highly effective in administering vaccines and such medications as insulin, morphine etc. The speed of absorption can be reduced by addition of vasoconstrictive agents, if possible with regard to the characteristic of substance. For application form a skin fold and make a puncture under a 45° angle.

**Usual places of subcutaneous injections:**

- Outer area of the upper arm
- Just above and below the waist, except the area right around the navel
- Upper area of the buttock, just behind the hip bone
- Front of the thigh, midway to the outer side, 10 cm below the top of the thigh to 10cm above the knee.

Changing the injection site keeps lumps or small dents called lipodystrophies from forming in the skin.

**C. Intramuscular injection (onset of effect 5–10 minutes)**

The intramuscular injection means a delivery of the medicaments directly into a muscle. The medicaments are used in the form of solution, emulsion or suspension in the amount about 1–20 mls. For an application make a quick puncture through the stretched skin in a 90° angle.

**Usual places of intramuscular injections:**

- Gluteus maximus muscle
- Gluteus medius muscle
- Quadriceps femoris – musculus vastus lateralis muscle
- Deltoideus muscle

**Complications of intramuscular injections:**

haematoma, puncture of a bone or nerve, abscess in subcutaneous tissue, puncture of the vein, microembolisation after cumulating of punctures in one site, when a medicament gets into the circulation (Hoigné syndrome in the depot form of Penicillin = May occur when the

suspension gets into the blood. It has rapid onset, but benign course. There is mental experiences – the fear of death, auditory and visual hallucinations in color, confusion, disorientation and dizziness, taste disturbance, tachycardia, heart palpitation), crank of a needle, inflammation etc.

#### ***D. Intravenous injection (onset of effect in 1 minute)***

This is the most direct route for the systemic administration of a drug, because it is placed directly into the circulatory system without having to cross any membranes. The rapidity of effects can actually be a disadvantage with this route of administration, since acute over dosage is possible. The most common usage of the intravenous route is the administration of anaesthetics, since the level of anaesthesia can be carefully titrated by monitoring vital signs. Additionally, drugs that would otherwise be severe irritants to local tissue can sometimes be administered via this route, owing to the resistant nature of the walls of the bloodstream and the rapid dilution of the drug in the moving fluid environment.

Arm and hand veins are typically used although leg and foot veins or the scalp veins on infants are occasionally used for intravenous therapy.

Intravenous therapy can be intermittent (bolus) or continuous (intravenous drip, infusion). The biggest advantage of infusion is the possibility to interrupt the administration of the medicament when undesired or toxic effects occur.

This method is not suitable for oily solutions or insoluble substances or substances that precipitate blood constituents or haemolyse RBCs.

#### **The way of application:**

- Put on the tourniquet to make the vein bulge
- Draw back slightly on the syringe to aspirate blood for verifying that the needle is really in the vein
- Remove the tourniquet and inject the drug

#### ***E. Intraarterial injection***

Intraarterial injection is used for e.g. vasodilator drugs in the treatment of vasospasm or thrombolytic drugs for treatment of embolism.

It is necessary to find a suitable place where adequate collateral arterial vessels are available

- Femoral artery has not adequate collateral supplies
- Brachial artery has not adequate collateral supplies
- Radial artery has good collateral supply from the ulna artery in case of vasospasm or clotting.

Patency should be assessed before with Allen's test: the radial and ulna arteries are occluded by firm digital pressure while the elevated fist is clenched for 20 seconds. Before the hand is opened ulnar artery is released only. Positive Allen test: up to 5 to 7 seconds hand turns to red, negative Allen test: the hand remains white.

### ***F. Intraosseous injection***

The intraosseous infusion is an indirect intravenous access because the bone marrow drains directly into the venous system. It is the second-line administration of drug (epinephrine, bicarbonate, calcium, lidocaine, and volume expanders), fluid or blood (and marrow aspirate drawn for laboratory analysis) through a butterfly needle directly into the bone marrow (a "noncollapsible vein") to a hemodynamically shocked child (mainly due to diarrhea or burns) in whom attempts to access the systemic vascular system have been unsuccessful. This route is indicated in a child in shock or cardiac arrest when two attempts to access peripheral vasculature have failed or when more than 2 minutes have elapsed in the attempt to gain access.

#### **Disadvantages of intraosseous injection:**

- Injury to the epiphyseal growth plate during the performance of this technique remains a serious problem. An insertion site of at least 10 mm distal to the tibial tuberosity is recommended to avoid epiphyseal growth plate injury and ensure ease of insertion
- Risk of bone fracture, lodge syndrome (acute limb ischemia requiring amputation), osteomyelitis

## **6. TRANSDERMAL ADMINISTRATION**

Usually in the form of patch placed on the skin a specific dose of medication can be delivered through the skin in the circulation.

An advantage of a transdermal drug delivery route over other types such as oral, topical, etc is that it provides a controlled release of the medicament into the patient.

A wide variety of medicaments can be delivered this way. Well known are nicotine patches created to help with cessation of tobacco smoking. Fentanyl patch is a user friendly way to relieve from a severe pain. Often used are also estrogen skin patches to prevent osteoporosis after menopause or lidocain patches to relieve the peripheral pain in Herpes Zoster etc.

## **7. TOPICAL ADMINISTRATION**

### ***A. Gel***

Gel is an apparently solid, jelly-like material formed from a colloidal solution. By weight, gels are mostly liquid, yet they behave like solids due to the addition of a gelling agent.

Dressings with gel are often used for healing of burn or other hard-to-heal wounds. Wound gels are excellent for helping to create or maintain a moist environment. They provide absorption, desloughing and debriding capacities of necrotics and fibrotic tissue.

Gels can also serve as reservoirs in topical drug delivery, particularly ionic drugs, delivered by iontophoresis.

Gel form of medication is often used also with a systemic effect. For example Diazepam rectal gel is a safe and effective treatment for acute repetitive or prolonged epileptic seizures in children.

### ***B. Cream***

A cream is a topical preparation usually for application to the skin. Creams for application to mucus membranes such as those of the rectum or vagina are also used.

Creams are semi-solid emulsions that are mixtures of two agents – oil and water. They are divided into two types: oil-in-water (O/W) creams which are composed of small droplets of oil dispersed in a continuous aqueous phase, and water-in-oil (W/O) creams which are composed of small droplets of water dispersed in a continuous oily phase. Oil-in-water creams are more comfortable and cosmetically acceptable as they are less greasy and more easily washed off using water. Water-in-oil creams are more difficult to handle but many drugs which are incorporated into creams are hydrophobic and will be released more readily from a water-in-oil cream than an oil-in-water cream. Water-in-oil creams are also more moisturising as they provide an oily barrier which reduces water loss from the stratum corneum, the outmost layer of the skin.

Cream can be used as a vehicle for drug substances such as local anaesthetics, anti-inflammatory (NSAIDs or corticosteroids), hormones, antibiotics, antifungals or counter-irritants.

### ***C. Ointment***

An ointment is a viscous semisolid preparation used topically on a variety of body surfaces. These include the skin and the mucus membranes of the eye, vagina, anus or nose. The vehicle of an ointment is known as ointment base. Ointments combine oil (80%) and water (20%). This combination generally forms a more effective barrier against moisture loss than creams and lotions so ointments tend to be better moisturizers.

Properties of an ointment base are:

1. Stability
2. Penetrability
3. Solvent property
4. Irritant effects

## 5. Ease of application and removal

Uses:

- Forms protective layer on the skin
- Strong moisturizer – better at locking in moisture than creams and lotions because contains more oil

### ***D. Instillations – eye, ear and nose drops***

#### **Eye drops**

A variety of medications can be administered in the form of eye drops for the treatment of allergies or non-allergic eye disorders such as conjunctivitis or glaucoma.

Mostly used eye drops: antihistamines, artificial tears, decongestants, NSAIDs, corticosteroids, antibiotics, glaucoma medications

Eye drops may also be used during eye examinations to dilate the pupils of the eye or administer an anaesthetic.

#### **Ear drops**

A sterile solution or suspension of medicament with local effect is directly put in the outer ear canal. It can be based on oil, water or alcohol. Ear drops are mostly used to soften ear wax or to treat a local inflammation.

Some formulations of ear drops are meant to be used strictly for the outer ear, and should not be used if there is a possibility that the tympanic membrane is not intact and the fluid will drip into the middle ear cavity. Many kinds of eye drops can be also used in the ear – but the opposite is not true.

#### **Nose drops**

Solutions or suspensions are supposed for intranasal administration. The most frequently used drops are decongestants. This medication promotes nasal drainage and relieves nasal stuffiness. It is used to relieve symptoms associated with a cold, hay fever, allergies, sinus infections and other related conditions. NSAIDs and antibiotics are causal treatment of an inflammation.

Saline nasal sprays and nose drops are used to keep nasal tissues moist, relieve nasal irritation, and help thick or dried mucus to drain. Steroid drops can be used in the treatment of nasal polyps or hay fever.

An intranasal route can be also used for systemic administration of medication (e.g. adiuretin)

## **E. Infiltration**

Infiltration is the infusion of fluid and/or medication outside the intravascular space, into the soft tissue. Clinically, there will appear a swelling of the soft tissue surrounding the puncture, and the skin will feel cool, firm, and pale.

Infiltration is used for application of a local anaesthesia to numb and provide pain relief to some part of the body during minor surgery, such as debridement, incision and drainage, repair of laceration, excisions, etc., or other medical procedures.

Relatively high drug doses or concentrations inhibit all qualities of sensation (pain, touch, temperature etc.) as well as muscle control. Lower doses or concentrations may selectively inhibit pain sensation with minimal effect on muscle power.

Anaesthesia persists as long as there is a sufficient concentration of local anaesthetic at the affected nerves. Sometimes a vasoconstrictor drug is added to decrease local blood flow, thereby slowing the transport of the local anaesthetic away from the site of injection. Depending on the drug and technique, the anaesthetic effect may persist from less than an hour to several hours.

# SURGICAL DRAINAGE, CATHETRIZATION

Surgical drainage is a procedure with the aim to remove blood, various secretions, pus, or gas (in the case of chest drainage) from the surgical wound, or various cavities or spaces. Surgical drainage may be performed with help of a drain or without it.

## **DRAINAGE**

There are two types of surgical drainage 1) natural drainage without drain, 2) artificial drainage with drain

### **1) The natural drainage without drain**

is a result of spontaneous perforation of the abscess. Furthermore, the natural drainage may be established with help of incision of the abscess or by releasing of a stitch of the surgical wound. This type of drainage is suitable, when the location of the abscess (or other focus) is superficial. Drainage due to spontaneous perforation is usually not sufficient and it is necessary to enlarge the opening into the abscess. Sometimes, incision or releasing of the stitch of the surgical wound is not sufficient. Thus the artificial drainage is necessary to perform.

### **2) The artificial drainage with a drain**

is inserting an artificial material – the drain into the surgical wound, or various cavities or abscess, which enables to remove out the liquid or gas (chest drainage). This type of surgical drainage usually enables the drainage according to gravity; therefore it is necessary to drain the cavity in its lower point.

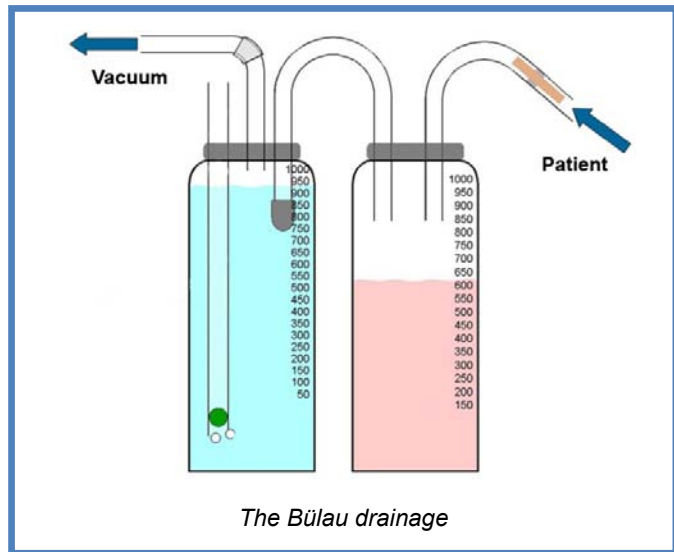
It is used to remove pus, blood or other fluids from a wound and thus it facilitates the healing. Even sterile body fluid may accumulate and in itself become a focus of infection.

It is possible to distinguish following ways of artificial surgical drainage:

- a) „Glove“ drain is a piece of sterile surgical glove inserted into the place which should be drained.
- b) Capillary drain is a gumm tube with a piece of textile inside. Removal of liquid is done due to capillary attraction. This type of drainage is not used frequently.

c) Tubular drain (usually tygon tube or gumm tube with perforation of the wall) enables higher efficiency of drainage.

d) The Bülau drainage is intended for drainage of the chest. The Bülau drain is placed into the pleural cavity and the free end of the tube is submerged under the water level, below the level of the chest. In practice, the flask with an antiseptic solution is placed on the floor under patient's bed.



This allows the air or fluid to

escape from the pleural space, and prevents anything returning to the chest. It actually enables one-way only floating of the gas or fluid from the pleural cavity towards outside. This type of drainage is used in pneumothorax or pleural effusion, etc.

e) Sucking drainage – this type of surgical drainage is more effective than the previous types. Most commonly used type of the sucking drainage is the Redon drainage. In this modification the end of the drain is connected to the flask with the vacuum which enables active sucking of the liquids.



f) Other types of surgical drainage: Pigtail drain is specially shaped drain (looking as a pig tail). It is intended for drainage of deeply located abscess (subdiaphragmatical or others). This and other types

of drains are placed under sonographical or CT control. Other drains are intended for drainage of biliary ways. These are placed using endoscope.

Drains may be hooked to wall suction, a portable suction device (Redon drain), or they may be left to drain by gravity. Accurate recording of the volume of drainage as well as the contents is vital to ensure proper healing and monitor for excessive bleeding. Depending on the amount of drainage, a patient may have the drain in place 1 day to weeks. Drains will have protective dressings that will need to be changed daily/as needed.



## CATHETERIZATION

is a placing a tube, catheter, into the preformed cavities, duct or vessel. Usually it leads out the content of the cavity (for example catheterization of urinary bladder). The term of catheterization is also used for intraluminal access into the vessels which enables to perform arteriography (diagnostic procedure) or angioplasty and stentage of the vessel (treatment).

In most uses a catheter is a thin, flexible tube: a "soft" catheter; in some uses, it is a larger, solid tube: a "hard" catheter.

The ancient Egyptians created catheters from reeds. "Katheter" originally referred to an instrument that was inserted such as a plug. The word "katheter" in turn came from "kathimai" meaning "to sound" with a probe. The ancient Greeks inserted a hollow metal tube through the urethra into the bladder to empty it and the tube came to be known as a "katheter".

Draining urine from the urinary bladder is called as **urinary catheterization**. It is the most frequent type of catheterization. Urethral catheterization may be performed as either a therapeutic or a diagnostic procedure. Therapeutically, the aim is to decompress the bladder in patients with acute or chronic urinary retention. Diagnostically, urinary catheters may be placed to obtain an uncontaminated urine sample for microbiologic testing, to measure urinary output in critically ill patients or during surgical procedures, or to measure post-void residuals. The only absolute contraindication to urethral catheterization is known or suspected urethral injury, usually in the setting of a pelvic fracture.

In practice the urinary catheterization is employed in hospital and nursing home settings to maintain urine output in patients who are undergoing surgery, or who are confined to the bed and physically unable to use a bedpan.

Patients who are unable to completely empty the bladder during urination (urinary retention), or patients who have a bladder obstruction, may require intermittent urinary catheterization. Disabled individuals with neurological disorders that cause paralysis or a loss of sensation in the perineal area may also use regular intermittent catheter insertion to void their bladders.

Procedure: The genital area near the urethral opening is wiped with an antiseptic agent. A lubricant may be used to facilitate the entry of the catheter into the urethra, and a topical local anaesthetic may be applied to numb the urethral opening during the procedure. The end of the sterile catheter is placed in a container. When urine flow stops, the catheter may be moved, or the patient may change positions to ensure that all urine has emptied from the bladder. Currently we use disposable devices only.

The main risks and complications connected with this procedure are the injury of the urethra and/or bladder, scarring and/or stricture of the urethra, and urinary tract infection.

Next examples of cathetrisation are administration of intravenous fluids, medication or parenteral nutrition with a peripheral venous catheter or with central venous catheter, cardiac catheterization, epidural anesthesia etc.

# LOCAL AND GENERAL POSTOPERATIVE TREATMENT, POSTOPERATIVE COMPLICATIONS

## POSTOPERATIVE CARE AND TREATMENT

Postoperative care is very important to prevent both immediate and long-term complications. Therefore, we should monitor the patient after operation at least once a day and if needed even more frequently. Postoperatively there are monitored vital functions on the recovery unit before the patient's transfer to the ward or on ICU in seriously ill patients. There should be recorded an operation and completed instructions and drugs prescription before the transfer of the patient to the ward.

We should monitor the following vital functions – airway, blood pressure, heart rate, conscious level, temperature, respiratory rate and depth, oxygen saturation and urine output, and of course, to assess the wound. Central venous pressure (CVP) and continual ECG monitoring is advisable in elderly patients after a major surgery and in patients with cardiac disease.

Key areas of **postoperative care** are:

- a) Early mobilization especially in patients with prolonged bed rest and in risk patients such as with diabetes.
- b) Postoperative diet which should be assessed in patients where an NG tube is used; sips of water may be administered when peristalsis returns. If fluids are well tolerated, the NG tube can be removed and a full diet can be introduced gradually.
- c) Intravenous fluids which should be administered according to the requirements, the input and output should be monitored and recorded.
- d) Urine output monitoring. If the patient has not passed any urine within 8 hours postoperatively, a doctor should decide whether any action has to be made in terms of catheterisation.
- e) Wound assessment for possibility of bleeding or developing of late complication.
- f) Analgesia, antibiotics and other routine medication necessary for postoperative treatment and administered either intravenously or per orally.

- g) Some laboratory tests such as Hb, FBC, U&E which should be done within 24 hours after operation in patients after major procedures. Sometimes it is necessary to perform X-rays or ECG.

### ***Postoperative fluid management***

Fluids requirements depend on the type of operation performed, whether it is maintenance or a replacement of fluids. It also depends on the extent of operation and its severity, and on postoperative period fluid balance (drain loss, oral intake, urine output, vomiting, loss through an NG tube, etc.). It can be monitored by checking the heart rate, blood pressure, total intake and output, and a urine output (minimum 0.5 ml/hour/kg of body weight). In situations when a patient is unwell, the CVP (central venous pressure) should be monitored as well.

Clinical symptoms of dehydration are represented by dryness of skin and mucosa, decreased skin pressure and muscle tonus, general malaise, increased pulse and decreased blood pressure. Keep in mind that despite ongoing dehydration the blood pressure can be normal for a long time due to the body compensating mechanisms.

Maintenance requirements for 24 hours are 1 litre of normal saline and 2 litres of 5% dextrose – **crystalloid solutions**. Potassium supplement is not usually necessary, but if the patient is on minimal oral intake for more than 24 hours, the potassium likely needs to be supplemented – minimum is 60 mmol of potassium chloride. During an excess loss due to vomiting, fistula, diarrhoea etc., the intake should be adequately increased.

If there is any blood loss, the patient needs substitution of a lost volume and blood. The **colloid fluids** can be used until the blood is available. The colloid fluids are more effective than crystalloids in maintaining of blood pressure. The indication for **blood transfusion** needs to be clear because transfusion itself is not without a risk. Possible alternatives should be used such as plasma substitution or iron therapy if necessary.

### ***Postoperative analgesia***

We should make sure that all patients after surgical procedures are pain free because an excess pain may be a symptom of a developing complication. Good postoperative analgesia improves respiratory functions and reduces a cardiac demand.

Patients should be informed preoperatively about the operation to relieve their pre- and post-operative anxiety which can in return reduce the severity of postoperative pain. There are different scales how to assess the severity of pain.

Different types of analgesia can be administered in different ways. The decision depends on the type of operation.

1. Major surgery – abdominal, thoracic surgery – the opiates are required, they can be given intravenously continuously or by patient-controlled analgesia (PCA) system, alternatives (epidural or intramuscular injections) can be used as well
2. Minor surgery – hernia repair, varicose vein surgery – simple oral analgetics such as paracetamol or non-steroidal anti-inflammatory drugs (NSAIDs), nerve blocks or infiltration of the wound with local anaesthetic.

### ***Postoperative nutrition***

It is necessary to ensure that the patient is in a good nutritional status pre- and post-operatively because it can prevent some possible complications. Many patients undergoing gastrointestinal operations are malnourished which is closely linked to decrease of resistance to infection and impaired wound healing. These patients are therefore at increased risk of postoperative morbidity and mortality. In indicated cases patients should have enteral nutrition preoperatively to improve their general status.

The patient should start to **eat** soon after most operations; in case of malnutrition or development of such complication where they are not able to eat, the feeding regime should be assessed. It is preferred to give an **enteral nutrition** because of the integrity of gut mucosal barrier and maintenance of secretion of gut hormones and enzymes. The feed can be given via nasogastric tube, gastrostomy or jejunostomy tube. When gastrointestinal function is improved, the patient can have a complete polymeric feed, only if the digestive enzymes do not work adequately, then the elemental feed is indicated.

**Total parenteral nutrition (TPN)** is given to some patients with a short gut, pancreatitis or a high-output fistula. TPN is administered via CVP line, which can cause potential complications such as vascular damage, thrombosis, line sepsis, haemopericardium and haemopneumothorax. Therefore, we should consider with a special care if TPN is needed.

### ***Postoperative complications***

All operations carry a risk of complications. Our goal is to prevent them or minimize their consequences.

They are usually classified as:

1. immediate – within the first 24 hours
2. early – in the first 2–3 weeks postoperatively
3. late – any complications at any subsequent period after the discharge

Complications can be divided into:

1. general – of any operation
2. specific – of individual operations

Next classification may be to the local and general complications.

There are a lot of complications, which can happen postoperatively, some of them are more frequent than others. To summarize possible complications, there is provided a Table showing characteristics of various complications.

***Summary of postoperative complications according to the affected body system:***

1. Haemorrhage – early postoperative and secondary haemorrhage, see chapter 14
2. Wound problems – infection, wound dehiscence, necrosis, burst abdomen, incisional hernia, haematoma, seroma, bleeding, stitch sinus, anastomotic breakdown.
3. Postoperative temperature  
Postoperative temperature has various causes in relation to the time of development after operation.
  - a) Peri-operatively – due to septic operation, blood transfusion, lung atelectasis
  - b) Within first 2 days – wound necrosis, lung atelectasis
  - c) Between 2 – 4 days – infection on site of intravenous access, urinary tract infection, pulmonary embolus, pneumonia
  - d) 5 – 10 days postoperatively – wound infection, wound dehiscence, seroma, dehiscence of anastomosis, intraabdominal abscess, peritonitisTemperature needs to be treated in relation to the cause, which has to be removed. The most important is the prevention including preoperative care, asepsis and antisepsis during surgery, antibiotic prophylaxis when indicated and postoperative care.
4. Shock – see chapter Shock
5. Cardiovascular – cardiac arrest, myocardial infarction, pulmonary oedema, arrhythmias, deep vein thrombosis
6. Lung – respiratory depression, atelectasis, aspiration, pneumonia, pulmonary embolus, pulmonary oedema, pneumothorax, ARDS (adult respiratory distress syndrome)
7. Cerebral – confusion due to sepsis, hypoxia, electrolyte dysbalance, alcohol withdrawal, stroke
8. Urinary – acute retention, urinary tract infection (UTI), acute renal failure
9. Gastrointestinal – nausea and vomiting due to paralytic ileus, mechanical obstruction, acute gastric dilatation, constipation, pseudomembranous colitis

10. Other – pressure sores

**Clinical features and management of postoperative complications**

Complication	Time postoperatively	Cause	Signs and symptoms	Management
<b>Respiratory depression</b>	< 24 hours	airway obstruction, general anaesthetic or excess analgesia	decreased resp. rate, altered conscious level, cyanosis	clear airway, reverse general anaesthetic or effect of analgesia
<b>Hypovolaemia</b>	< 24 hours	haemorrhage, inadequate fluid replacement, sepsis	decreased blood pressure, increased heart rate, decreased urine output	intravenous fluids—crystalloids and colloids, antibiotics for sepsis
<b>Atelectasis</b>	24 – 48 hours	poor analgesia, smoking, previous chest problems	increase temp., increased resp. rate, decreased O <sub>2</sub> , decreased airway at the bases of lungs	as a preventive care: early mobilisation, as a treatment: analgesia, physiotherapy, nebulizers
<b>Respiratory infection</b>	> 48 hours	poor analgesia, smoking, previous chest problems	increase temp., increased resp. rate, decreased O <sub>2</sub> , decreased airway and crepitations, sputum production	as a preventive care: early mobilisation, possibly antibiotics, as a treatment: analgesia, physiotherapy, nebulizers and antibiotics
<b>Deep vein thrombosis (DVT)</b>	5 – 10 days	operations causing immobility (e.g. pelvic, orthopaedic), oral contraceptive use, malignancy	increased temperature, swollen leg, tender calf	as a preventive care: lowmol. heparines, sufficient amount of fluid, early mobilisation, as a treatment: Doppler USS or venogram, anticoagulation
<b>Pulmonary embolus (PE)</b>	5 – 10 days	DVT, immobility, no signs of DVT in 50% case	present as pleuritic chest pains, multiple small PEs, or massive PE with collapse or death	as a preventive care: lowmol. heparines, sufficient amount of fluid, early mobilisation, as a treatment ECG, V/Q scan, anticoagulation
<b>Wound infection</b>	5 days	haematoma, contamination at operat., corticosteroid use, diabetes mellitus, malignancy, jaundice, long-duration operation	increased temperature with redness, tender and swollen wound	antibiotics

<b>Complication</b>	<b>Time postoperatively</b>	<b>Cause</b>	<b>Signs and symptoms</b>	<b>Management</b>
<b>Urinary tract</b>	5 days	immobility, catheterization	increased temperature, confusion in elderly, dysuria	antibiotics+– drainage of infection
<b>Wound dehiscence</b>	5 – 10 days	Poor operative technique, infection, haematoma, corticosteroid use	red serous discharge from wound, protruding intestine	resuscitation, return to theatre to repair wound
<b>Paralytic ileus</b>	> 4 – 5 days	normal response, but if occurs after more than 4–5 days there may be intra–abdominal pathology or low K+	NG aspirate, abdominal distension	resuscitation, NG aspiration, correct electrolytes
<b>Acute cystic dilatation</b>	2 – 5 days	vomiting, decreased blood pressure, increased heart rate associated with paralytic ileus	NG aspiration	
<b>Anastomotic dehiscence</b>	5 – 10 days	Poor operative technique, infection, diabetes mellitus, vascular insufficiency	decreased blood pressure, increased temperature, increased heart rate, peritonitis	resuscitation, laparotomy, antibiotics, lavage, defunction bowel
<b>Secondary haemorrhage</b>	7 – 10 days	infection of suture line	decrease blood pressure, increased heart rate, bleeding	resuscitation to stop haemorrhage
<b>Pseudo–membranous colitis</b>		following prolonged antibiotic use, due to Clostridium difficile toxin	diarrhoea, dehydration, abdominal pain	resuscitation, oral vancomycin



## **NUTRITION AND DIETETICS IN SURGERY**

The complex response to the physiological stress of surgery or injury, mediated via hormonal changes and the sympathetic nervous system, is one of hypermetabolism and catabolism. There is marked salt and water retention and increases in basal metabolic rate and hepatic glucose production. Wound healing accounts for 80% of the increased glucose production and also requires protein synthesis. Fat (adipose tissue) and protein stores (lean muscle mass) are mobilised to meet the needs of glucose and protein synthesis, which results in negative nitrogen balance and weight loss. Overall, the catabolic response increases energy and protein requirements, the magnitude and duration depending on the extent of the surgery. A critical point is that semi-starvation (that is, intake consistently below potentially increased requirements) is also catabolic and further exacerbates negative nitrogen balance and weight loss. Indeed, recent evidence suggests the catabolic response to surgery may not be obligatory and can be prevented by adequate intake.

Adequate energy and protein intakes are essential to limit net protein and fat losses. The basic components of nourishment are proteins, saccharides, fats, minerals including microelements, and vitamins.

The metabolic response to surgery can be worsening, if poorly managed in aspect of nutrition, in increased postoperative morbidity and mortality. Positive outcomes for surgery depend heavily on adequate immune defence and wound healing. Both rely on enhanced synthesis of new proteins, which is significantly limited by negative nitrogen and energy balance. A key point is that positive nitrogen balance (net protein synthesis) cannot be achieved with negative energy balance. Semi-starvation will result within days rather than weeks, when intake fails to meet requirements, particularly for protein and energy.

Serious problems with poor energy malnutrition, i.e. severe multiple injury or burns, or inflammatory diseases, such as acute pancreatitis, and sepsis, mainly coupled with immune deficiency in older patients or patients with malign tumours or with other immune impaired diseases, greatly increase the risk of fatal post-op course.

Nutritional interventions can only be effective if energy requirements are both accurately estimated and then achieved. The standard approach is to estimate energy requirements from basal energy expenditure, using regression equations and activity and stress factors.

### **Evaluation of nutritional status**

1. History: duration of illness, weight loss, change in appetite, dietary habits.
2. Physical examination: general appearance, loose skin folds, loss of skin contours over bony prominences, muscle wasting, and peripheral oedema.
3. Weight: in relation to height. This is the so-called BMI (body mass index) = **index of physical weight** is the number used as a measure of obesity, allowing statistical comparing of people with different height. Index is calculated by dividing the weight of the man by the square of his height: **The formula is fulfilled with weight in kilograms and height in meters.** The resulting unit kg/m<sup>2</sup> is to be omitted. The formula was created in the 2<sup>nd</sup> half of the 19th century by A. Quetelet working on his system of "social physics". Therefore BMI is sometimes referred as Quetelet index.

<b>Category</b>	<b>Range BMI – kg/m<sup>2</sup></b>	<b>BMI Basic</b>	<b>Weight persons 180 cm high</b>
<b>severe malnutrition</b>	BMI ≤ 16.5	less than než 0.6	less than 53.5 kg
<b>underweight</b>	16.5 to 18.5	0.6 to 0.74	from 53.5 to 60 kg
<b>ideal weight</b>	18.5 to 25	0.74 to 1	from 60 to 81 kg
<b>overweight</b>	25 to 30	1 to 1.2	from 81 to 97 kg
<b>mild obesity</b>	30 to 35	1.2 to 1.4	from 97 to 113 kg
<b>central obesity</b>	35 to 40	1.4 to 1.6	from 113 to 130 kg
<b>morbid obesity</b>	BMI > 40	of 1.6	over 130 kg

4. Anthropometric measurements: e.g. triceps skin fold thickness.
5. Laboratory tests: e.g. Hb, serum albumin, and serum iron.

### **Remember:**

Some patients can be clearly malnourished prior to surgery or trauma:

1. Increased catabolism, e.g. sepsis, repeated major surgery.
2. Excessive losses, e.g. chronic liver disease with loss of protein, losing enteropathy.
3. Poor intake, e.g. dysphagia, vomiting, general debility, bad absorption, e.g. fistulae, short bowel.
4. Other causes, e.g. major trauma, chemotherapy.

### **Administration of nutritional support**

With regard to ensure the nutritional need we can divide the patients into:

1. Those, who do not want to eat
2. Those, which cannot eat
3. Those, which must not eat

According to this classification we use the following routes:

## **1. ORAL NUTRITION**

The golden rule is “if the gut works, use it”. This is the most efficient, least expensive, most pleasant, more natural and safest route for the patient. If the GI tract is available and patient is able to take oral nutrition then this method is the appropriate. There is little evidence that parenteral is more effective than enteral nutrition, but it is certainly costlier and associated with higher risks of serious complications, particularly infection. There is evidence that early (within 24 hours) enteral feeding has significant benefits over late enteral and parenteral feeding. Prolonged absence of nutrients from the gut alters gut flora and may compromise amino acid metabolism. It also changes and reduces mucosal structure and function. The start may be several hours after the surgery as sip feed.

A correct diet is an important component of the treatment of surgical patients. The basic aim is to ensure negative nitrogen balance after the surgery and to exert regenerative processes of the body, including the protection of operated organ and its habituation to normal food. It may also prepare the patient for special examinations.

The diet must provide a sufficient nutrition with easily digested groceries. Nutritional value and proper consistency are important. Both must change and be variable depending on the post-op stage (acute, delayed, and chronic) and individual need (age, race, habits).

Every facility has its own rules and score for the diet classification, there is common frequent labelling:

### **0– Liquid diet**

It is mostly used for a shorter period after surgery, may be longer after surgical procedures within GIT.

### **1 – Purée diet**

Again it is indicated in operations of the digestive tract.

### **2 – Protective diet**

It is applied in disorders of the digestive tract with a prolonged course (functional gastric disorders, gastroduodenal ulcers, certain conditions following gastric resection).

### **3 – Rational diet**

It is for all diseases requiring no special modification of normal food.

#### **4 – Low-fat diet**

It is used for diseases of the biliary tract and of the pancreas.

#### **6 – Low-protein diet**

In renal diseases when a limitation of protein intake is necessary.

#### **7 – Low-cholesterol diet**

It is reserved for patients with complications of arteriosclerosis (after myocardial infarction, vascular cerebral accidents etc.).

#### **8 – Reducing diet**

It is used for obese people, in surgery commonly as a prepare for elective surgeries.

#### **9 – Diabetic diet**

It is the basic part of the treatment of diabetes mellitus.

#### **10 – Salt-free protective diet**

It is ordered for patients with serious vascular diseases.

#### **11 – Highly nutritive diet**

It is intended for patients with malnutrition, for example malignant tumours.

#### **12 – Diet for toddlers**

#### **13 – Diet for older children**

Special diets

**0 – S Tea diet** is administered for a short time during acute illness (biliary colic) or for the first few days after operation within the abdominal cavity, prior to restoration of passage.

#### **1 – S Nutritional liquid diet**

In patients where an intake of food is possible only in fluid form, a highly energetic intake is conceivably mandatory.

**4 – S A diet with a strict** limitation of fat is used after cholecystectomy and similar procedures

**9 – S Diabetic protective diet** is for diabetics with chronic diseases of the digestive tract.

For long-term treated patients, where is no special medical need the offer may be replenished on demand.

When the peroral intake does not cover 2/3 of daily need, it is possible to add liquidized food, linefeed or supplements by enteral nutrition. This is used for patients with a functioning small bowel but with problems to take nutrients by mouth, e.g. those who are seriously unable to swallow or to put the food into the mouth cavity, which is involved by pathological process (e.g. surgical wound or some lesions like herpetic stomatitis).

There are following ways:

1. Fine-bore naso-gastric or naso-jejunal tubes: liquidized food, linefeed or supplements are given via a tube passed via the nose into the stomach.
2. Surgically created gastrostomy or jejunostomy are appropriate for long-term enteric feeding.

In both the above methods the feed is dripped slowly into GI tract. Bolus feeding should be avoided as it gives diarrhoea and if given via a nasogastric tube in large volume may result in regurgitation and aspiration pneumonia.

## **2. PARENTERAL NUTRITION**

However, many patients are unable to eat enough to meet increased needs and/or prevent losses after surgery. Common and often underrated issues such as pain, nausea, medication, dry mouth, gastric discomfort and distension, fasting, unpleasant procedures, anxiety, unfamiliar food and hospital routines all potentially reduce appetite and intake. If the need is too high and oral supply is not sufficient or where GI function is inadequate or failed, the parenteral nutrition is necessary. There are the most frequent clinical examples:

1. Overload by surgery with excessive loss of fluids, extreme surgical stress, acid-base balance disorders (metabolic acidosis and alkalosis, respiratory acidosis and alkalosis), hypokalaemia, hyperkalaemia, oliguria coming from fluid lack)
2. Failure of GIT passage: prolonged obstruction, ileus, prolonged vomiting, short bowel syndrome (Crohn's or after surgery)

This route may be risky and careful monitoring is required:

1. Fluid balance
2. Level of glucose
3. Level of electrolytes

4. Hepatic and renal disorder
5. Blood picture

It must cover not only the increased need done by the load of surgery or injury itself, but also the addition covering the losses (drain, vomiting...). Controlled rates administration are essential and this is achieved either by a counting device attached to the drip line or via a pump. If the patient develops pyrexia and no cause is found, it may be necessary to remove the catheter and send its cut tip for culture.

Nutrition is administered via the venous system.

Peripheral line: Short-term feeding (up to 5 days, or by others 7–10 days) may be given via a drip in a peripheral vein. Solutions used with this method must be isotonic; otherwise they cause irritation of vein wall resulting in thrombophlebitis.

For longer installation we use central line: This is the most appropriate route and is used parenteral nutrition. For short-term use percutaneous subclavian line may be used. For longer the catheter is usually placed into the superior vena cava.

Central venous catheters are introduced through the v. subclavia or v. jugularis interna, v. femoralis or, rarely then v. jugularis externa, or v. mediana cubiti or v. basilica.

**The basic need of fluid is 30–100 ml /kg/daily.**

**The basic need of energy is 25 kcal/kg/daily, consists of 15–25% proteins, 30–50% saccharides, 30–50% fats, minerals (Na, K, Ca, Mg, P, and microelements I, F, Mn, Cu, Cr, Zn, Fe, Se, Mo), and vitamins (A, B, C, D, E, K, B12, Panthenol, Ac. folicum).**

# PHYSIOTHERAPY IN SURGERY

Physiotherapy is a scientific health care system that primarily heals through movement. The goal of physiotherapy is to identify, correct and alleviate prolonged or acute movement dysfunction and restore the natural movements of the body.

Physiotherapy can trace its origins to a glorious past well before 3,000 BC. As early as 460 BC, Hippocrates speaks about massage in his works. The modern practice of physiotherapy started in the 1920s. It is used to address conditions like recurring pain and movement disorders of different diseases and dysfunctions of the human motor apparatus at different ages. Physiotherapy is both curative and preventive. Fundamental objectives of modern rehabilitation are promotion of health and well-being.

The treatment process includes assessment, diagnosis, planning, treatment and evaluation of the progress of the patient. Physiotherapy is carried out as a part of care in hospitals and/or in special health facilities for this kind of treatment.

Physiotherapy uses a wide range of techniques. They exert both local and global effects, the improvement of the blood supply of tissues, exert antiphlogistic effects, and relieve muscular and vascular spasm.

Let us name some of the common practices:

1. **Electrotherapy:** Electric current, modulated at different frequencies, has stimulating effects to the muscles.
2. **Massage and manipulation** are mainly used to improve circulation. The massage normalises muscle tension and improves relationships between vascular and nervous motor systems, normalising the tissues trophies.
3. **Exercise and movement** strengthen and improve mobility. It starts immediately after surgery at the bed and continues up to full activity. It may be general or specific intensive exercises to strengthen particular parts of the body are also possible.
4. **Hydrotherapy** helps to improve circulation, to stimulate the nerves, to relieve pain and to release tension in warm, shallow water or a special hydrotherapy bath, alternating with hot and cold showers, jet sprays, jet massage and whirlpool baths.

All those techniques are used with the aim to prevent pathological changes manifesting like pathological muscle length–tension relation, bone resistance and elasticity, physical characteristics of cartilages, muscles, fascias and tendons. The clinical signs are muscular contractures, contractures of non–contracting soft tissues, muscle malfunctions, fatigue, bad body posture, static disturbance in sagittal and frontal plane, walking disorders etc.

An inherent part of physiotherapy is psychological care helping to the patient to overcome the post–op or posttraumatic period. The physiotherapist must lead a patient to positive attitude toward undergone treatment. It is recommendable to work in tandem with the family to ensure a strong support system.

In surgery the physiotherapy improves most of post–op and posttraumatic healing processes, supporting the recovery and accelerating return to desired activities and good quality of life. Simultaneously it prevents or limits the development of various unwanted secondary changes.

In elective procedures its concern may be even pre–operative treatment in particular patients. For example major surgery on a joint may take two or three hours in the operating room. Getting full range of motion, strength and flexibility back in that joint after surgery usually takes months. That's where pre–operative exercise and education and post–operative physiotherapy programs come in to prepare a patient physically and emotionally for surgery, and to maximize his/her recovery after operation.

But the main process is of course postoperative physiotherapy. It can differ according surgical specialization, however the preventive physiotherapy of pulmonary and thromboembolic postoperative complications is important everywhere. Therapeutic exercises endeavour the efficiency of the whole body and the strength of those organs, which should not remain at rest during the healing process.

Respiratory kinesitherapy and respiratory exercises start immediately at the finishing moment of the surgery when patient wakes up. Active exercises promote the ventilation of the lungs. They depend not only on the type of surgery but also on physiology and pathophysiology of respiratory system of particular patient. Chest physiotherapy is used to prevent and treat postoperative pulmonary complications, especially in high–risk patients with a history of obesity, smoking, or old age, where lung function may be relatively impaired. This is good evidence that prophylactic physiotherapy reduces postoperative lung complications in people undergoing abdominal surgery. Breathing exercises must renew the ventilation, the breath depth and oxygenation and prevent bronchopulmonar infection. Usually in practice patient provides the exercises every couple of hours several times. It means to take a slow deep breath in through the nose, filling the very bottom of the lungs. Then the patient slowly



exhales and relaxes. It is necessary to cough up any phlegm. When coughing he/she must support his/her wound by firmly pressing with his/her hand. Then he/she takes a slow deep breath in, tightens the support and coughs strongly out.

The early movement belongs to main preventive steps of thromboembolism and leads to faster recovery. Again it starts with the end of surgery. In practice, usually the first day after surgery, a patient moves with legs and sits out of bed. The second day he/she starts walking short distances, with assistance if required. Following days the independency of patient may escalate till complete self-action. All staff must help and encourage the patient in this process.

Therapeutic exercise techniques are passive or active. Passive movements serve for the prevention of contractures and of dystrophic changes. Active movements promote the function of muscles and an increase of their tissue. They are further subdivided into isometric leading to a contraction of the muscle without any movements of the given segment, and isotonic leading to movements of the given segment. The active methods may be reduced-load exercises and active reduced-load exercises with dosed resistance, active exercises with resistance, assisted and self-assisted exercises, redressments and self-redressments, muscle piezometric relaxation, stretching, isometric exercises, synergistic exercises (ipsilateral and contralateral), coordination exercises, breathing exercises, relaxation exercises, fitness exercises, morning gymnastics, balance exercises, verticalization (passive, active), walking.

Operating exercises represent training of every day life activities.

A large number of people suffer from a wide variety of afflictions even without any trigger like surgery or acute injury. Special attention must be paid to these patients, who have been bedridden and less mobile before the surgery, suffering for example from chronic oedemas, joint rigidity, and pareses. The causes are quite varied ranging from posttraumatic sequels, some diseases, mainly with degenerative origin, or simply an unhealthy lifestyle, resulting in weak muscles and ligaments or other mobility impairments. These people usually pass the post course more difficulty and have more complications. In addition they use a lot of analgesics. But especially these patients hardly need the physiotherapy to reach acceptable healing course and results. Massage, electrical nerve stimulation, movement exercise, acupuncture, meditation and the application of hot or cold compress are some examples of the techniques, which are being employed in treating a usual wide range of complaints in these patients.

The special aids may be used depending on patients need (underwater massage, whirl massage, massage gear like aquavibron, vibrator, and therapeutic ointments).

Physiotherapy as psychological care is very important in cases where the injury or surgery cause great change of the life quality. Physiological responses to exercise always represent the improvement of physical activity and health. In addition to solution of post-surgical problems physical activity is a prevention of the most common diseases like coronary heart disease, diabetes, obesity, hypertension, and osteoporosis.

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