Educational materials

Anesthesiology, intensive and urgent medicine require, in addition to theoretical knowledge, practical skills. Both need to be combinedin a critical situation with limited time and without omission of important steps. To facilitate learning and being able to solve these situations, many commonly accepted algorithms/**guidelines** exist for a number of various conditions (eg. trauma, cardiac arrest, etc.).

Managing a life-threatening condition is primarily a matter of quickly identifying **failure of vital functions**, detecting and eliminating their causes, and ultimatem their support or substitution. The following texts are intended primarily for students of medical specialties and provide a brief overview of the basic skills and algorithms of urgent care. These skills are also taught in our simulation centre.

USEFUL TERMS

Polytrauma - is the injury of at least two organ systems, at least one of which is life threatening.

Multiple injury - is the injury of at least two organ systems that do not pose immediate harm to the patient.

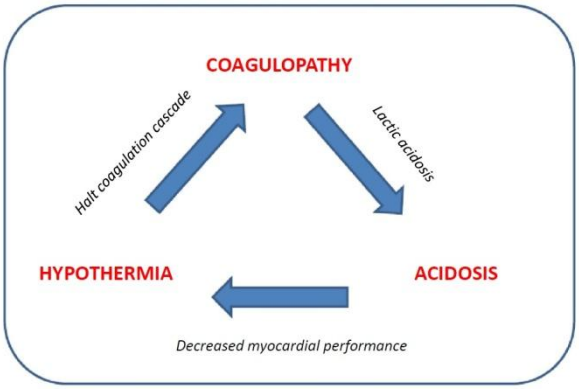
Trauma Centre - is a hospital or a department highly specialized in trauma care. Provides comprehensive diagnostic and therapeutic care for „triage positive patients“ and patients with severe injuries.

Damage control surgery - is a set of life-saving, step-by-step treatments for severe intra-abdominal injuries, historically known as "shortened laparotomy." The goal of early treatment is to limit the influence of the malignant triad (acidosis, hypothermia, coagulopathy). The definitive treatment of tissue injury is postponed in this concept to after hemodynamic and hemocoagulation stabililization of the injured patient.

Damage control resuscitation - is a systematic approach to the care of a traumatized patient with serious injuries, which begins in pre-hospital care and continues through emergency care and surgery, to the intensive care unit. DCR includes hemostatic resuscitation, permissive hypotension (where appropriate), and damage control surgery. It aims to maintain circulating volume, control bleeding and correct coagulopathy to allow for stabilization of the patient and definitive treatment.

Permissive hypotension – The concept of blood pressure control (using fluids and vasopressors) in a traumatized patient. The goal is to maintain BP at values lower than usual but still sufficient to maintain organ perfusion until the recognition and definitive treatment of the bleeding source. The reasoning is that blood pressures higher than absolutely necessary to maintain baseline organ perfusion may lead to exacerbation of yet uncontrolled bleeding and further hypovolemia and hypotension in a viscious cycle.

Malignant Triad - A term describing the combination of hypothermia, acidosis and coagulopathy leading to increased mortality in a traumatized patient.



Difficult airway - a situation where endotracheal intubation requires three or more attempts by an experienced professional using direct laryngoscopy.

BACT - Bougie Assisted Cricotyroidectomy - a method of urgent airway management by introducing an endotracheal tube into the trachea through the cricothyroid ligament.

ROTEM – a method of rotational thrombelastography (improvement on the older TEG method). Provides quick and comprehensive information about haemostasis status, incluidng analysis of primary hemostasis. Analyzers are used for acute diagnosis of coagulation disorders. They help determine the causes of bleeding or detect thrombotic risk in time.

FAST - Focus Assessment with Sonography for Trauma – an ultrasound protocol for the traumatized patient to detect free fluid in three body cavities - pleural, pericardial and abdominal.

eFAST - FAST protocol extended to include pleural examination to detect pneumothorax.

GCS - Glasgow Coma Scale – the most common scale to quantify level of consciousness (eye opening, best word response, best motor response), rated on a scale of 3-15 points.

AVPU - Alert, Verbal stimuli, Paintful stimuli, Unresposive - a mnemonic tool to assess level of consciousness

LMA - laryngeal mask airway, the most commonly used type of supraglottic airway device.

SGD – Supra Glottic Device

BASIC LIFE SUPPORT

EUROPEAN RESUSCITATION COUNCIL
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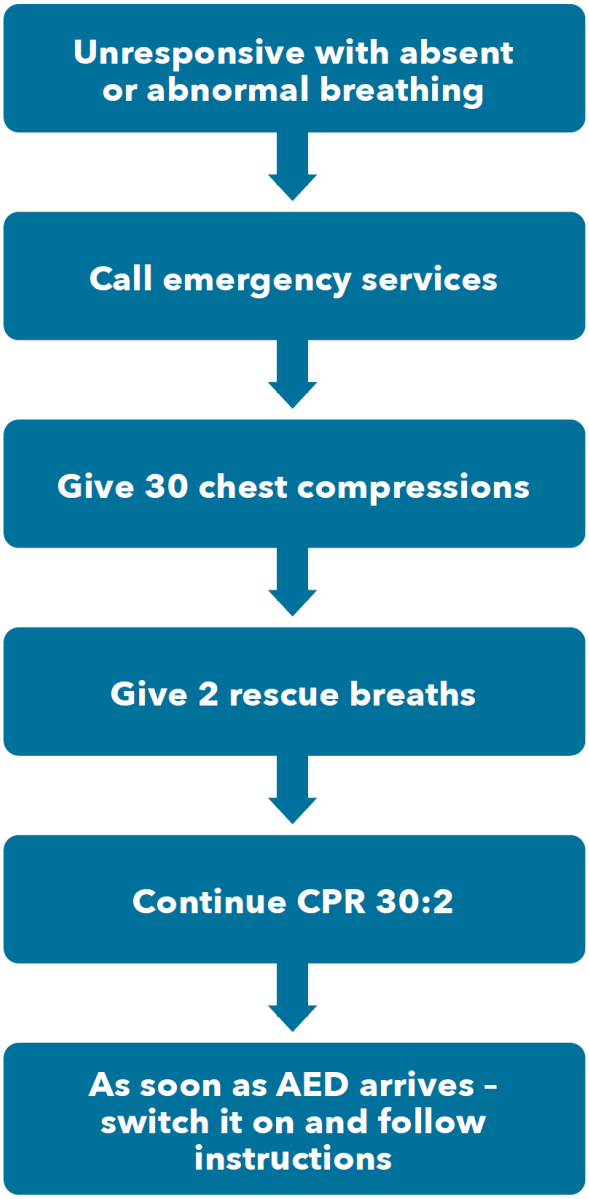

EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání

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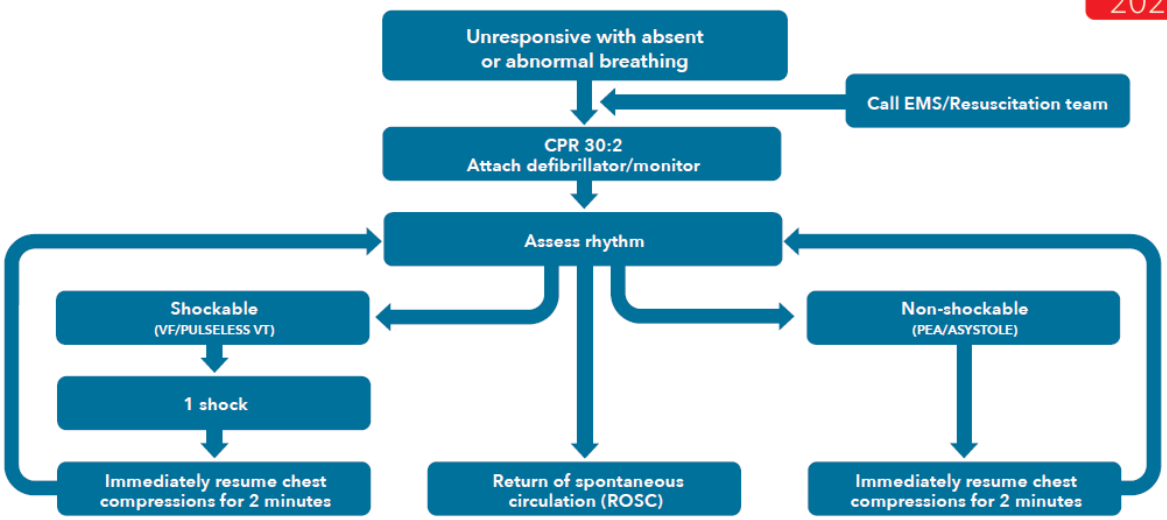
ADVANCED LIFE SUPPORT

EUROPEAN RESUSCITATION COUNCIL
GUIDELINES 2021



Give high-quality chest compressions and

- Give oxygen
- Use waveform capnography
- Continuous compressions if advanced airway
- Minimise interruptions to compressions
- Intravenous or intraosseous access
- Give adrenaline every 3-5 min
- Give amiodarone after 3 shocks
- Identify and treat reversible causes

Identify and treat reversible causes

- Hypoxia
- Hypovolaemia
- Hypo-/hyperkalemia/metabolic
- Hypo-/hyperthermia
- Thrombosis - coronary or pulmonary
- Tension pneumothorax
- Tamponade- cardiac
- Toxins

Consider ultrasound imaging to identify reversible causes

Consider

- Coronary angiography/percutaneous coronary intervention
- Mechanical chest compressions to facilitate transfer/treatment
- Extracorporeal CPR

After ROSC

- Use an ABCDE approach
- Aim for SpO_2 of 94-98% and normal $PaCO_2$
- 12 Lead ECG
- Identify and treat cause
- Targeted temperature management

UNIVERZITA KARLOVA
1. lékařská fakulta

EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
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IN-HOSPITAL RESUSCITATION

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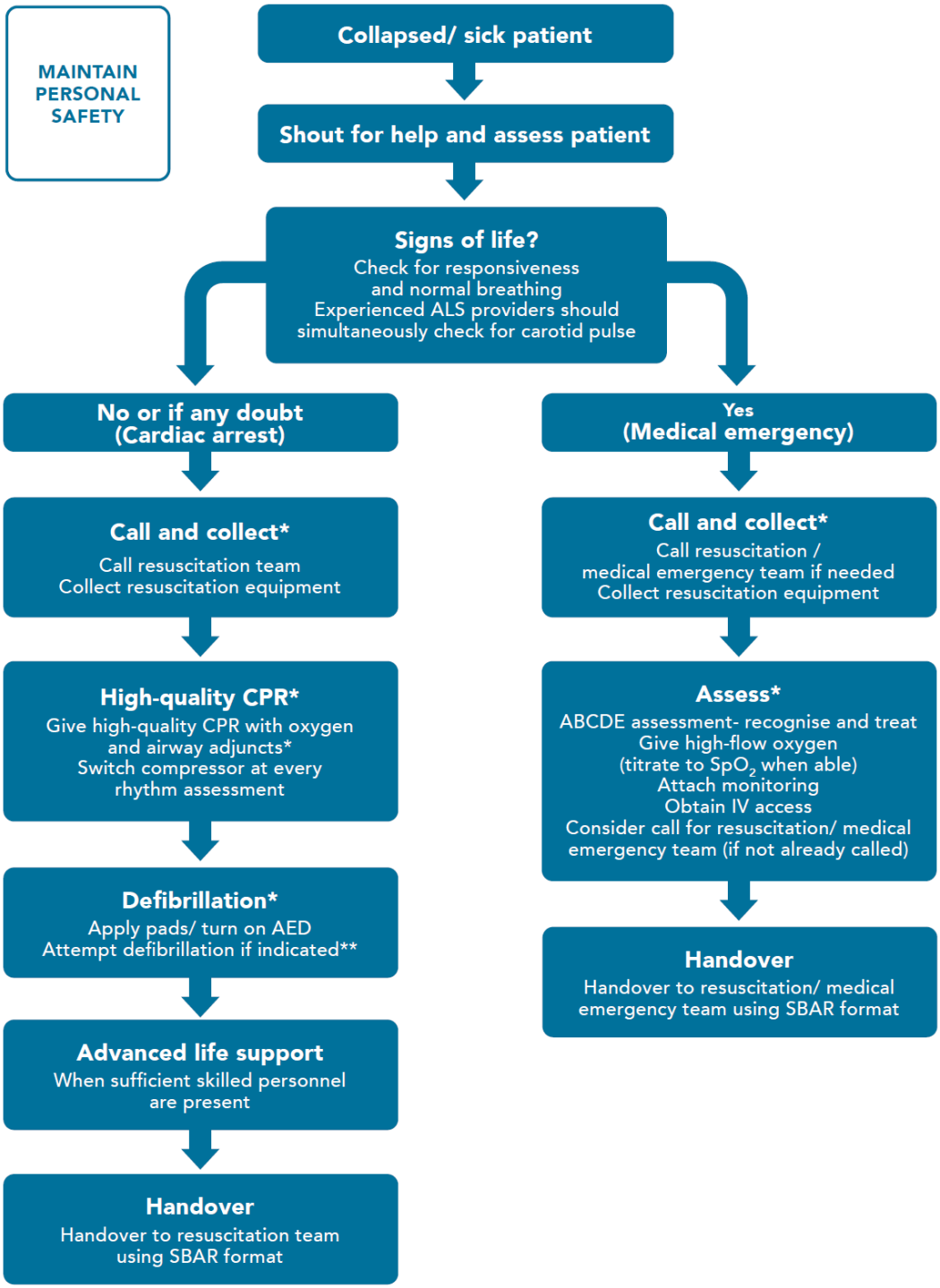

** Undertake actions concurrently if sufficient staff available*
***Use a manual defibrillator if trained and device available*

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ADVANCED TRAUMA LIFE SUPPORT (ATLS)

ATLS is an emergency care protocol for patients with trauma, consisting of a comprehensive system of standardized procedures. The term polytrauma is used to refer to a patient with simultaneous injuries of at least two body systems, at least one of which (or their combination) is life-threatneing. The creation of the ATLS program has resulted in a consistent approach to patients with trauma and the creation of **trauma centres** - specialized hospitals/departments which provide comprehensive care for patients with severe trauma.

In pre-hospital care, healthcare professionals have to identify **„Triage Positive Patients"** - patients meeting defined criteria for transport directly to a trauma centre. These criteria include failure of vital functions, and site or mechanism of injury.

The ATLS concept emphasizes that death of a patient occurs in a certain logical sequence. The **ABCDE** mnemonic sets the basic priorities for **primary assessment** and defines the specific individual examinations and interventions that are universal for all traumas.

Airway (airway control + immobilisation of the cervical spine)

Breathing (ventilation control)

Circulation (circulation and bleeding)

Disability (control of neurological status)

Exposure (patient exposure and temperature control)

Airway - Assess the airway patency, or need to secure it. With the same priority we assess and care for stabilizing the cervical spine.

Breathing – Even patent airways do not guarantee adequate gas exchange. Sufficient function of the lung, chest wall and diaphragm are needed. In the case of a trauma patient, ventilation is particularly vulnerable to tension pneumothorax or possible massive hemotorax, which must be resolved by urgent thoracic puncture/drainage.

Circulation - the most common cause of shock in patients with trauma is blood loss with subsequent hypovolemia. Bleeding must be identified and resolved. A crucial tool for this assement is a bedside ultrasonographic examination called FAST (Focused Assessment with Sonography for Trauma). Important sources of bleeding include fractures of the pelvis and long bones.

Disability - Rapid evaluation of neurological status. We determine the status of consciousness (Glasgow Coma Scale classification), pupil reaction and potential spinal injury.

Exposure – Complete stripping of the patient and detailed examination of all parts of the body (even from behind). After complete assessment cover the patient with a heated blanket.

After completing the primary examination urgent surgical procedures, called Damage Control Surgery, are performed, if required by the nature of the injuries. Intervention proceeds according to the following priorities - **LIFE SAVING > INTEGRITY> FUNCTION**

After an early surgical procedure, the patient is taken to the intensive care unit. Here the priority is to achieve thermal homeostasis, optimize circulation, modify the patients acid/base and mineral balance, and minimize secondary post-traumatic damage.











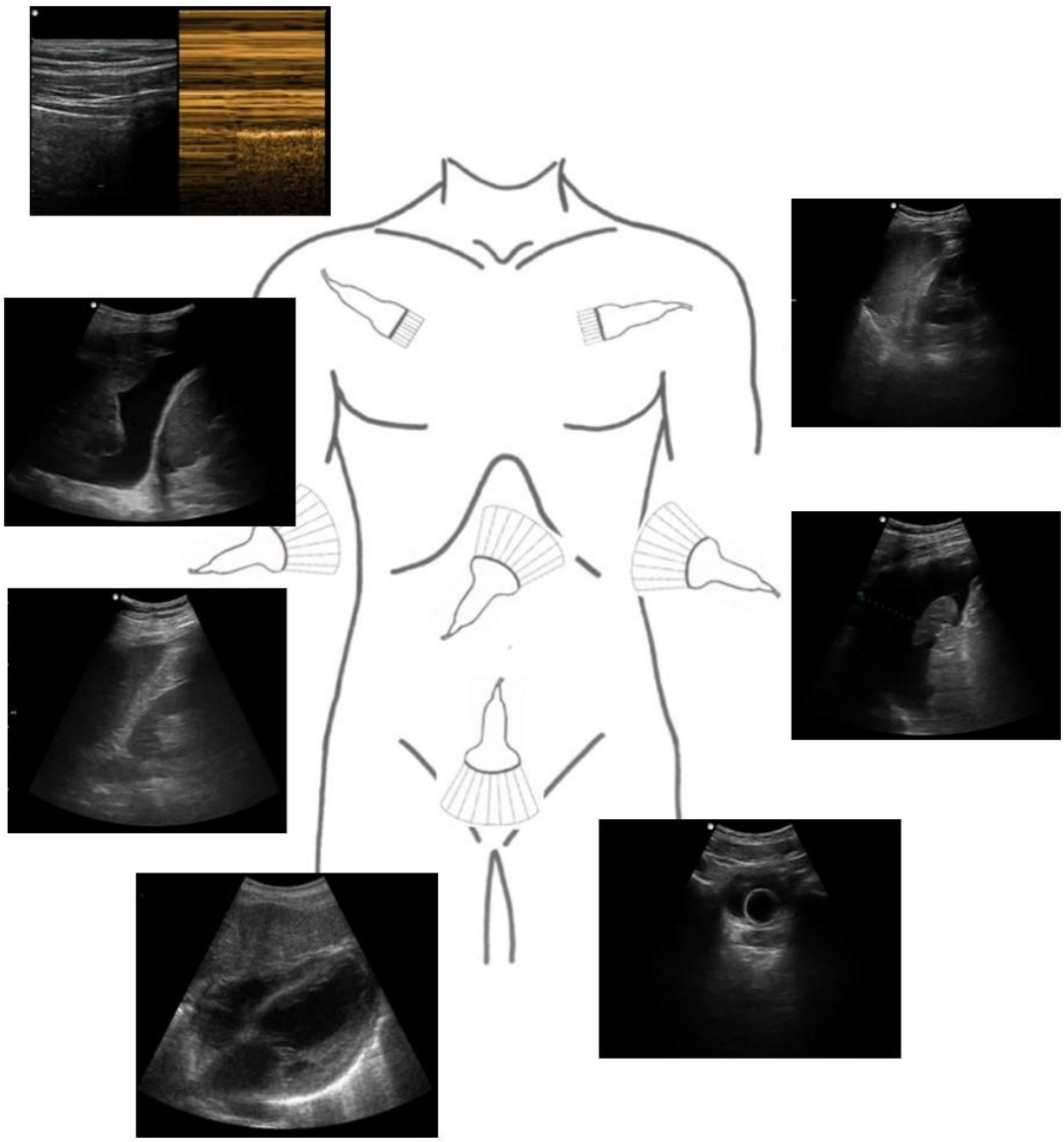






FAST/eFAST

FAST - Focused Assessment with Sonography in Trauma is a rapid ultrasound scan to detect free fluid in the abdominal, thoracic and pericardial cavity. It is an important initial examination for a traumatized patient during admission to the emergency room. **eFAST** - Extended FAST for pleural examination with a linear probe to exclude pneumothorax.



AIRWAY MANAGEMENT

Indications are basically four (Paint P!)
1) **Patency** (to keep the Airways open)
2) **Interface for MV** (self-infating bag, ventilator...)
3) **Toilet (Hygeine)** (suction of mucus and airway secretions)
4) **Protection** (against aspiration)

	Patency	Interface	Toilet	Protection
Manual airway maneuvers	+	-	-	-
Oral/nasal airway	+	-	-	-
Face mask	+ (1)	+	-	-
Supraglottic airway device	+	+	+/-	+/-
Endotracheal tube	+	+	+	+
Recovery position	+/-	-	-	+/-

1) Only in combination with manual maneuvers or nasal/oral airway

A situation where it is necessary to secure the airways and it is difficult or impossible to intubate a patient is called **"Difficult airway".**

MANUAL AIRWAY MANEUVERS

"Head tilt chin lift airway maneuver" – with one hand placed on the forehead lift the patients chin with the fingers of the other hand. It is performed by tilting the head backwards by applying pressure to the forehead and the chin. The maneuver is used in any patient in whom cervical spine injury is not a concern and is taught in most first aid courses.

"The Triple Maneuver" or „Jaw Thrust“ – Grasp the angles of the lower jaw and lift with both hands, one on each side, moving the jaw forward.

The cause of airway obstruction may also be the presence of a foreign body, i.e. vomit or coagulated blood. In the unconscious patient if the presence of a foreign body in the airway is suspected we can try to remove the body either manually, with a suction unitor with the aid of special equipment (Magill's forceps, laryngoscope).

Maneuvers to remove a foreign body from the airways:

Gordon's maneuver or back blows between the scapulas.

Heimlich's Maneuver: Use only in the conscious patient who is unable to cough out a foreign body from the airways and in whom blows between the scapulae were not effective. We hug the patient from behind and connect the the hands at the abdomen in the area of the epigastrium, sharply pushing up and back toward the diaphragm several times. It is contraindicated in children and pregnant women.

ORAL / NASAL AIRWAYS

Simple tools to keep airway open.

Oral (Orophanryngeal, Guedel) – insert with the concave part facing cranialy and after reaching the posterior wall of the pharynx rotate caudally 180 degrees. The appropriate size is determined by the distance between the incisors and the angle of the jaw. In addition to secuing the airway, it can also be used as an anti-biting tool.

- ☺ easy and fast to use
- ☹ with preserved reflexes may cause vomiting with consequent risk of aspiration

Nasal airway (Nasopharyngeal, Wendel) - prior to introduction needs to be lubricated, decongestion of the nasal mucosa may also be necessary i.e. by decongestant drugs. The optimal length can be estimated by the distance between the tip of the nose and the earlobe. It is used for facial trauma or in case of trismus (masseter spasm or lockjaw)...

- ☺ tolerated even in patients with preserved reflexes
- ☹ bleeding risk, difficulty during introduction

COPA (Cuffed Oro-pharyngeal airway) – a modified oral airway. At the distal end, it is fitted with an inflation cuff which serves to stabilize the position of the device as well as to further distatance the root of the tongue from the posterior wall of the hypopharynx. Some types allow interface with MV (working as a SGD).

FACE MASK

Anatomically shaped device with a sealing cuff, of various shapes and sizes, universal for connection to the self-inflating bag or ventilator. Can be also used in a spontaneously ventilating patient as well asfor positive pressure ventilation. Correct placement and holding of the face mask, with inclination of the head and the jawthrust forward to ensure patent airway, is one of the basic skills. The position of the head, the so-called "sniffing position", is important. If, even with optimal head position, correct size and position of the mask, optimal ventilation cannot be achieved it may be appropriate to use it in combination with an oro-/naso-pharyngeal airway.

- ☺ non-invasive, connection to MV
- ☹ use of both hands, poorly functional in toothless or obese patients, and in patients with facial injuries.

SUPRAGLOTTIC AIRWAY DEVICE

Devices introduced into the supraglottic space (not through the vocal cords). Laryngeal masks (LMA) are most common and well-known. There are currently a variety of different shapes and sizes available.

- ☺ requires shorter training time than laryngoscopy
- ☺ use in cases where direct laryngoscopy is impossible (eg . due to the patient's position)
- ☺ effective ventilation and oxygenation
- ☺ without the risks associated with endotracheal intubation
- ☺ effective even for the smallest children

- ☹ does not provide 100% protection against aspiration
- ☹ inefficient ventilation in the case of laryngospasm
- ☹ risk of dislocation when changing patient position



ENDOTRACHEAL INTUBATION

This procedure involves the insertion of anendotracheal tube through the mouth or nose into the trachea, thus allowing the patient to be connected to mechanical ventilation, maintaining patency of the airway, and preventing aspirtaion of gastric contentsby the inflated sealing cuff. It is the "gold standard" in securing airways in intensive care.

Equipment:
Laryngoscope - A device for direct visualization of the larynx. It consists of a handle that can be connected with a blade (curved, straight or with a flexible distal end). Available in different sizes and blade types.

Endotracheal tube - tubes with marked diameter and distance from the distal end for checking depth of insertion usually with a sealing cuff, may be un-cuffed or so-called smooth (used mainly in children).

Stylet - metal wire coated with plastic/rubber inserted into the ET tube to mold it to facilitate insertion.

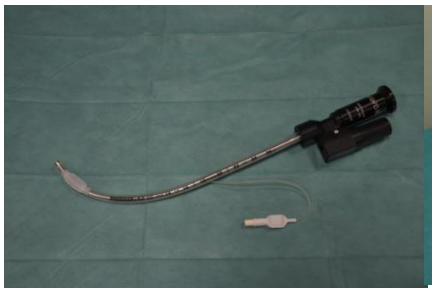
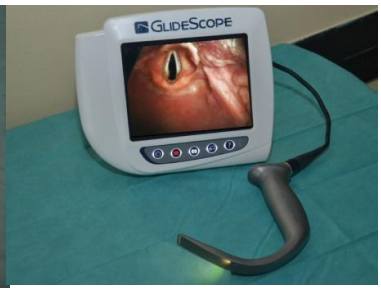
Magill´s forceps - mainly used for nasal intubation, used to grab the tube at the distal end and move it into the larynx, under direct laryngoscopic guidance.

The suction unit – absolutely necessary equipment that should be within reach (and functional) before each intubation begins.

Capnography - resp. monitoring of exhaled CO2 - to verify the accuracy of tube placement into the airways.



VIDEOLARYNGOSCOPE

DIFFICULT AIRWAY

There are many scoring systems available to estimate the difficulty of securing the airway but none of them achieve 100% predictive value. In the case of expected difficulty, the only completely safe procedure is to keep the patient spontaneously ventilating during intubation, for example by using topical anesthesia and fibroscopy. The real challenge is the unexpected difficult airway. In order to successfully manage this stressful situation there are few things you need to know: to call for help in time, to have alternative devices available (laryngeal mask airway, videolaryngoscope) and do not try to intubate at any cost, if you can, ventilate with a simpler device (LMA, face mask). If these fail and if we are in a "CAN'T VENTILATE, CAN'T INTUBATE" situation, proceed to the coniotomy early rather than wasting time with multiple failed attempts at intubation.

FIBREOPTIC INTUBATION

A procedure in which we are able to insert anendotracheal tube into the airway under visual control even in situations where direct laryngoscopy cannot be performed. The fibroscope is pre-loaded with an intubation tube and then serves as a guide. Usually only under local anesthesia in a spontaneously ventilating patient, the device is inserted into the trachea and after it is withdrawn through the ET tube. After verification of the position of the tube (under direct visualization with the fibroscope - the end of the ET tube is above the carina, and detection of etCO2) we can induce the patient into general anaesthesia.



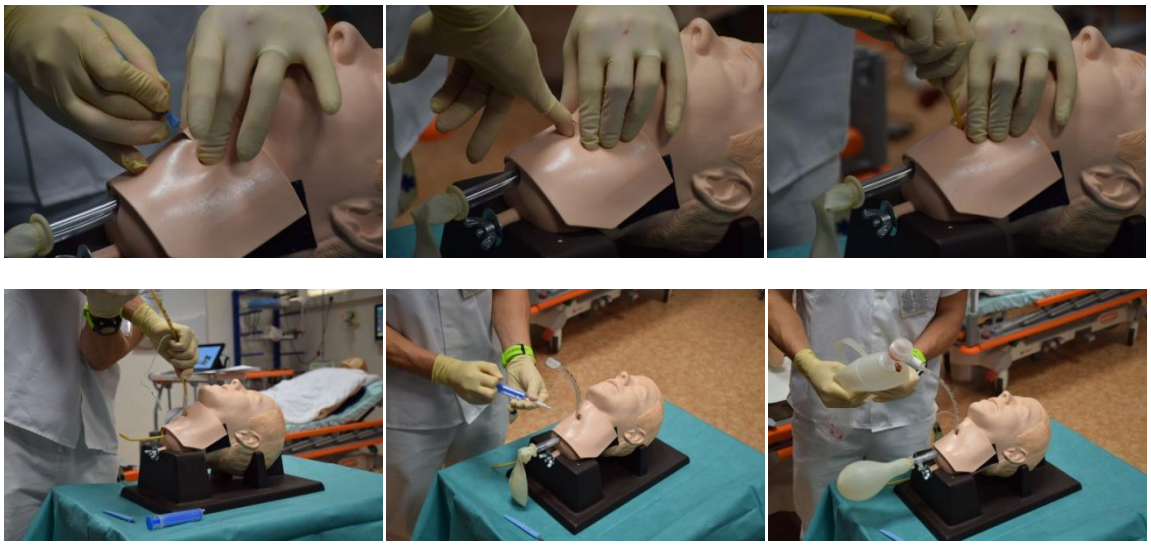


CRICOTHYROTOMY

A procedure to urgently secure the airway that is performed between the thyroid and cricoid cartilage in the cricothyroid membrane (also called the conus elasticus) **"the first soft place** (the membrane) **under the hard one** (the thyroid cartilage)". This area is suitable due to the absence of structures whose injury could cause significant and difficult to resolve bleeding. It serves as a temporary solution to bridge the period before "definitive" securing of the airway.

There are a number of, more or less useful, commercial-prepared coniotomy sets.

Currently the so-called **BACT** - (bougie assisted cricothyrotomy) (see Fig.) is being promoted as a simple and safe procedure. It is a surgical method developed in 2007 consisting of **three steps**. First we make a short **incision** in membrane of conus, then an elastic **bougie** is inserted into the incision, which serves as a guide-wire, after which a cuffed **endotracheal tube no. 6 is inserted** into the trachea (MV can then be fully employed).



VASCULAR SYSTEM ACCESS

There are three general indications:

1) when I want to apply something there
2) when I need to take blood samles
3) when I want to measure something

Techniques of cannulation in general:

Through-the-needle - catheter insertion through a puncture needle.

Over-the-needle - puncturing the required space (blood vessel, trachea ...) using a "set" consisting of a needle and a custom catheter/cannula "threaded" over the needle. After needle insertion, the catheter is slide over the needle into the desired vessel.

Seldinger technique - a method of cannula insertion begining with puncture of the required space (blood vessel, trachea...) using a needle, followed by insertion of a guide wire, followed by dilatation of the subcutaneous structures, and finally catheter/cannula insertion over the guide wire.



The basic access to the vascular system is peripheral vein cannulation. If peripheral venous circulation is insufficient or inaccessible or for the administration of irritating drugs (hyperosmolar solutions such as parenteral nutrition, concentrated electrolytes, chemotherapeutics etc.) we usually choose central venous cannulation. In urgent situations, especially in pre-hospital settings, an intraosseous needle is a suitable alternative to peripheral vein cannulation. A special category is long-term venous cannulas used to administer medications over a number of weeks/months without the risks associated with CVC.

Maximum flow rates (indicative) through individual types of cannulas:

Type	Flow
PERIPHERAL CANNULA 24G - yellow 22G - blue 20G - pink 18G - green 16G - gray 14G - orange	 24 ml/min 35 ml/min 60 ml/min 105 ml/min 210 ml/min 345 ml/min
INTRAOSSOUS NEEDLE 15G – red (1.5cm) 15G – blue (2.5cm) 15G – yellow (4.5cm)	Variabile (20-200 ml/min)
CENTRAL VENOUS CATHETER (depending on the number, width and length of the lumens 18-14G)	35-70 ml/min
„HIGH FLOW“ CATHETER (high-flow central venous catheter)	+/- 400ml/min

PERIPHERAL VENOUS CANNULATION

The most common technuique of venous access by introducing a catheter into a peripheral vein for the purpose of administering drugs, infusions or blood derivatives, or taking blood samples from the patient.

Theoretically, it is **possible to cannulate any accessible vein**, however we prefer places best accessible and suitable for nursing care.

We prefer veins of the upper limbs-the back of the hand, the forearm, the antecubital fossa. Alternatively, the veins of the neck (external jugular vein), the lower limbs (instep or medial side of the ankle), and in very small children veins on the head canbe used.

Equipment:
Intravenous cannula of required diameter, tourniquet, disinfectant, gloves, sterile dressing.

Procedure:
After choosing an appropriate site (we cannulate a predominantly non-dominant limb or non-paretic limb), tourniquet placement and skin disinfection at the injection site, we insert the catheter - most often using the **"over-the-needle"** technique.

- ☺ minimal invasiveness
- ☺ relatively simple approach

- ☹ not suitable for hyperosmolar drugs (parenteral nutrition), drugs with pH below 5 or above 9, vasoactive substances (catecholamines)
- ☹ short-term access (usually safe to use for one week max.)

CENTRAL VENOUS CATHETERIZATION

A central venous catheter is used to provide temporary venous access for a period of 1-3 weeks. In the case of insertion into the upper half o the body, the distal end should ideally be located in the cavo-atrial junction after insertion. It is most often introduced into the internal jugular or subclavian vein. Alternatively the femoral vein can be used.

Technique of cannulation:
Cannulation is performed using sets which most commonly use the **Seldinger technique**.
The site of puncture is usually detected using anatomical landmarks or by ultrasound. The depth and correct position of the guide wire (or catheter) is either blind or ECG-guided (by connecting to the guide wire or through the salt-bridge where the conductor is an electrolytic fluid).

INTRAOSSEOUS NEEDLES

Intraoseous access is an alternative method of obtaining intravenous in situations where standard methods of access may be difficult or impossible. It allows for administation of drugs to the vascular system through a the non-collapsible bone marrow tract. It is currently used mainly in pre-hospital care, but also in emergency hospital care situations where rapid access to the vascular system is needed.

All intravenous drugs can be administered via an inraosseous needle, in identical doses, with onset of action comparable to standard intravenous administration. Due to the higher pressure in the intraossous space compared to a peripheral vein, drugs and fluids have to be administered at a higher pressure. In general, the flow rate corresponds to a 20-21G i.v. cannula. It should be noted that i.o. application is initially painful, so it is recommended to initially flush with a local anesthetic first in the case of a vigilant patient.

The most common site of insertion is the proximal part of the tibia (2 cm below the tibial tuberostiy) or proximal humerus, less common sites include the distal tibia (inner ankle), femur or sternum.

Equipment:

Intraosseous needle: **3 sizes** (short, medium, long) chosen depending on patient´s age, constitution and site of insertion.

3 types according to how the cannula is inserted into the bone:

1) MECHANICAL
☺ good depth control during insertion
☹ difficult to use, a higher force to insert is required

2) BONE INJECTION GUN
☺ simple to use, as quick as 20 sec. including preparation
☹ the depth of insertion must be set in advance according to age and site

3) DRILLS
☺ very easy to use, site preparation and introduction within 10 s
☺ high success rate - 97% and minimal risk of complications
☺ the currently preferred method
☹ more expesive

LONG-TERM I.V. ACCESS

These types of cannulas are usually inserted into the deep venous system, most commonly in the upper limbs, usually under ultrasound navigation.

Depending on the placement of the end of the catheter, either in one of the peripheral veins or in the cavo-atrial junction (where the superior vena cava meets the right atrium), we differentiate between **Midline** catheter and **PICC** (Peripherally Inserted Central Catheter). Preferred veins for cannulation in the upper limbs are the basilic vein, the cephalic vein or the brachial vein. General indications are the long-term use of antibiotics, parenteral nutrition, fluids, electrolytes and chemotherapy.

☺ relatively low frequency of bacterial infections (dependent on proper nursing care)
☺ complications related to the insertion of CVC are avoided
☺ suitable for outpatients
☺ safe in high-risk patients (coagulopathy, anticoagulation therapy, tracheostomy)

☹ practically demanding, requires ultrasound experience

ARTERIAL CANNULATION

Arterial access is one of the most commonly used invasive techniques in intensive cere medicine. It could be a single puncture (for blood sampling) or the insertion of the arterial catheter.

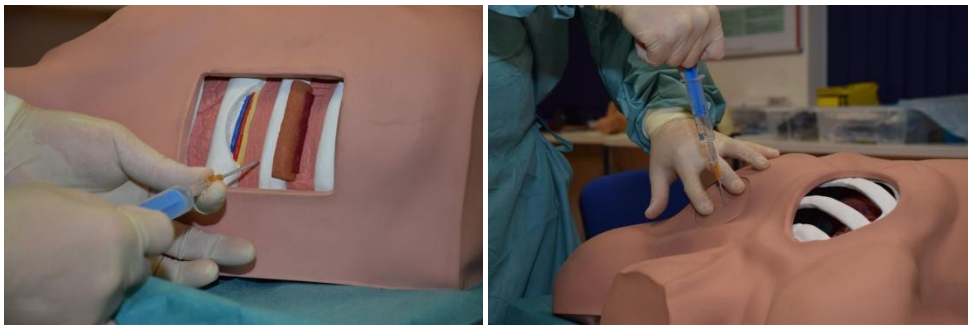
Any accessible artery can theoretically be cannulated, but we prefer places which are accessible, easy for nursing care, and we try to avoid "end arteries" (arteries without distal circulation), so we usually choose the radial artery. Alternatively, the femoral or brachial artery are also commonly used.

Seldinger technique is the preferred method of cannulation, but **over-the-needle** technique can also be used.

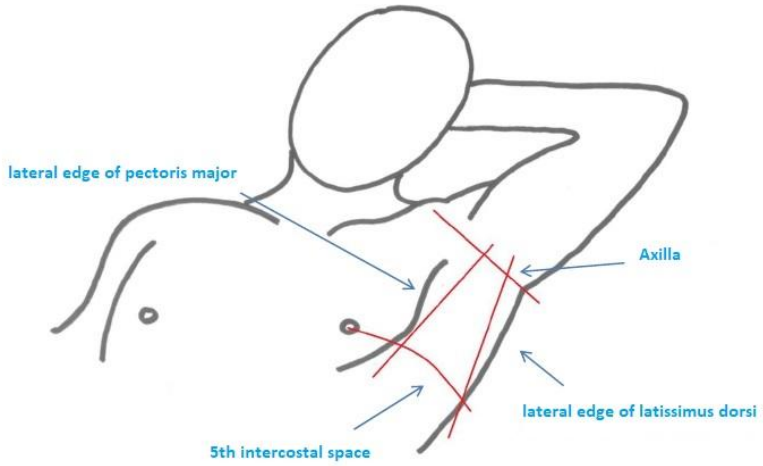
THORACOCENTHESIS / THORACIC DRAINAGE

Refers to puncture of the chest wall to evacuate pathological content of the pleural cavity (gas, fluid). It is a life-saving procedure in the case of sudden cardiac arrest caused by development of obstructive shock due to tension pneumothorax/hemothorax.

The puncture is a one-time evacuation (therapeutic or diagnostic). Drainage then requires the introduction of a drain with connection to a collecting system (either gravity or active suction).



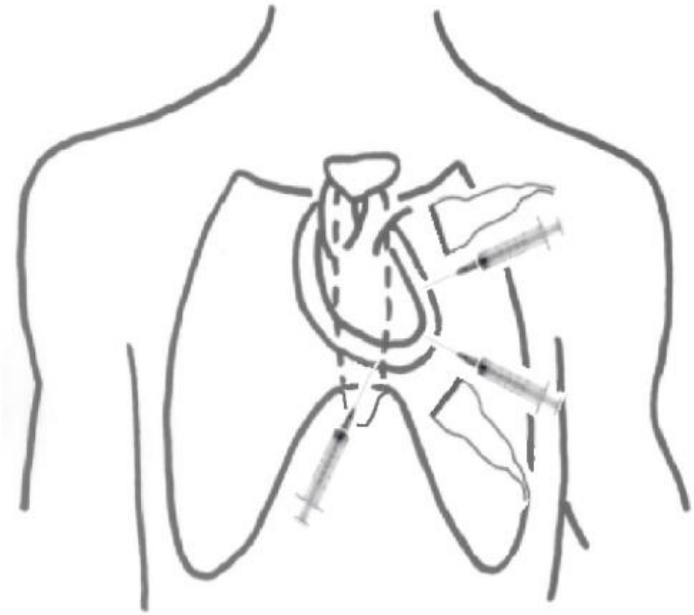
The puncture site is detected by physical examination (percussion, auscultation) and using landmarks (anatomical structures) or by imaging methods – e.g. CT navigation and increasingly popular ultrasound navigation. The use of US in these conditions significantly increases puncture/drainage success and reduces possible complications.

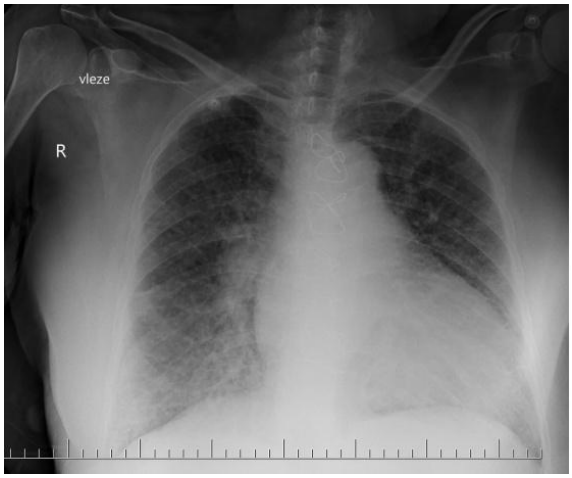


PERICARDIOCENTESIS

Refers to pericardial puncture for the evacuation of pericardial fluid (blood, effusion, pus) in situations where the accumulation of fluid leads to pressure on the heart chambers (especially right), i.e. cardiac tamponade, and eventually hemodynamic compromise and obstructive shock.

In hospital conditions, it is usually done with ultrasound navigation. This increases success of puncture while minimizing possible procedure-related complications. In out of hospital conditions (pre-hospital care) or in the unavailability of an ultrasound device, the pericardium can be punctured blindly with only landmark navigation.





ELECTRICAL IMPULSES THERAPY

These are therapeutic procedures using an electrical impulse to treat various cardiac dysrhythmias. These include defibrillation, cardioversion and cardiac stimulation.

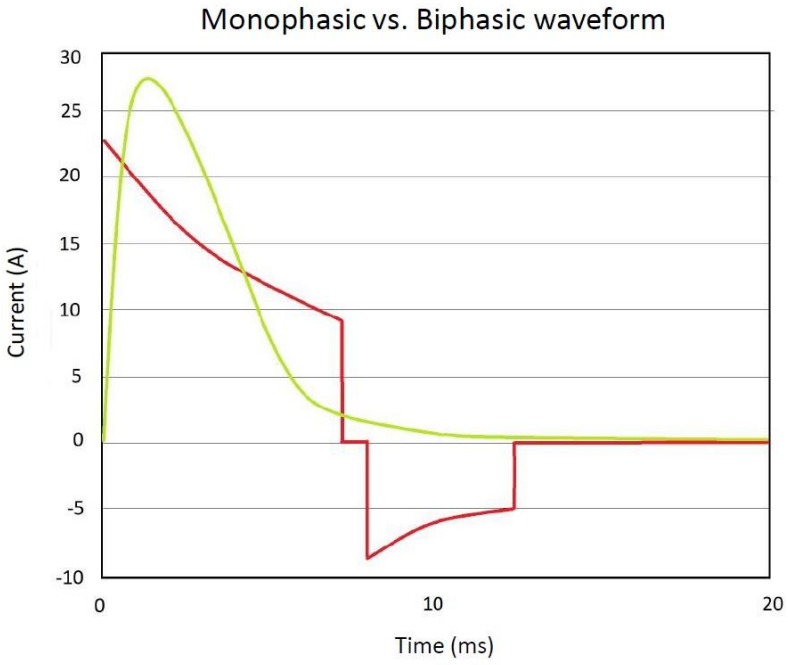
Defibrillator - A device used to diagnose and treat cardiac arrhythmias. Devices are made with or without a monitor, as well as automated versions (AED). Important components are batteries, capacitor, and defibrillation electrodes usually referred to as paddles.

To diagnose heart rhythm, we can use standard "small" electrodes, or use the paddles as "large" ECG electrodes.

To achieve adequate discharge the correct electrode placement is essential (the goal is to "hit" as much of the myocardium as possible).

DEFIBRILATION:

A therapeutic method using an electrical impulse to terminate a malignant arrhythmia (ventricular fibrillation, pulseless ventricular tachycardia) during cardiopulmonary resuscitation. The impulses generated by the defibrillator can be either monophasic (no polarity change) or biphasic (where a polarity change occurs - it achieves both positive and negative values).



CARDIOVERSION:

Electrical cardioversion is a procedure that is used to resolve various supraventricular and ventricular tachyarrhythmias. Unlike defibrillation, however, cardiac output is maintained in the patients, despite the arrythmia (but in most cases is less effective). Thus, it is an elective procedure in which the patient is fully conscious, requiring a only a short period of general anesthesia.

The amount of applied energy differs according to the type of arrhythmia (usually 50-200J). Another difference from defibrillation is the use of so-called synchonization (compliance with R wave on the ECG). With activation of this function, the device discharges during the absolute refractory phase where the myocardium is not excitable and there is no risk of inducing ventricular fibrillation.

CARDIOSTIMULATION:

A method using regular electrical stimulation to treat slow rhythmsor recurrent tachyarrhythmias. We distinguish between temporary and permanent (pacemaker implantation) cardiac stimulation. We can temporarily stimulate the patient transvenously, transesophageally, epicardially or transthoracically (external or transcutaneous stimulation).

The application of pulses by external stimulation is reserved for urgent use only and is relatively painful, requiring deep sedation, often with the need to connect the patient to mechanical ventilation.