

Anesthesia

Analgesia

- Trauma dept. UH Brno



**FAKULTNÍ
NEMOCNICE
BRNO**



TRAUMACENTRUM

**MUNI
MED**

- Pain - most common cause of meeting with physician
- Lat. pati / patiens - to bear/ suffer
- Pain – tissue damage – disease, injury, inflammation

medical procedures:

- Diagnostic
- Therapeutic



Terms

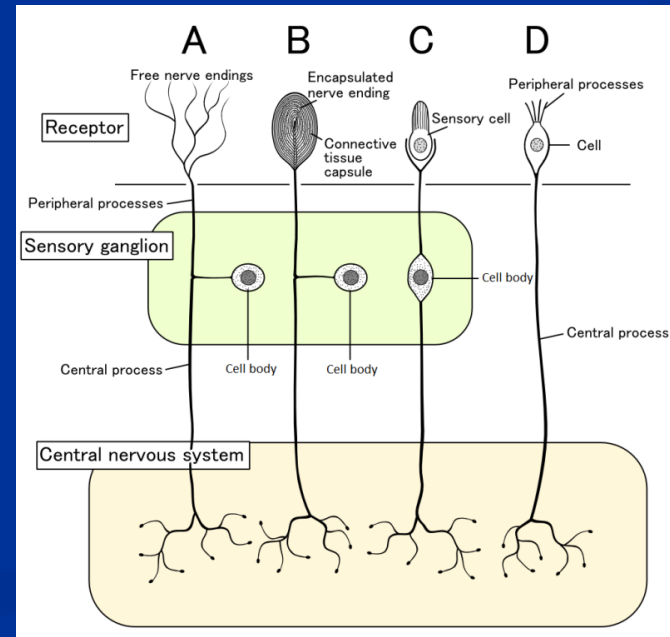
- From Greece
- **Anesthesia** - an aesthos - without perception
 - Removal of all perceptions, even consciousness
- **Analgesia** – an algos – without pain
 - Removal of just painful perception
- **Analgo-sedation**
 - Painless with persistent but decreased state of consciousness
 - Preserved spontaneous ventilation, patient alertness after stronger stimulation

Pain

- **Pain** is an subjective unpleasant sensory and emotional experience arranged by ascending nerve system and brain cortex. It is arising from actual or potential tissue damage or described in terms of such damage
- Pain pathway – three neuron ascending pathway, associated with activation of sympathetic
- *Nociception* – origin and transmission of signal of pain
- *Pain* – the result of processing of signal from nociceptor in central nervous system

Origin of pain

- The pain originates from direct painful stimulation of nociceptors when tissue is damaged or as affection of nociceptors when inflammatory / ischemic condition occurs in surrounding tissue.



Nociceptors

- **Free nerve endings** – usually no active (silent receptors) are activated by decrease of pH, increased level of extracellular K^+ , prostaglandins, leukotrienes, histamine
- **Polymodal nociceptors** – normally - cold, heat, mechanical stimulation, proprioception threshold stimulation – pain stimulation
- **High-pressure nociceptors** – usually sensation, pressure, vibration, pain when overstimulation

Nerve fibers

- **Fibers A δ** – low myelinated, „fast fibers“ 5-30 m/s, first acute, fast, sharp pain immediately with injury, discrete receptive area, precise localization of pain
- **Non-myelinated fibers C** – „slow fibers“ 0,5-2m/s, terminal endings, second dull, itching, burning, throbbing pain, large receptive area, localize just general body parts .
- **Fibers A α /A β** – strong myelinated, lower stimulation threshold than A δ /C, mainly transfer harmless tactile sensation – vibration, tingling, 30–70 m/s, can diminish A δ /C perception
-

Types of Pain

- **Acute** – short lasting seconds - weeks, max up to 3M
 - trauma, surgical incision, disease.
 - acute stress - vegetative sympathetic activation - catecholamine's – HR, RR, sweating, catabolism, hyperglycemia, muscle tension
- **Chronic** – longer > 3M , persist even after removing / healing up painful stimulus. Interferes with functioning and quality of life, chronic stress, no vegetative sympathetic signs –

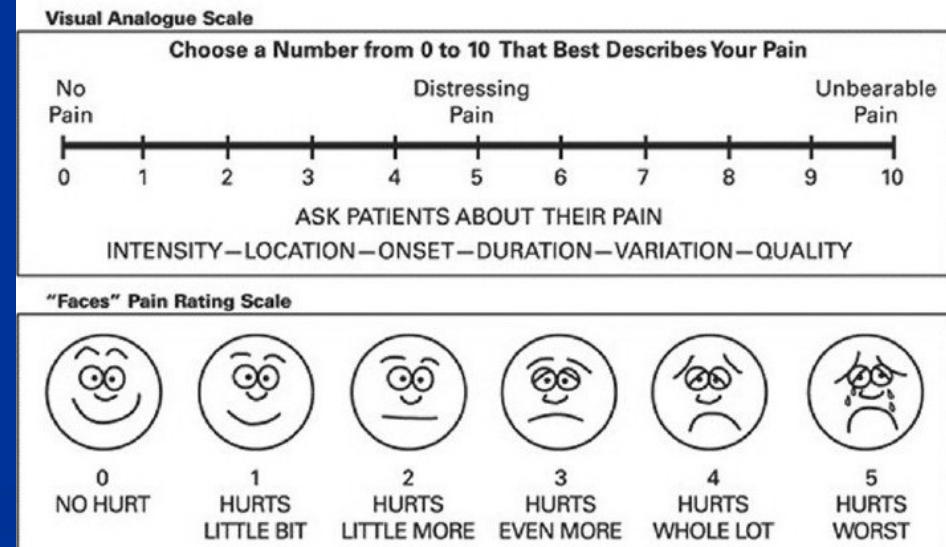
- **Superficial somatic pain** – sharp, well localized, precision of localization depends on areal density of receptors (face / back)
- **Deep somatic and visceral pain** – dull, aching, burning, long lasting, diffuse badly localized, can be figurative for other body parts (MI – left arm), sympathetic reaction, hyperesthesia
- Somatic - A δ /C fiber, parietal surface abdom., thor.
- Visceral only C fibers
- **Nerve root pain** – (radicular pain) irritation of nerve roots (spur, herniated disc, infection) , pain burning or sharp, stemming from the back to periphery, tingling, numbness, muscle weakness, increased

- **Neuropathic pain** - painful perception due to damaged / malfunctioning nerves
 - Diabetic neuropathy, trigeminal neuralgia, Phantom pains - changed threshold of perception,

Pain assessment

- The pain is a subjective perception, there is no objective measurement. Each measurement of pain depends on individual patient feeling of pain.
- Pain assessment on scale – from no pain up to the most unbearable pain.
- Visual analogue scale
- Numeric scale 0-10
- Faces pain scale

Figures: Tools Commonly Used to Rate Pain

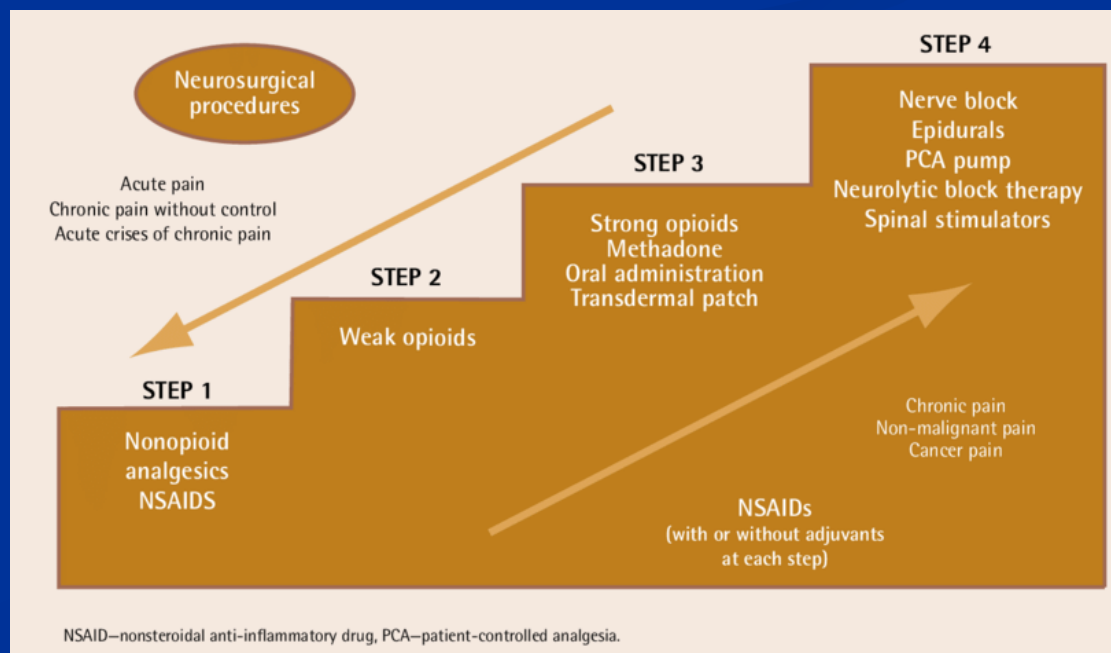


Medicine for pain relieve

- Non-opiate analgesics
 - antipyretics – Paracetamol /Acetaminophen ,
increases pain threshold
 - Nonsteroidal anti-inflammatory drugs (NSAID)
inhibition prostaglandins synthesis COX
- Opiate, opioids
 - bind specific receptors in brain and spinal cord
- Local anesthetics (catheter techniques).
- Adjuvant Co-analgesics (TCA, anti-convulsive)

WHO pain management ladder

- Step 1 – Nonopioid analgesics (Paracetamol, Metamizol, Brufen).
- Step 2 – moderate opioids (Tramadol, Codeine) + Nonopioid analgesics.
- Step 3 – Strong opioids (Morphine, Oxycodone) + Nonopioid analgesics + regional anesthesia



Post-operative pain management

- Paracetamol 1000mg i.v. q6-8h
- Dipidolor (piritramide) i.v./i.m.; tramadol;
- Morphine 10mg i.v. / s.c. (onset 5/15 min) q4h; increased 5-10mg;
- Sufenta continuous (5-10 ug/h i.v.)
CAVE – respiratory depression

Analgesics administration

- In a sufficient dosage
- Sufficiently long period
- Respect dosage intervals according to biological T1/2 half-life.

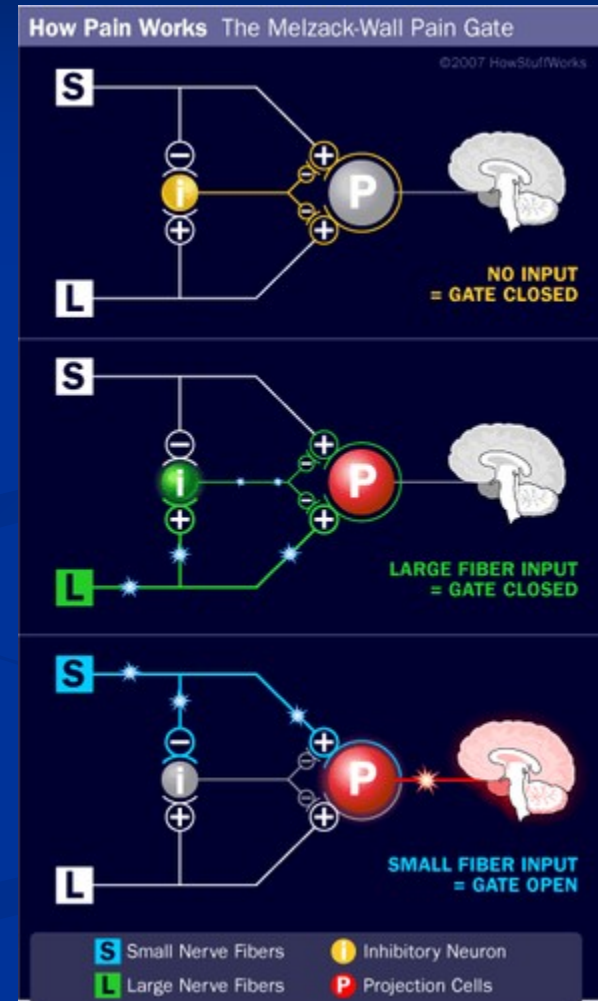
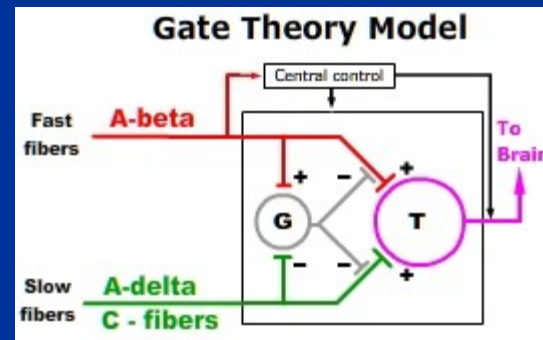
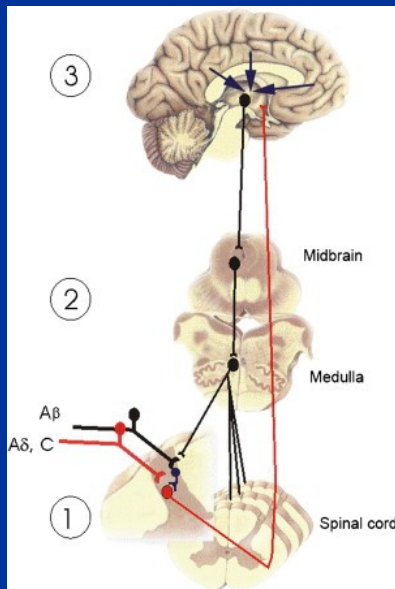
+ regional
anesthesia

Non-pharmacological pain management

- Immobilization
- Cryotherapy - Ice – reduce pain and swelling, apply 15-20min /h, decrease nerve conduction velocity
Heat – reduce pain and muscle spasm, apply 20-30min q2h, up to 2cm, improves blood flow
- Massage techniques – relax tight muscles
- Transcutaneous electrical nerve stimulation (TENS) unit – peripheral neuropathy - low level current over painful area cca 30 min, (PENS) - percutaneous
- Physical therapy - correction of posture
- Acupuncture – stimulation acupuncture points

Gate control theory

- Painful and mechanical, thermal stimulation go through same projection interneuron in dorsal horn
- Large myelinated non-nociceptor fibers reduce stimulation from small nociceptor fibers – pain sensation is reduced by other forms of stimulation



Anesthesiology

- **Anesthesiology** - is a branch of medicine that focuses on pain relieve during and after surgery / procedures.
- **Resuscitation** - is a term describing the process of correcting physiological disorders in an acutely unwell patient
- **Intensive care medicine** or **critical care medicine** is a branch of medicine concerned with the diagnosis and management of life-threatening conditions requiring sophisticated organ support and invasive monitoring
- **Chronic pain management** – relieve from degenerative diseases pain, cancer pain



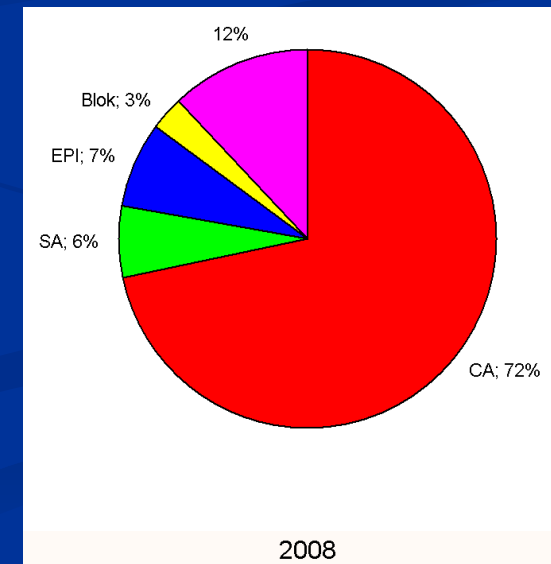


ICU



General anesthesia

- Temporary medically induced coma and loss of protective reflexes and all perceptions resulting from the administration of one or more general anesthetic agents
- Reversible condition that is characterized by unconsciousness, amnesia, analgesia, muscle relaxation, maintenance of physiologic stability with low reaction to surgical stress
- Control
- Requires protection of airways and ventilation



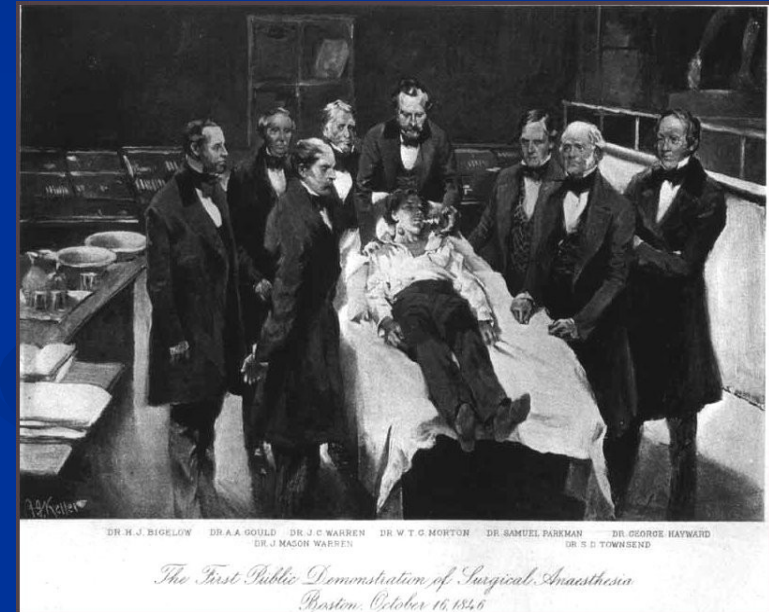
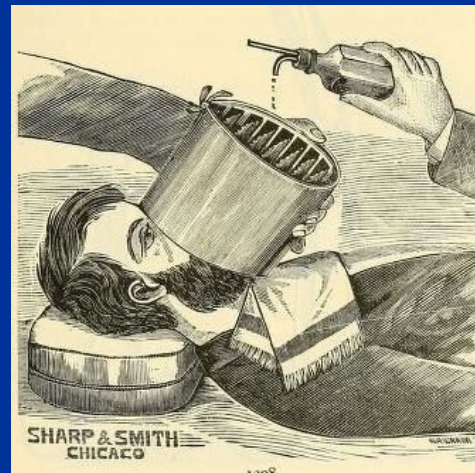
History

- Pain management
- Ancient Egypt, Syria, Greek – decoction /infusion from opium, Mandrake root



- 3000 B.C. - Egypt = nerve compression (axilla – hand)
- 16th century - alcohol + opium

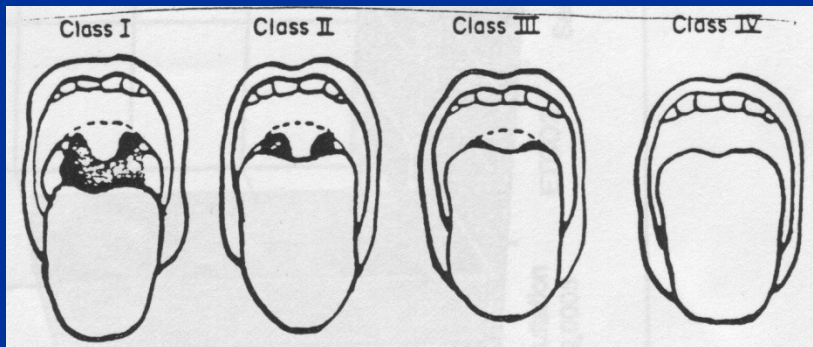
- 1846 - Morton (USA) – Ether, 1st General Anesthesia – tumor of mandible
- 1847 - 1st ether General Anesthesia in Bohemia – Celestin Opitz, Prague
- 1884 – Local anesthesia



- 1847 – chloroform 1950's – halothan
- 1955 – 1st Anesthesiology dept. St. Anne's UH

Preoperative phase

- Preoperative examination – GP, internal medicine, labs, ECG, chest X-ray
- **Preop. Anesthetic. evaluation** - reduce intraoperative risks
- Assess risks
- Choose most appropriate type of anesth.
- premedication
- Airway exam
- Informed consent



- Premedication – anxiolysis, sedation - tranquilizers (benzodiazepine), elimination of unwanted vagal reflexes – reduces use of medication at induction of GA
- Assess the risks

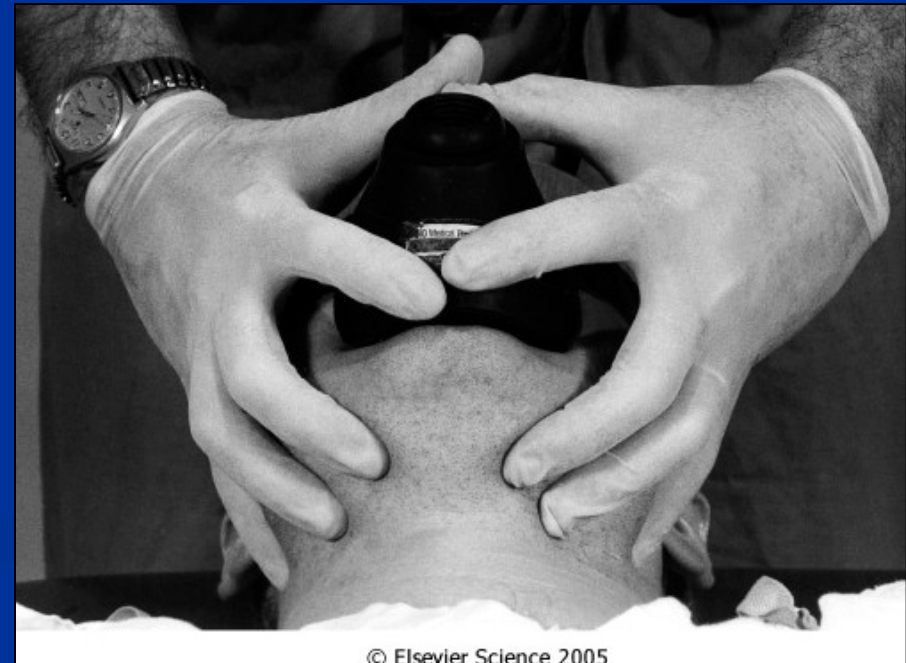
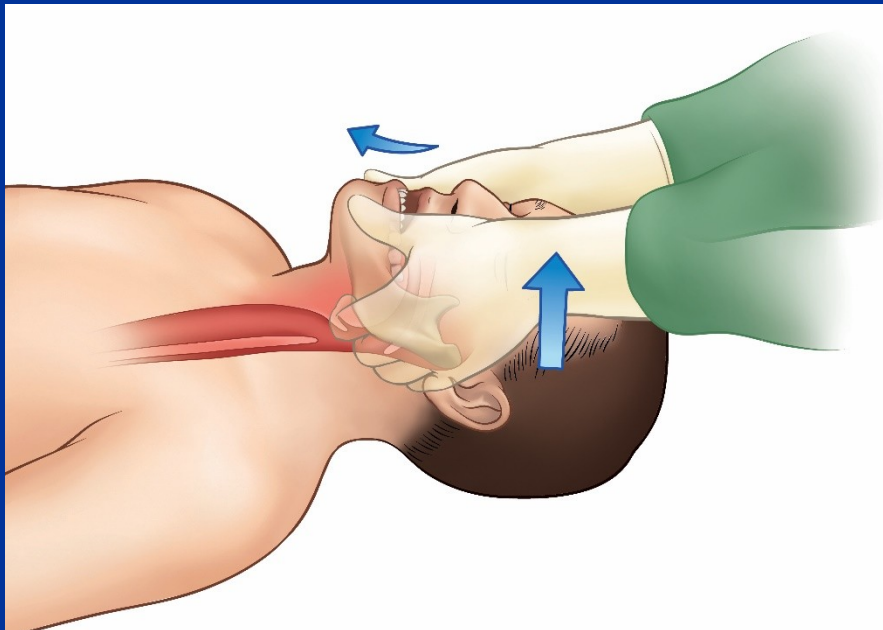
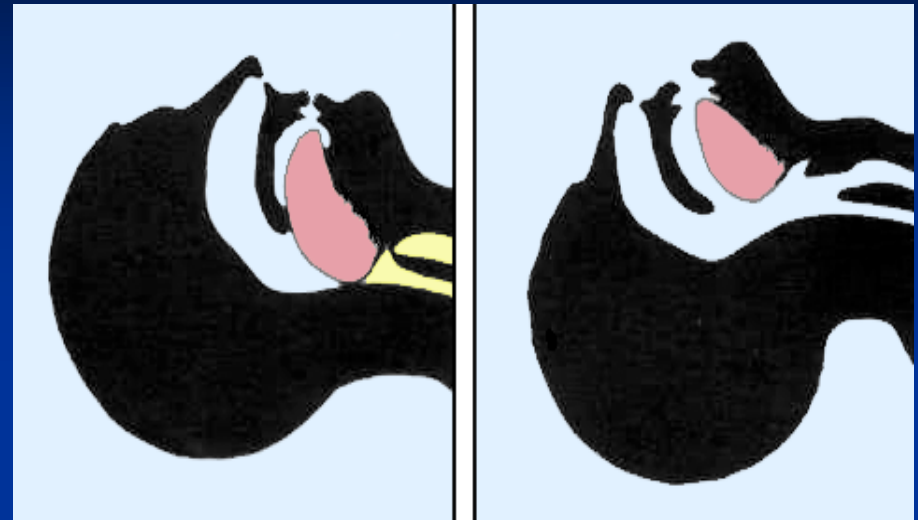
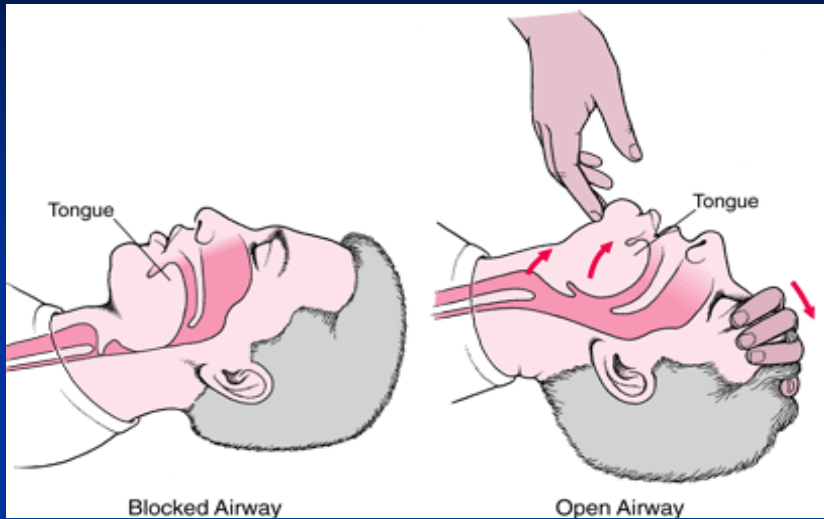
Fig. 1a ASA classification

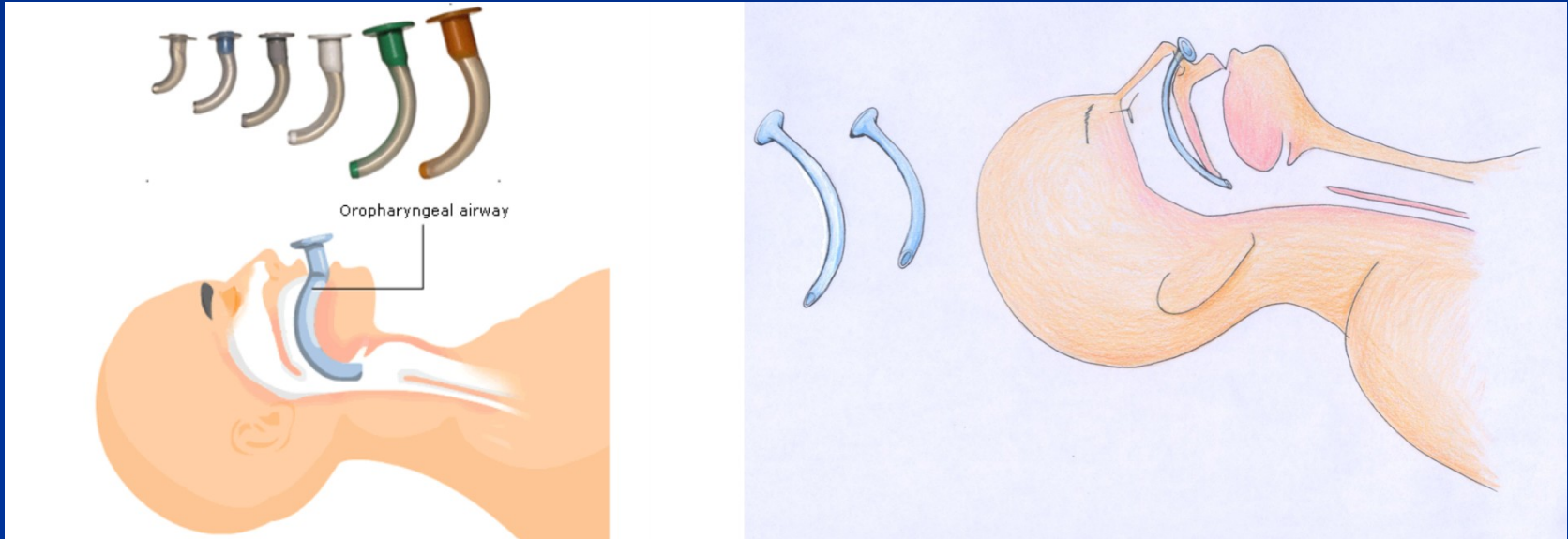
ASA I	Normal healthy patients
ASA II	Patients with mild systemic disease
ASA III	Patients with severe systemic disease that is limiting but not incapacitating
ASA IV	Patients with incapacitating disease which is a constant threat to life
ASA V	Moribund patients not expected to live more than 24 hours
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes

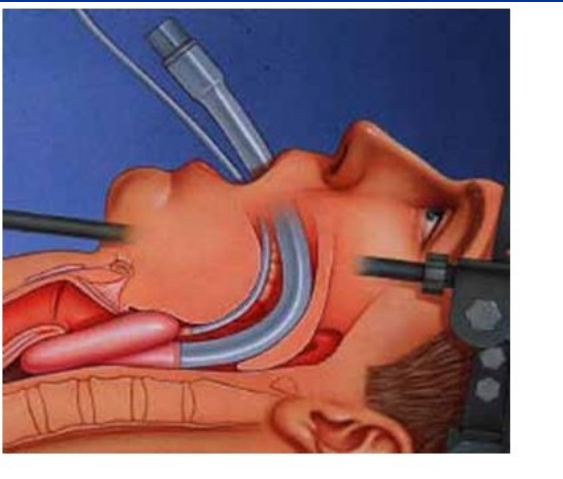
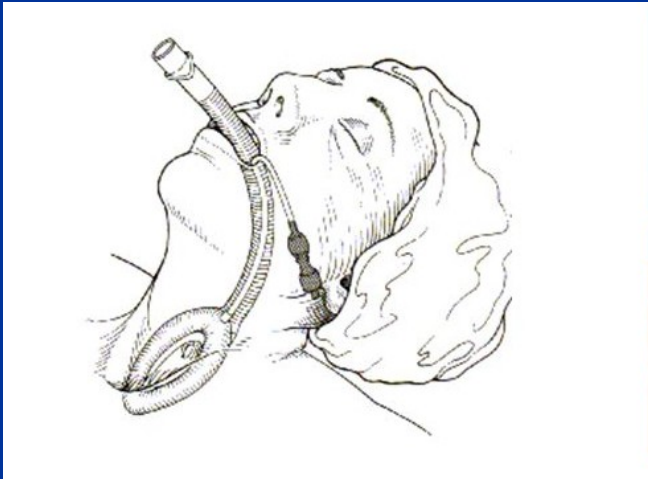
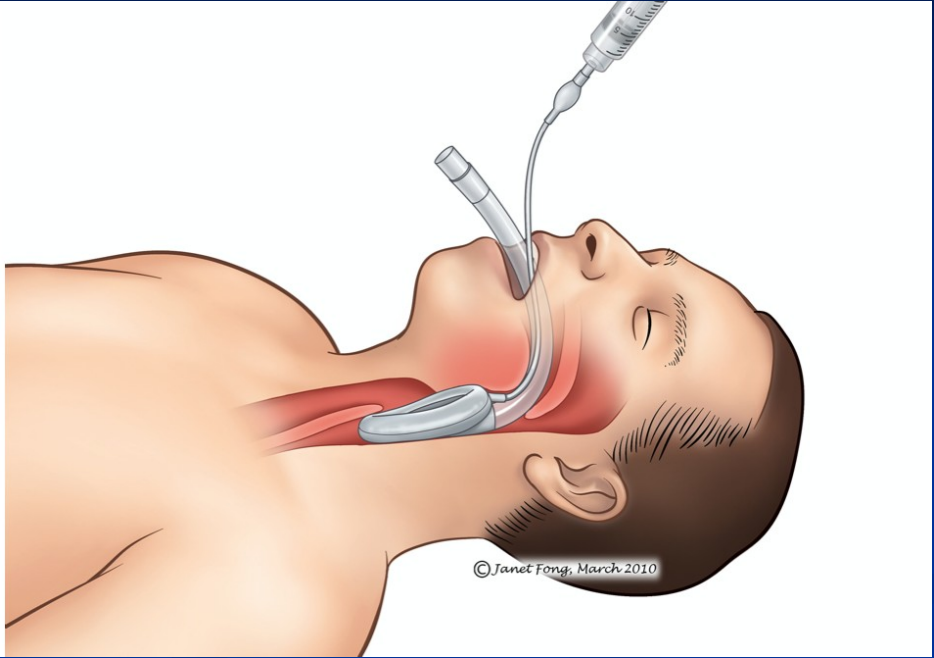
Airways management

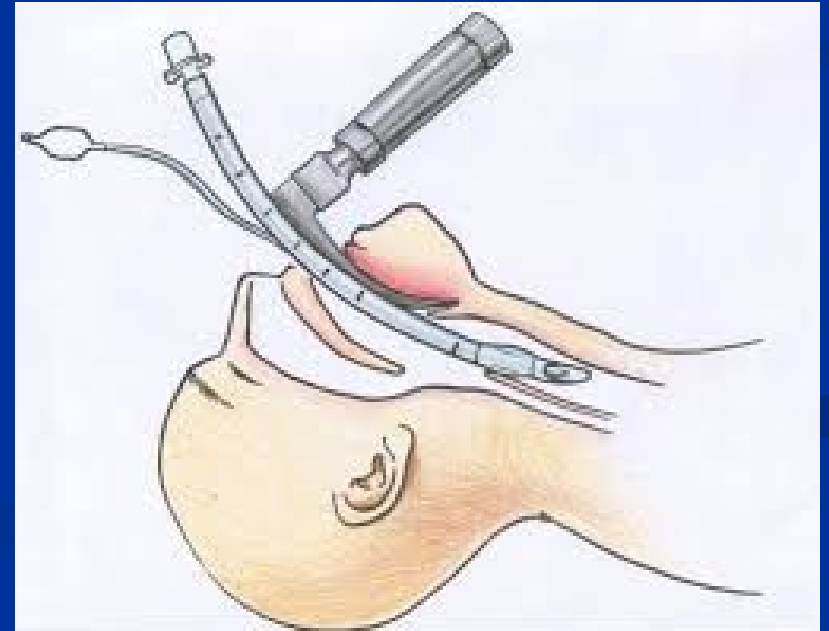
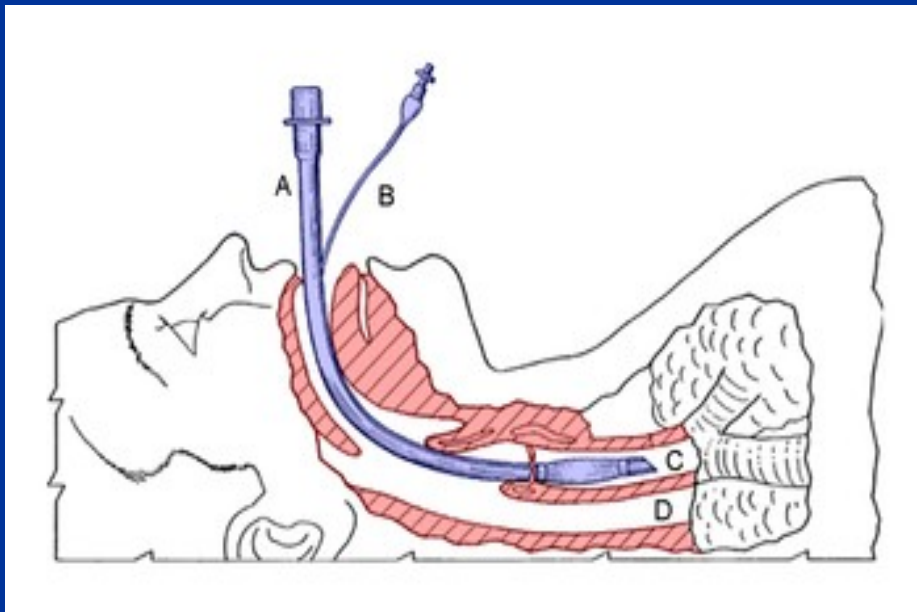
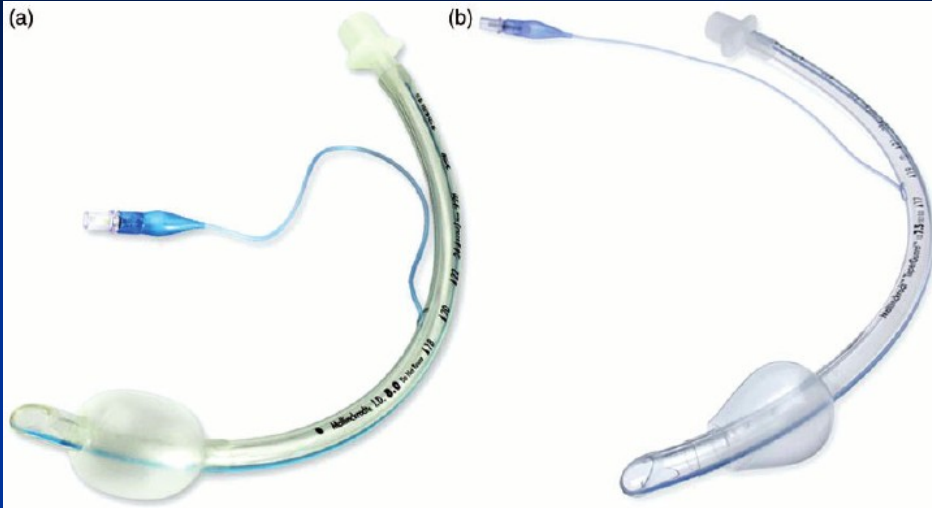
- Jaw thrust – chin forward movement, oro/nasopharyngeal airway, mask laryngeal mask - don't protect airways against aspiration / leakage
- Endotracheal tube with balloon – sealing under vocal cords
 - indication – full stomach (ileus, trauma), prone, lateral decubitus position,
 - Hemodynamically / respiratory unstable patient
 - Selective lung intubation
 - Essential - muscle relaxation (Sukcinylcholin)

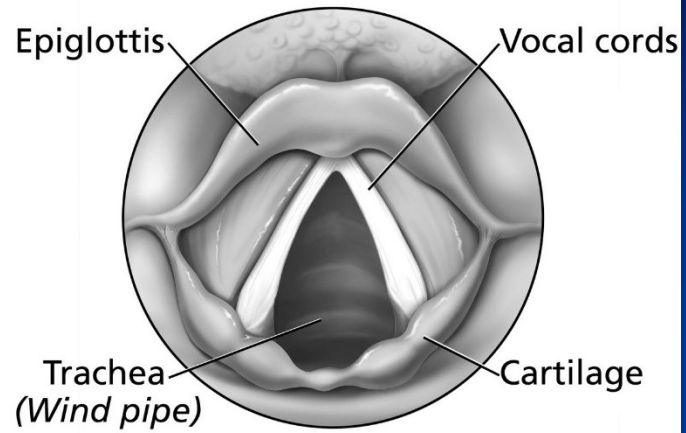
head-tilt/chin-lift, jaw-thrust maneuvers



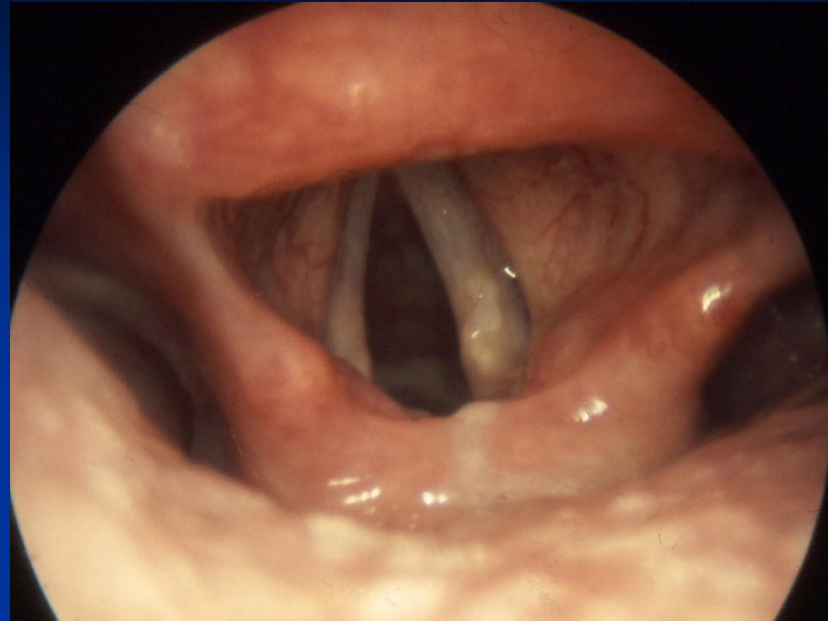


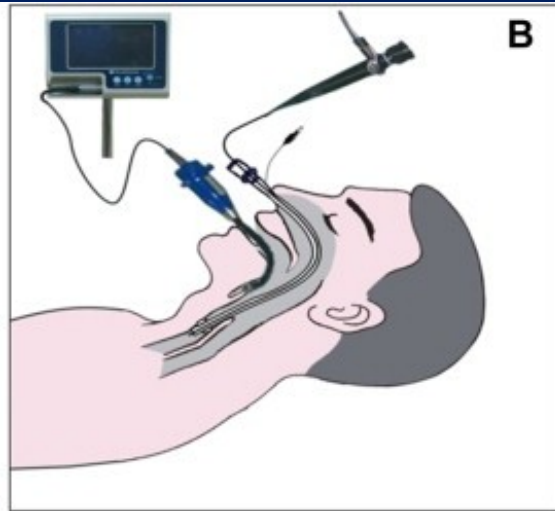






National Cancer Institute



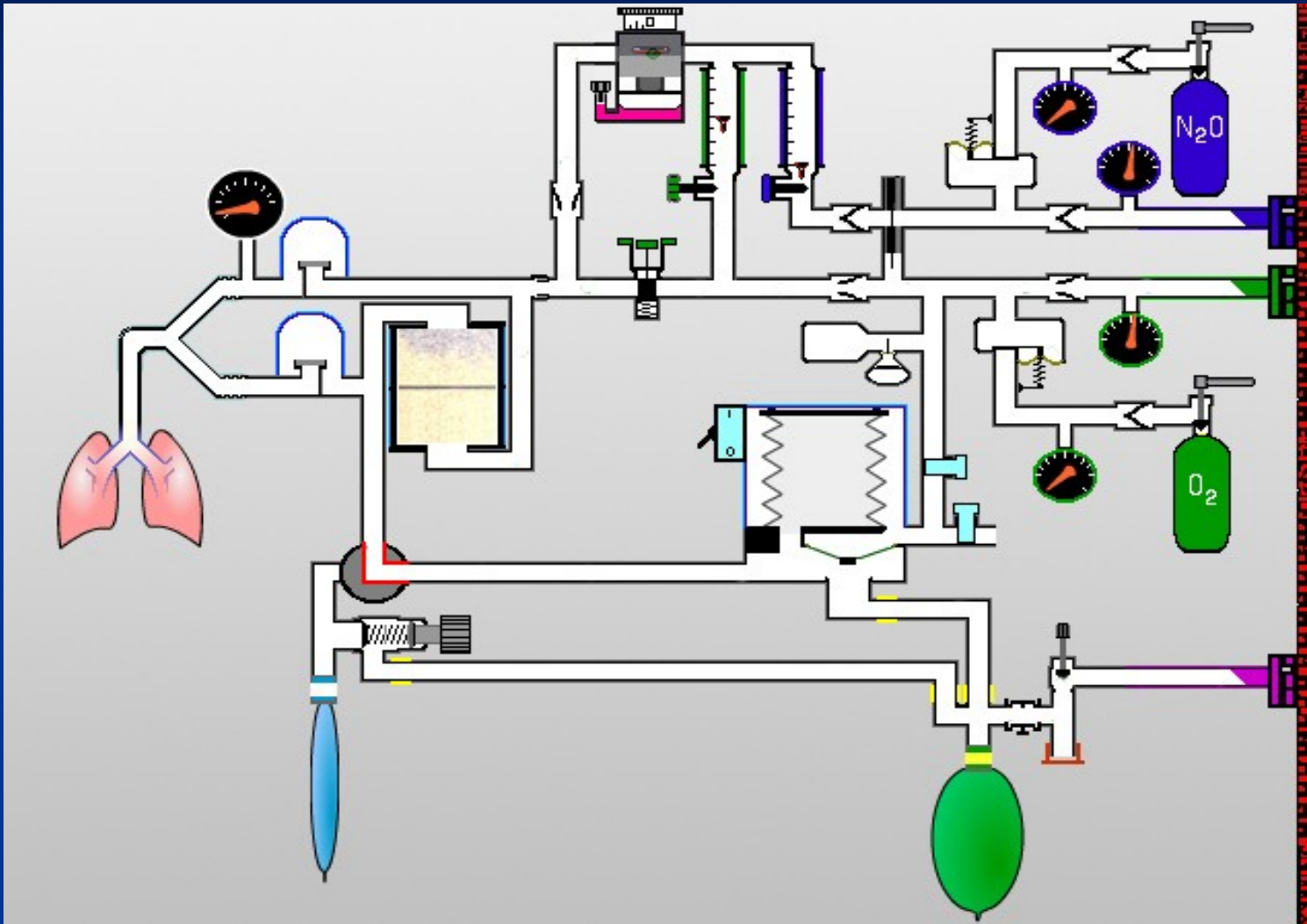


Anesthesia machine

- Technically enables mechanical ventilation, monitoring of vital signs
- administer O₂/AIR/N₂O, inhalation anesthetics
- High pressure system
- Low pressure system – mixture of breathing gases with inhalation anesthetic
- Breathing circuit – inhalation/exhalation circuit
- Ventilation systems (manual and mechanical)
- Scavenging system – used gases

- INSULFLATION mixture of gases with anesthetics
- inspirium (20-25 cm H₂O)
- expirium - passive, stop of insufflation





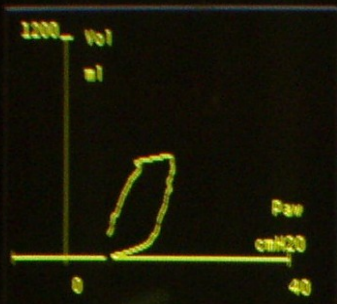
Basic monitoring through GA

- Vital signs, respiration, ventilation, intensity of anesthesia
- ECG
- NIBP
- SpO₂
- Temperature
- Pressure in airways, inspiration/expiration volume
- EtCO₂



PLICNICE 16:59

Kerber Miroslav



Adult cmH2O ml
 Ppeak 20 TVinsp 560
 Pplat 19 TVexp 450
 Pmean 15 1/min
 PEEPe 8 MVinsp 10.3
 PEEPi --- MVexp 10.6
 I:E 1.2 : 1
 Compl 36 ml/cmH2O
 Raw 6 cmH2O/l/s

HR **80** /min Arrh. analys: Severe
 SpO2 **95** %
 Art **(88)** mmHg 120/71
 PA **(30)** mmHg 44/23
 CVP **(110)** mmHg 110/109
 CO2 % ET **4.3** F1O2 **64** %
 RR **16** /min

C.O. PCWP
 l/min mmHg
7.09 **13**
 15:50 15:48

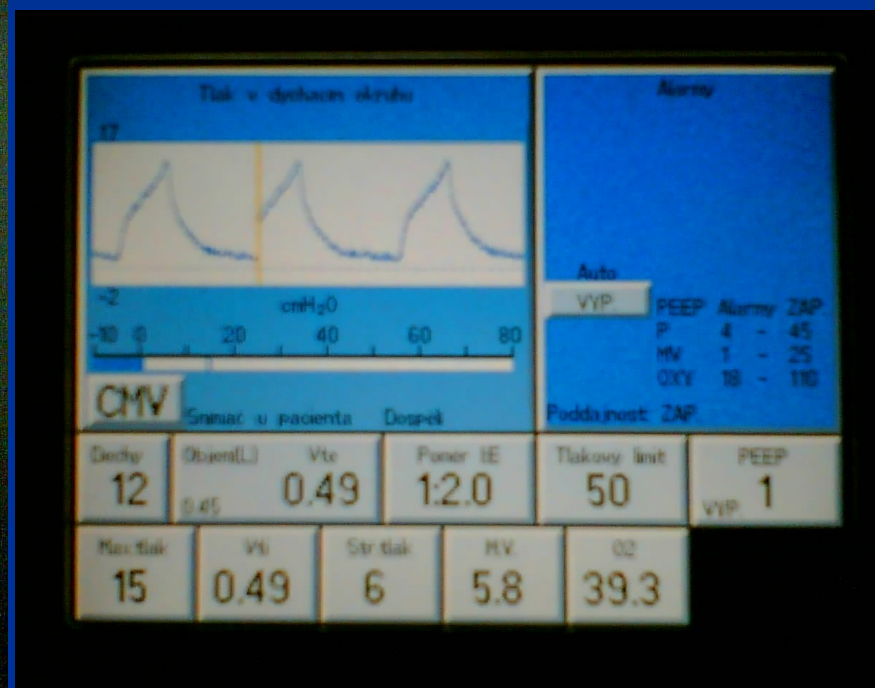
C.I. PCWP
 l/min/m2 mmHg
3.53 **13**
 15:50 15:48

PgCO2 P(g-Et)CO2
 kPa
7.6 **3.5**
 0 10 min

Tblood °C
38.7

■ Monitoring

ventilator



Advanced monitoring

- Invasive BP (MAP)
- CVP; (PAWP)
- Analysis of ventilation gases (O₂, N₂O, anesthetics)
- spirometry
- Hourly urine output
- relaxometry



Induction of GA

- 3 drugs supplementary GA

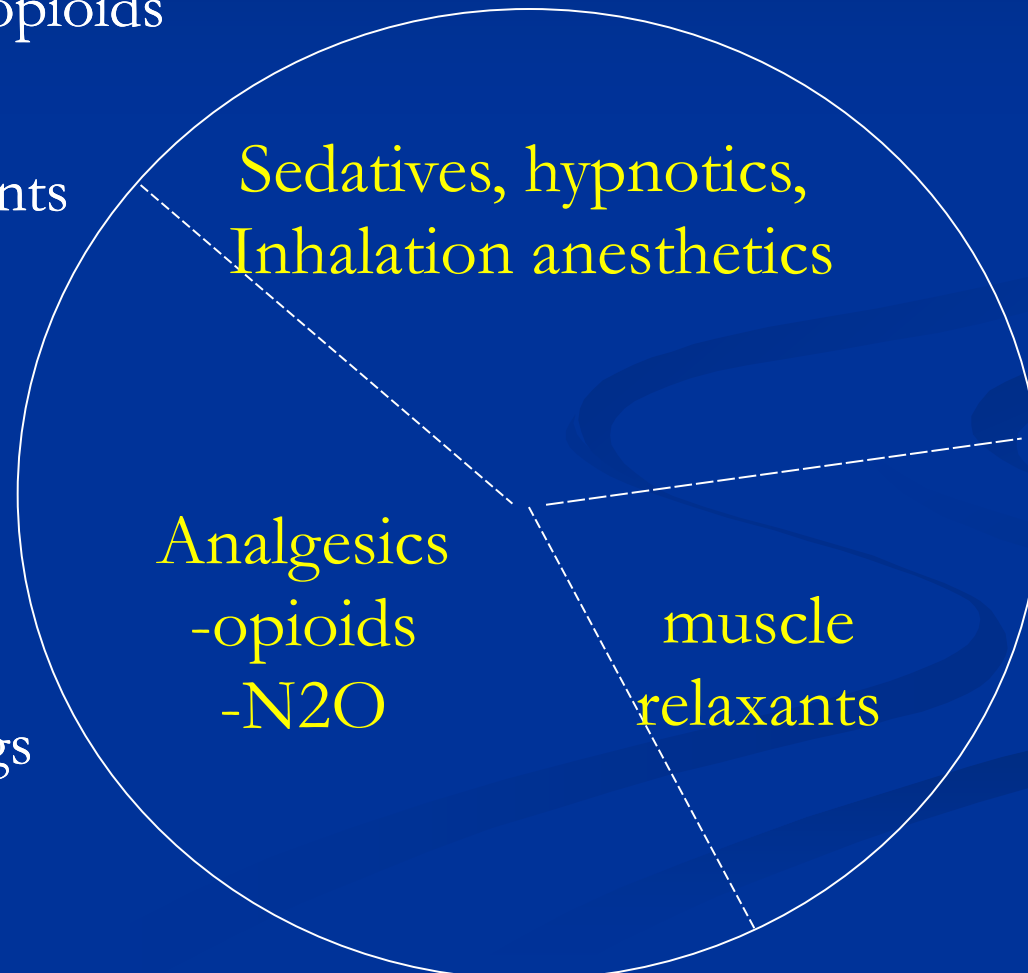
- Analgesics – opioids

- Anesthetics

- Muscle relaxants

- infusion

- Auxiliary drugs



Induction of GA

- 1 – 3 drugs i.v - the most effective application way
- In lethal doses
- Lead to no self-control, unable call for help, suppression of vital autoregulation mechanisms
- (through GA we count on perfect residual autoregulation functions)
- unmask of compensated disturbances (hypovolemia, relative respiratory insufficiency)
- 30 - 60s from fully conscious to vitally dependent on anesthetist

- **Opioids** - i.v.
- Bolus / continual

- Fentanyl, Alfentanil, Sufentanil, Remifentanil, Morphine

- **Muscle relaxants**- i.v.
- Enables intubation, mechanical ventilation, enables surgical procedures

- Not necessary every time
- Place of action – neuromuscular junction

Anesthetics

■ I.V. - TIVA

- Propofol
- Barbiturate: Thiopental
- Etomidate
- Ketamine



- ## ■ Inhalation - enters through pulmonary veins, acts in the brain, spreads through partial pressure gradient
- Halotan, Isofluran, Sevofluran, N₂O

■ i.m., p.r.

- ## ■ Benzodiazepiny: Diazepam, Midazolam

Depth of GA

- Due to concentration of inhalation anesthetic
- **I. stage:** analgesics phase – administration, analgesia and subsequent amnesia up to loss of consciousness. Conversation possible
- **II. stage:** excitement stage – unconsciousness, irregular respiratory and heart rate, breath holdings, uncontrolled movements, risk of vomiting, risk of cardiac
- **III. stage:** surgical anesthesia – muscle relaxation, respiratory, heart rate depression and stabilization, loss of reflexes.
- **IV. stage:** too much anesthetic – overdose – brain stem/ medullary depression, vasomotor, and respiratory inhibition respiratory and cardiac arrest.

STAGE	Respiration		Ocular movem.	Pupil size	Reflexes	SK. mus. tone	B. P.	H. R.	USES
	Thor.	Abd.							
I ANALGESIA			NORMAL		EYE LID PHARYNGEAL CORNEAL LIGHT				Labour, Incisions and Minor ops.
II DELIRIUM			ROVING EYE BALLS						NIL
SURGICAL ANAESTHESIA III	1								Most of the surgical operations
	2								Occasionally reached now
	3								Never attempted
	4								Never attempted
IV MEDULLARY PARALYSIS									

Intraoperative care

- procedure in the operating field
- operation of technical systems
- Vital signs monitoring
- Maintenance of 3rd phase of anesthesia – sufficient analgesia and anesthesia, circulation volume supplementation

- Reaction to surgical stimuli (pain)

i.v.: - opioids

- infusions

- sympathomimetic

Change concentration of inhalation anesthetics

Postoperative care

- Put out of GA
- Finished surgical procedure
- No surgical bleeding
- Stable ABC's
- Regain of muscle strength
- Exhalation of the anesthetic (body, not lungs)
- Regain of conscious and alertness
- obey simple calls , to cough, rises head above the pad
- Unstable ABC's, unconsciousness - continue analgo-sedation + MV – go on ICU

Postoperative care

- observation 2h – ICU/ HDU/ Postanesth. Care Unit – PACU – monitoring of vital signs
- Follow-up monitoring - up to 4-6 h post op. – BP, HR, SpO₂, consciousness, urine out put
- Necessary sufficient postoperative analgesia, volume therapy



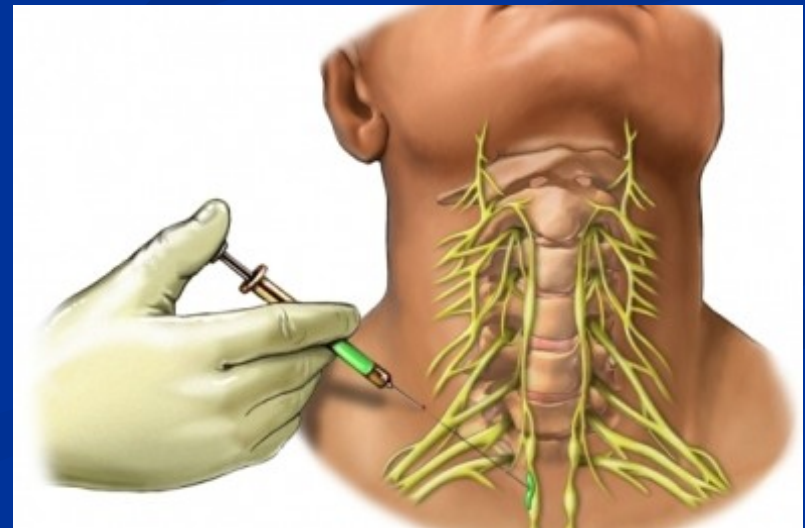
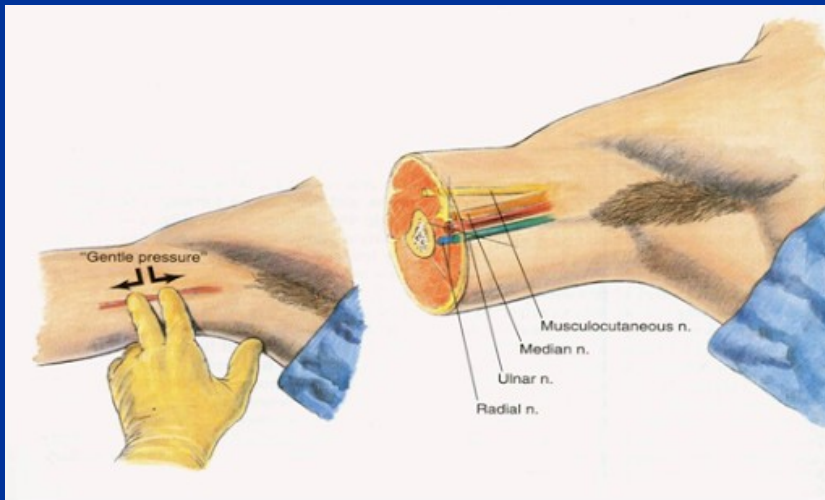
Risks and complications of GA

- The most risky part – induction and termination of GA (stages I-III / III-I)
- risk – the more co-morbidities/ emergency procedure
- Aspiration (low pH, full/ atonic stomach) - pneumonia
- Anaphylactic shock, embolism, IM, malignant hyperthermia, dysrhythmia
- Hypoventilation - asphyxia (the end of GA, extubation)

- Hidden hypovolemic shock with temporary centralization
- Surgical complication – bleeding

Local /Regional anesthesia

- Blocking of pain pathways
- acts on the peripheral nerves (no CNS), - from the output of radicular nerves to the terminal end
- Wide range of procedures – bronchoscopy up to TJR, consciousness preserved
- positives : postoperative analgesic effect, improves perfusion, does not restrict breathing, allows contact with patients



Sorts of local anesthesia

- **Topical** (skin, mucosal) - application to the surface anesthetics, vocal cords, trachea, urethra
- **Infiltration** - infiltration on-site surgery
- **Field block** - interrupts conduction of nerve fibers in small distance from the surgical site
- **Peripheral nerve block**
- **Plexus anesthesia**
- **Epidural anesthesia**
- **Spinal anesthesia**

Local anesthetics

- Amid
- Ester

Esters	Max Dose (mg/kg)	Duration (h)
Chlorprocaine	12	0.5 – 1
Procaine	12	0.5 – 1
Cocaine	3	0.5 – 1
Tetracaine	3	1.5 – 6

Amides	Max Dose (mg/kg)	Duration (h)
Lidocaine	4.5/(7 with epi)	0.75 – 1.5
Mepivacaine	4.5/(7 with epi)	1 – 2
Prilocaine	8	0.5 – 1
Bupivacaine	3	1.5 – 8
Ropivacaine	3	1.5 – 8

- Cave - allergies
- Ester type allergies more common



angioedema

- **Topical anesthesia**

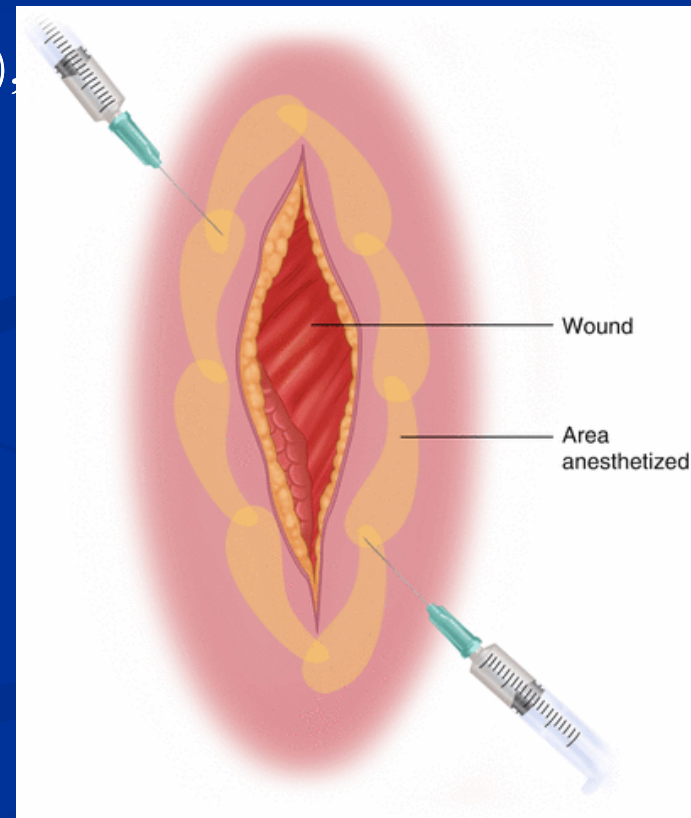
- lidocain, benzocain, tetracain

- dentistry, ORL, ophtalmology, urology, Ob/Gyn, pediatric....(tattoo)

- Spray, jelly, cream

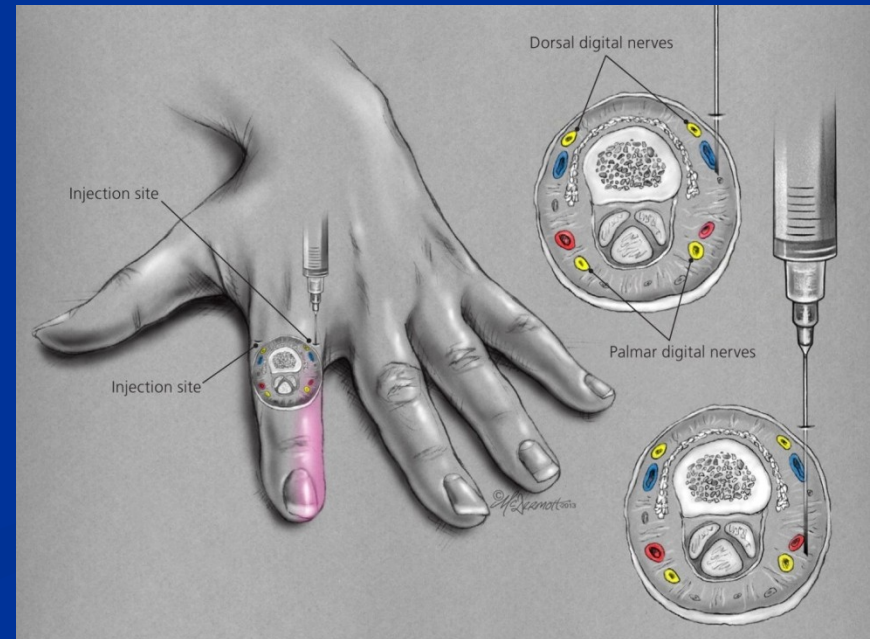
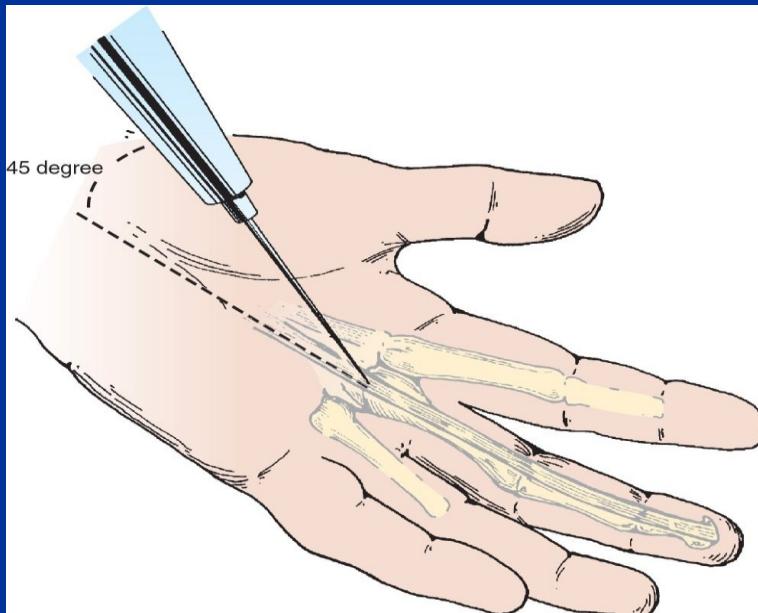


- **Infiltration anesthesia**
- infiltration on-site of surgery
- Trimekain (Mesocain), Artikain (Supracain), Chirokain (Levobupivakain), Marcain (Bupivakain)
- vasoconstriction + anesthetics



- **Field anesthesia**

- interrupts conduction of nerve fibers in small distance from the surgical site



- **Peripheral nerve block and Plexus anesthesia**

- Instillation of anesthetics near to the main nerve branches

- Brachial plexus block

- axillary block

- Sciatic nerve block

- Femoral nerve block

- FICB

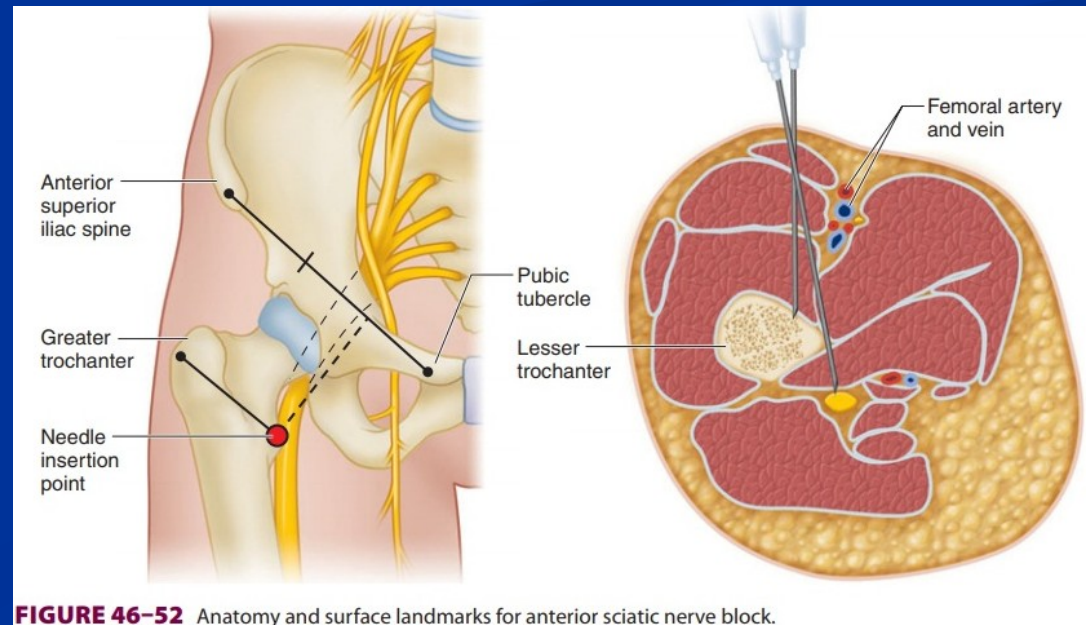
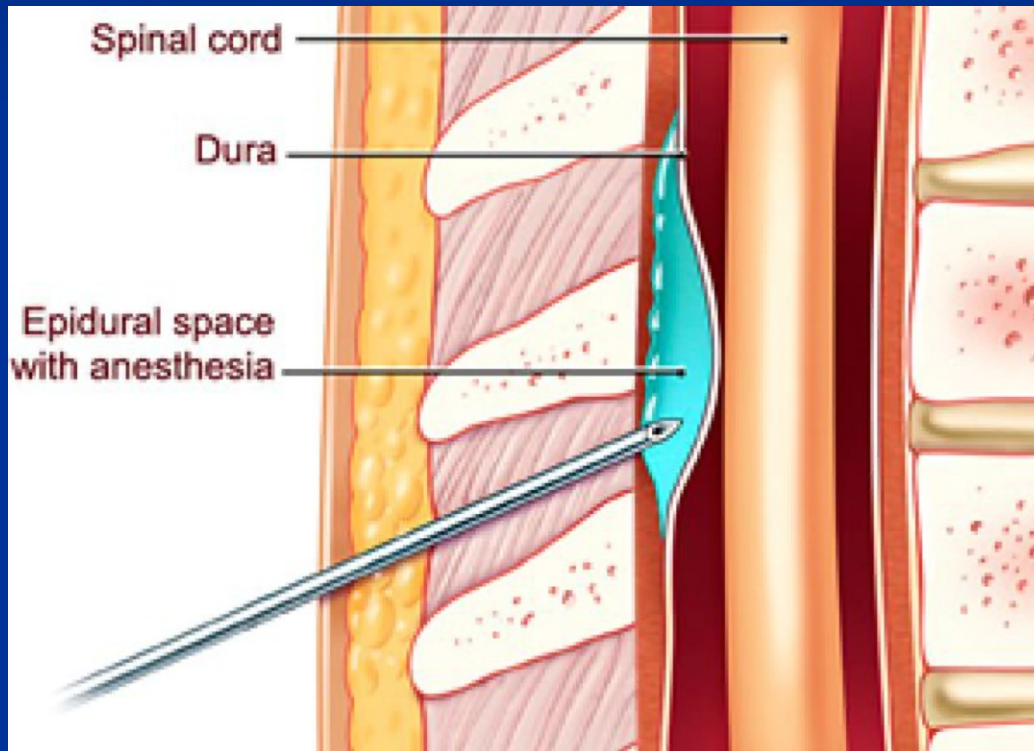


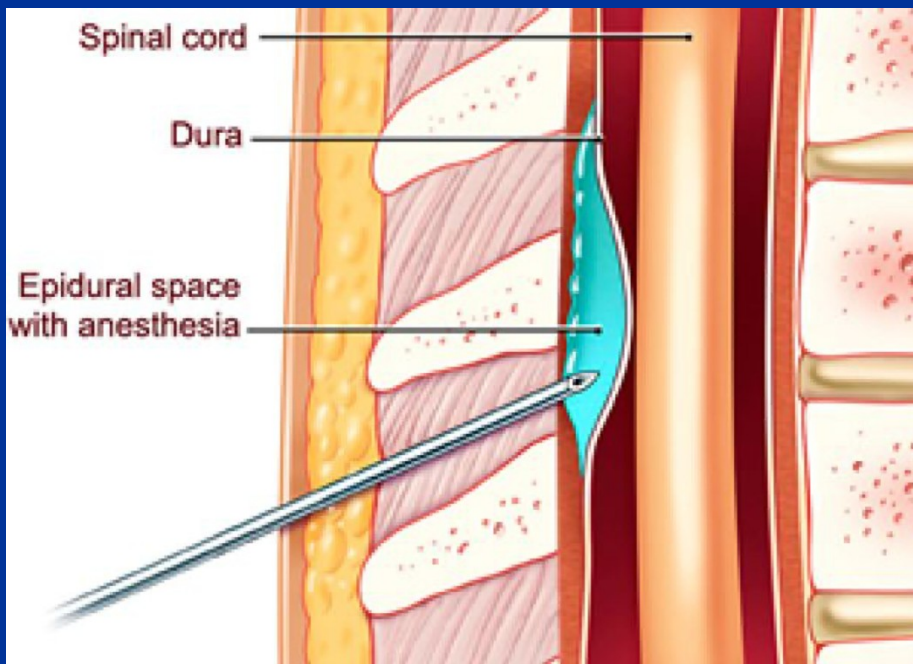
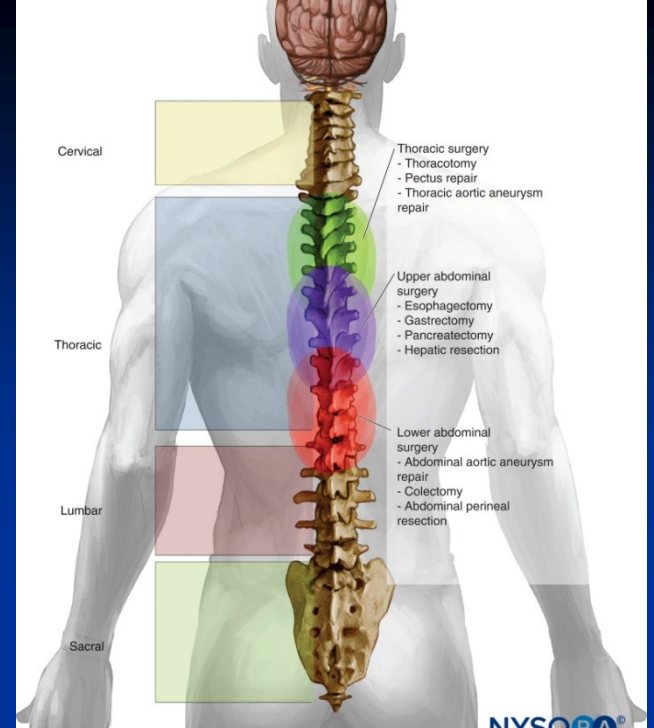
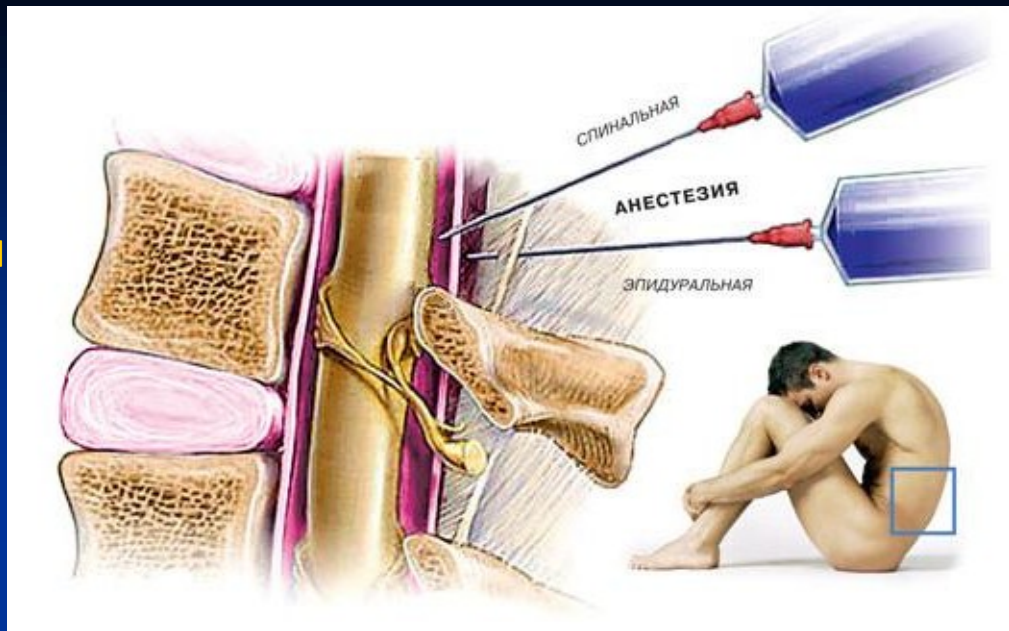
FIGURE 46-52 Anatomy and surface landmarks for anterior sciatic nerve block.

Central nerve blocks – neuraxial anesthesia



Epidural anesthesia

- Epidural anesthesia involves the use of local anesthetics injected into the epidural space
- produce a reversible loss of sensation and motor function
- LA deposited in epidural space. Block spinal nerve roots that traverse peridural space. Blocks sympathetic nerves traveling with the anterior roots. Applications range from sensory analgesia, minimal motor block, or dense anesthesia and full motor block – controlled by drug choice, concentration, dosage
- Loss of resistance technique / hanging drop – negative pressure
 - improves perfusion
 - Single-use needle / catheter for long period , slow onset
 - Vasodilatation – due to sympathetic effect – hypotension
 - According to the level of puncture:
 - A. Lumbar puncture (L3–L4)
 - B. Thoracic
 - C. Cervical



Spinal / subarachnoid anesthesia

- LA deposited at subarachnoid space, through dura mater, into CSF
- Acts on spinal nerves and dorsal ganglia,
- Produces sympathetic block, sensory analgesia and motoric block
- Procedures below diaphragm (upper abdomen up to toes), CS
- Vasodilation – hypotension
- Single shot , rapid onset
- spreading density and body position
- instillation L4

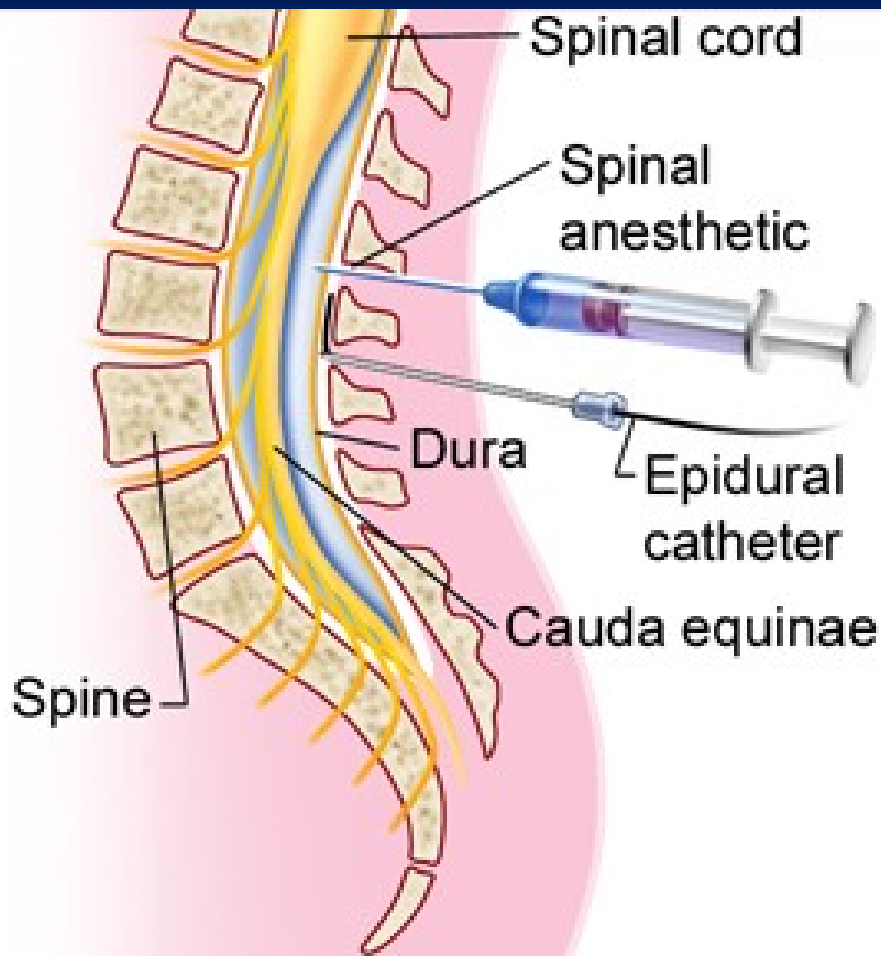
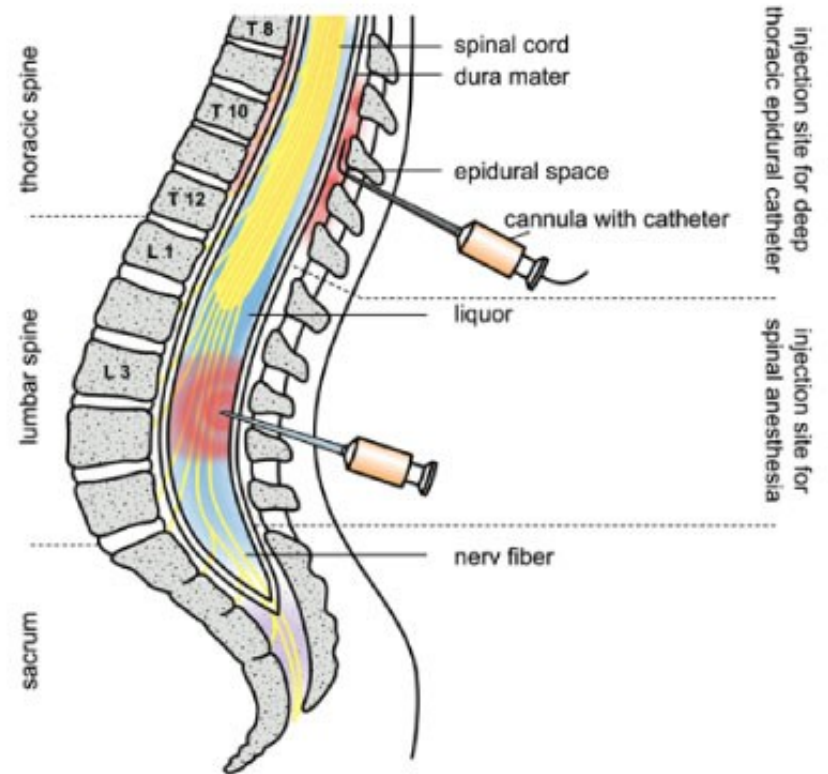


Figure 1 - Method of CSTEА.



Complications of SA

- bleeding
- SSI
- failure effect
- wrap catheter in the epidural space
- hypotension during anesthesia –volume therapy, ephedrine
- the upward spread of the anesthetic in the subarachnoid anesthesia (cough, hypobaric solution, incorrect posture) => motor paralysis, hypotension, respiratory insufficiency
- urinary retention
- Nerve injury
- Post-puncture syndrome - headache



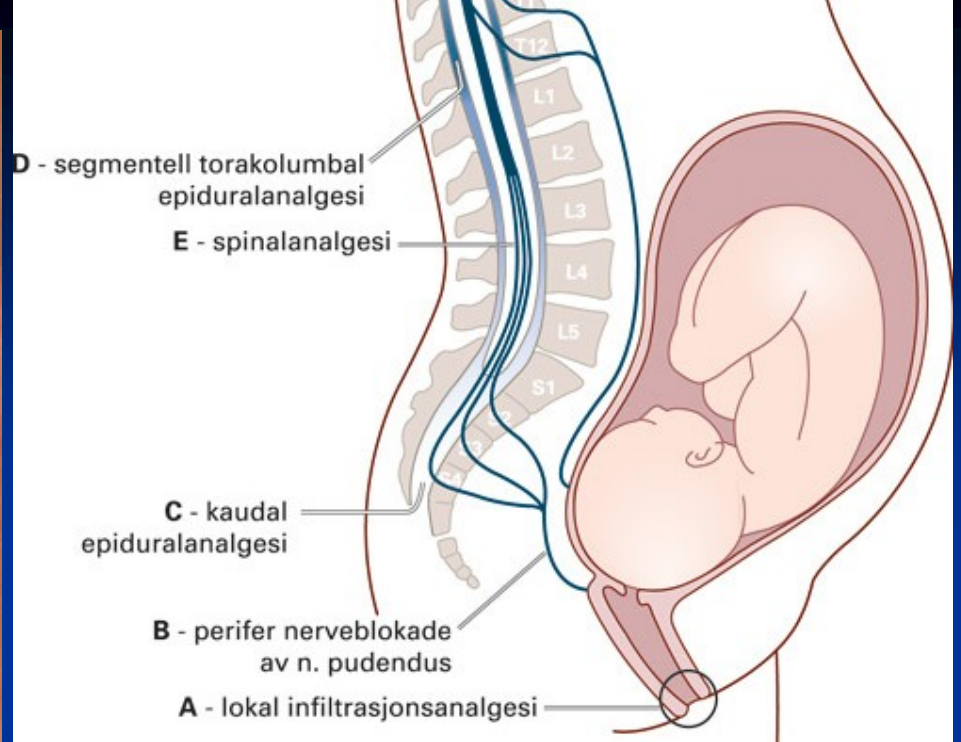
D - segmentell torakolumbal epiduralanalgesi

E - spinalanalgesi

C - kaudal epiduralanalgesi

B - perifer nerveblokkade av n. pudendus

A - lokal infiltrasjonsanalgesi



Standard Tuohy needle



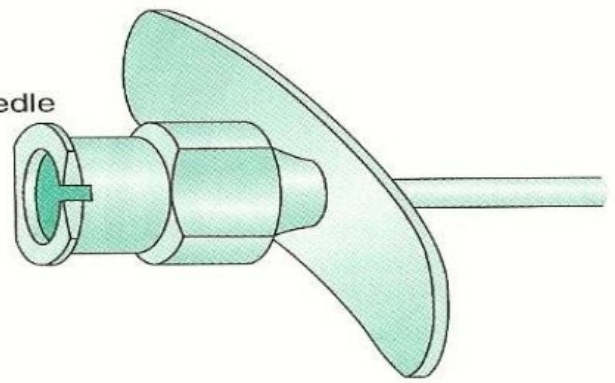
Blunt tip



Crawford needle (thin walled)



Weiss winged needle





Urologist



Surgeon



Anesthesiologist

