



# **Anesthesia**

## **Sanda-Maria Copotoiu**

**I. Preanaesthetic consult**

**II. Objectives**

**III. Types**

**I. GA**

**II. Loco-regional an**

**I. Epidural**

**II. Spinal**

**III. Perriferal nerve blocks**

**IV. Local - topical**

**IV. Basic principles**

# **Preadnestic consult**

- **History**
- **Physical exam**
- **Anterior lab+ supplemental**
- **Patient information certainty as to his ability to understand and take decisions**
- **Informed consent**
- **Primary evidence— drug interactions, preop medication**
- **ASA risk assessment**

# ASA risk assessment

- ✱ **ASA 1 = no organic, functional, biochemical, psychiatric disease**
- ✱ **ASA 2 = Mild to moderate systemic disease, resoc or not for surgery eg:**
  - ✱ **cardiopathy moderately impinging on physical activity**
  - ✱ **Essential HBP,**
  - ✱ **Diabetis**
  - ✱ **anemia,**
  - ✱ **Age extremes,**
  - ✱ **Morbid obesity,**
  - ✱ **Chronic bronchitis**

# ASA risk assessment cont

## ✿ ASA 3

**Severe systemic disturbances, cause or not for surgery eg:**

- ✿ Cardiac diseases limiting physical activity
- ✿ Essential HBP difficult to cope with,
- ✿ Diabetes + vascular complications,
- ✿ Chronic pulmonary disease
- ✿ angina ,
- ✿ History of AMI

# ASA risk assessment cont

- ✱ **ASA 4 Severe life threatening systemic diseases  $\pm$  surgery e.g:**
  - ✱ **Congestive cardiac failure,**
  - ✱ **Persistent angina,**
  - ✱ **Pulmonary failure,**
  - ✱ **Cardiac failure,**
  - ✱ **Liver advanced failure**

# ASA risk assessment cont

- ✱ **ASA 5 Moribund patient, limited survival chances, surgery is the last remedy (resuscitation effort)**
- ✱ **ASA 6 Brain dead, donor**
- ✱ **E Any patient operated in emergency**

# Anesthesia choice

- **Coexisting diseases  $\pm$  connection with surgery**
- **Site of surgery**
- **Position during surgery**
- **Elective character, or emergency**
- **One-day surgery**
- **Full stomach risk (occlusion, postingestion)**
- **Age**
- **Patient' wish, verbally or expressed in writing, fully consciousness**



# Anesthetists' responsibilities

- **Physical status evaluation – functional assessemnt**
- **Anesthesia risk assessment**
- **Tailoring according to**
  - **comorbidities**
  - **Pts' wishes**
  - **Surgery needs submitted to the best interest of the patient**
- **Choice of the adequate anesthetic technique**

Cardiac Risk Factors in Patients Undergoing Elective Major Noncardiac Surgery	
High-risk surgery	Abdominal aortic aneurysm
1 point	Peripheral vascular operation
	Thoracotomy
	Major abdominal operation
Ischemic heart disease	History of myocardial infarction
1 point	History of a positive exercise test
	Current complaints of angina pectoris
	Use of nitrate therapy
	Q waves on electrocardiogram
Congestive heart failure	History of congestive heart failure
1 point	History of pulmonary edema
	History of paroxysmal nocturnal dyspnea
	Physical examination showing rales or S <sub>3</sub> gallop
	Chest radiograph showing pulmonary vascular redistribution
Cerebrovascular disease 1 point	History of stroke
	History of transient ischemic attack
Insulin-dependent diabetes mellitus 1 point	
Preoperative serum creatinine concentration > 2 mg/dL 1 point	

1. Points 0: Class I Very Low (0.4% complications)
2. Points 1: Class II Low (0.9% complications)
3. Points 2: Class III Moderate (6.6% complications)
4. Points 3: Class IV High (>11% complications)

# Types of anesthesia

- **GA**
- **Regional**
- **Perifferal nerve blocks**
- **Local an**



**Conduction  
anaesthesia**

- **Shen Nung 2<sup>nd</sup>**  
**Chinese emperor**  
**cannabis**







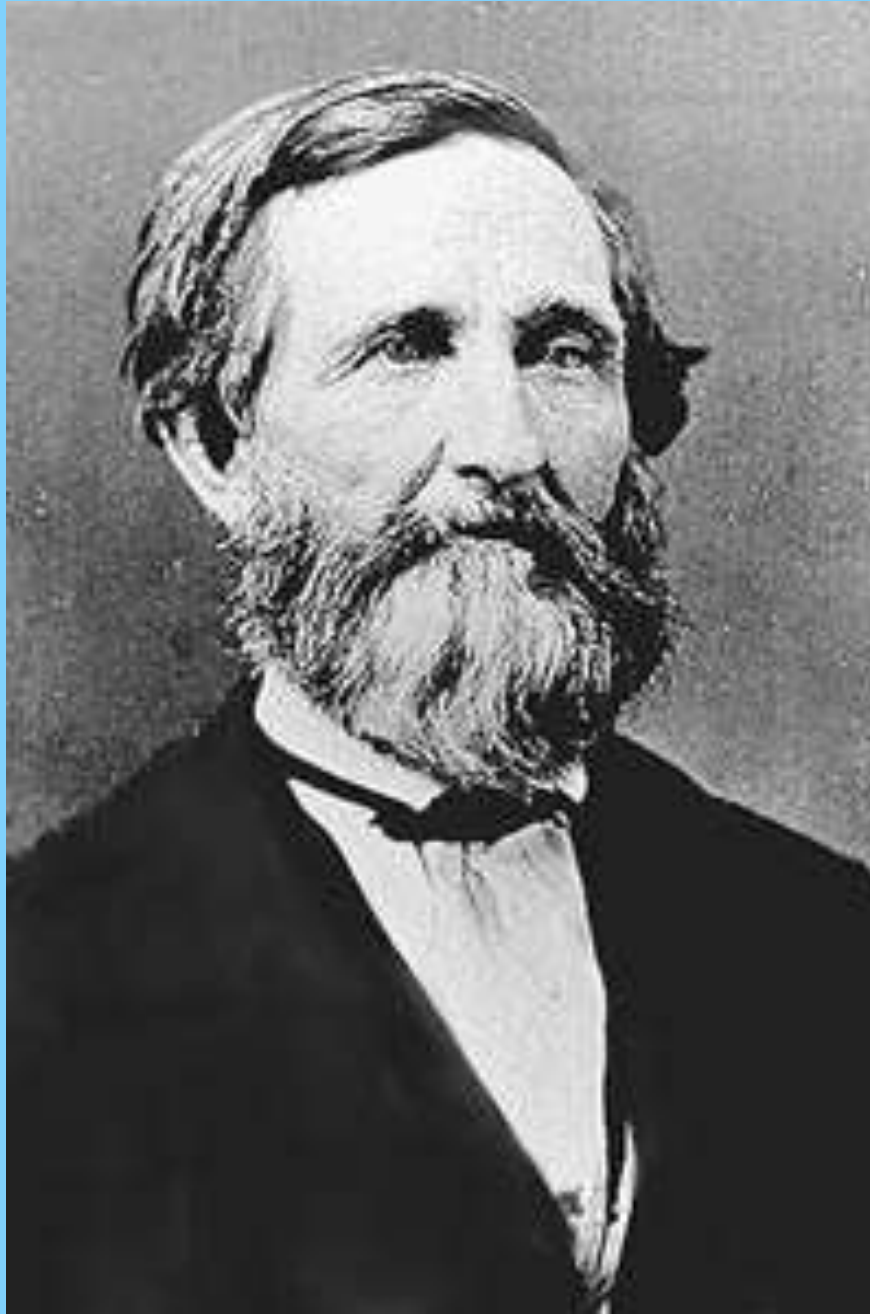








# Crawford Long



# Horace Wells







# Morton Dagherotip















MASSACHUSETTS GENERAL HOSPITAL

Ambulances Only

Main Entrance & Emergency

Fallon  
AMBULANCE









Diabetes



Ether Dome

Neuroendocrinology

# Obstetric anesthesia

- **James Young Simpson – obstetrician, Edinburgh, 4.XI.1847, autoanesthesia**

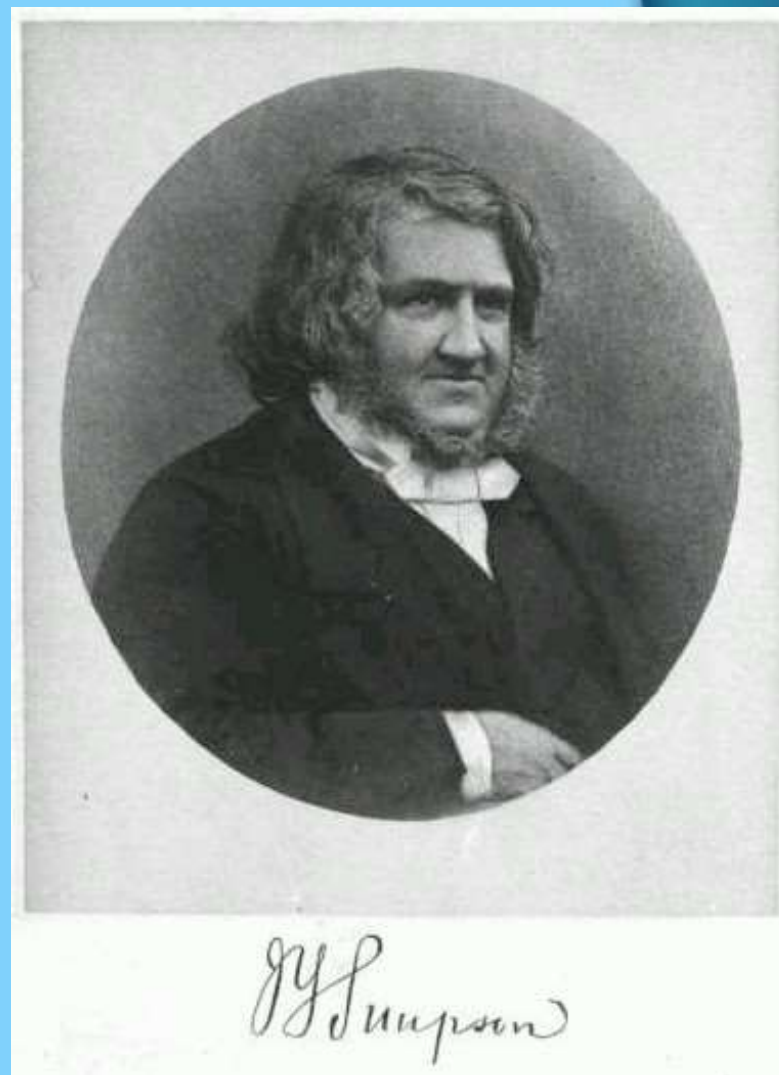
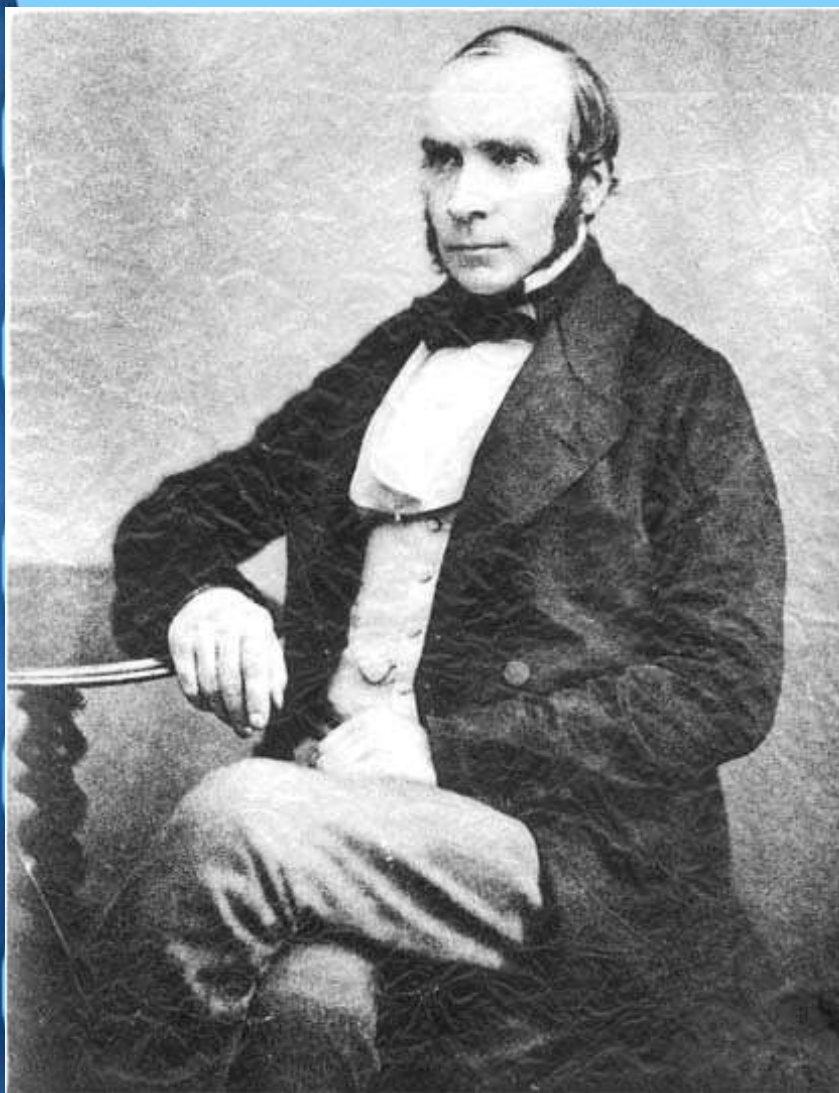
***Answers to the Religious Objections  
Advanced against the Employment of  
Anaesthetic Agents in Midwifery and  
Surgery and Obstetrics***

- **John Snow**

***Dr Snow gave that blessed chlorophorm  
and the effect was soothing, quieting,  
and delightful beyond measure.***

***Queen Victoria***





# Queen Victoria



# GA objectives

- **Analgezia**
- **Hypnosis**
- **Vital and neurovegetative stability, block of the vegetative response to pain**
- **Muscle relaxation**

# **GA steps**

- **Induction**
- **maintenance**
- **Awakening**
- **Postoperative analgesia– Recovery room, PACU**



# **Induction**

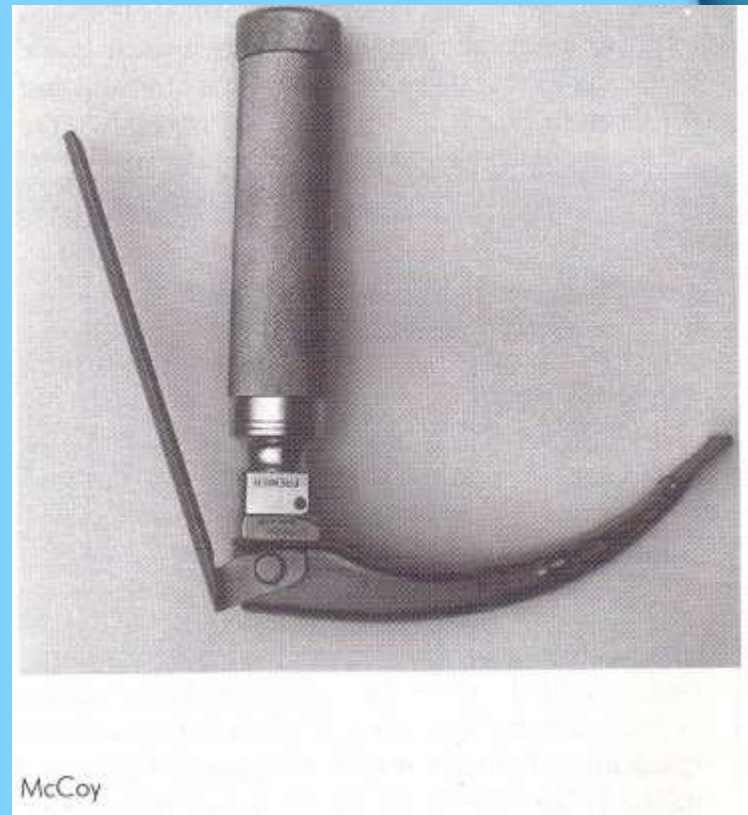
## **Monitoring!!!!**

- **Hypnotics**
  - **Barbiturates – thiopental, metohexital**
  - **Benzodiazepine**
  - **Propofol**
  - **Etomidate**

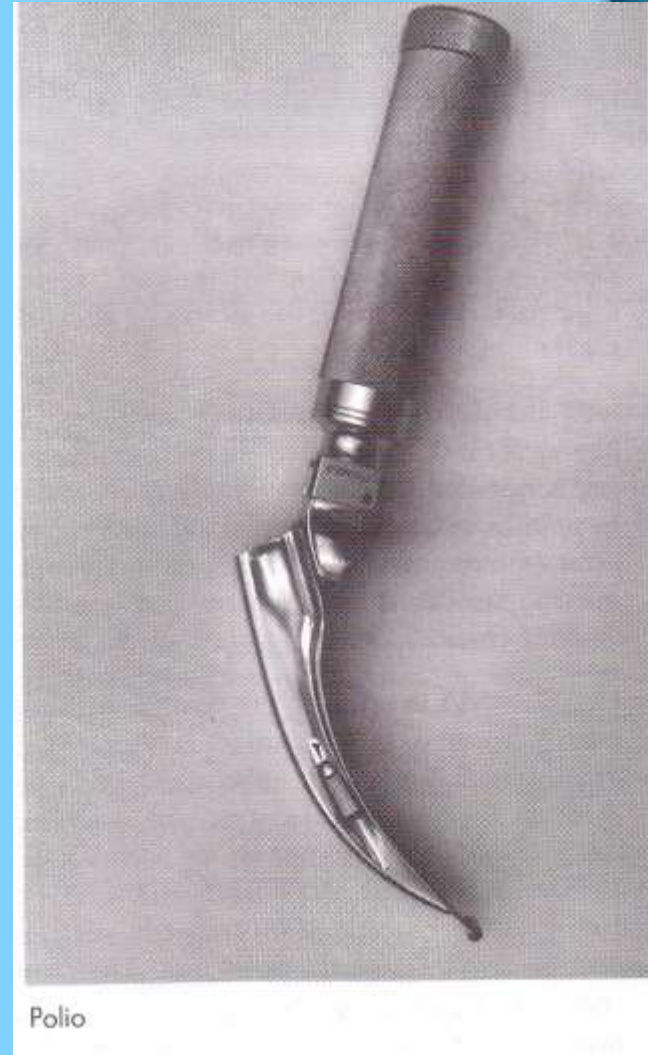
### **Preoxygenation !!!**

- **Rapid sequence induction – crush induction**
- **Relaxation – priming, timing**

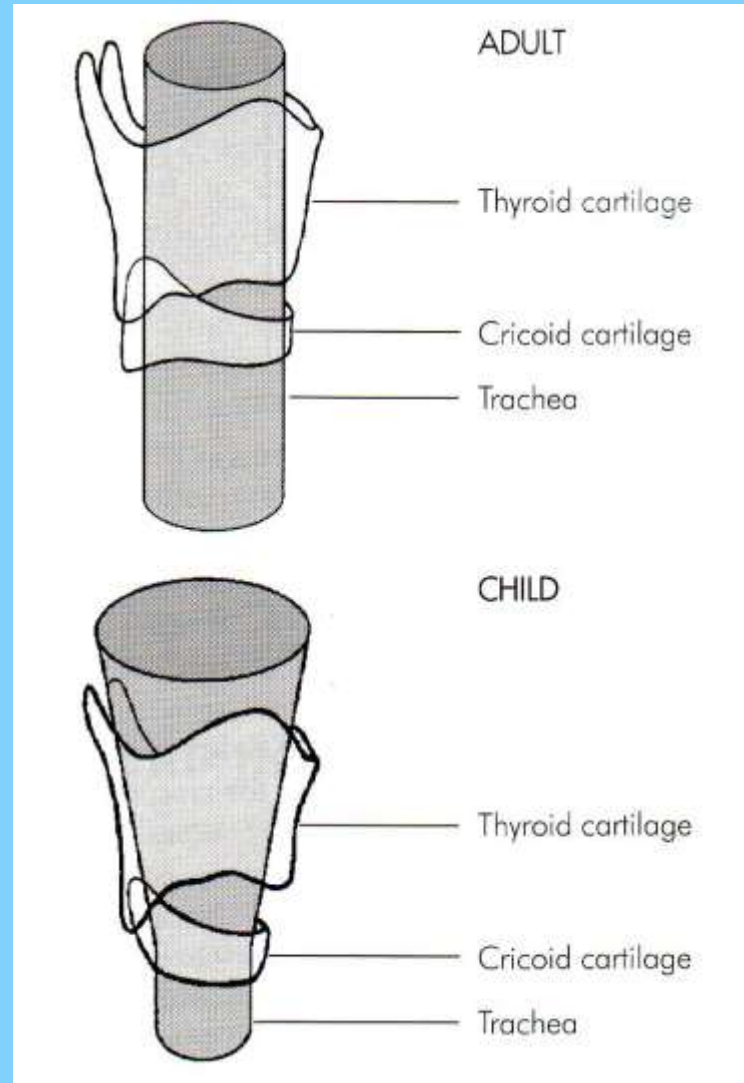
# Laringoscopes



# Laringoscoape

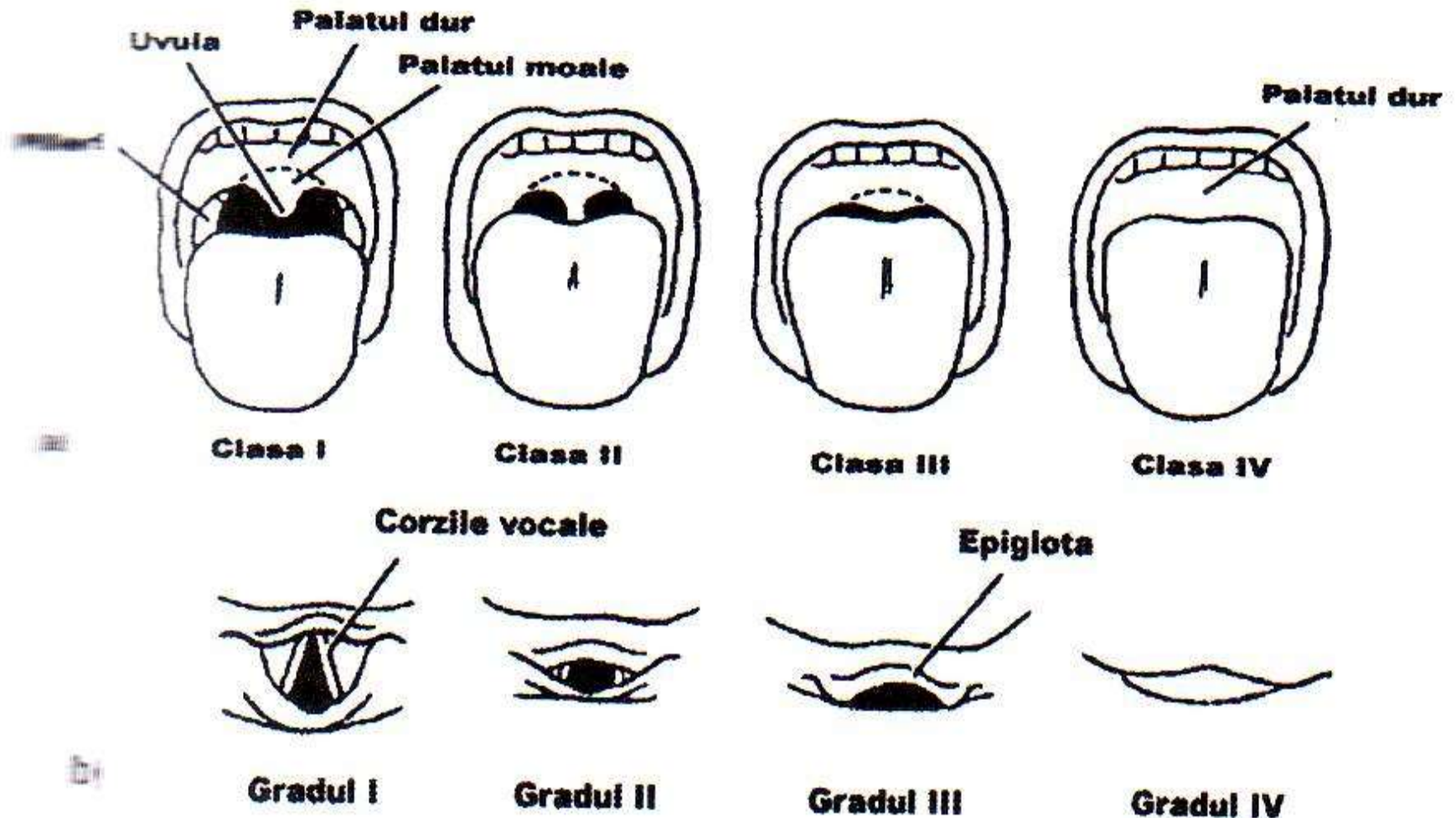


# The adult and child larynx





# Intubation difficulty Mallampati; Cormack și Lehane



# Taft





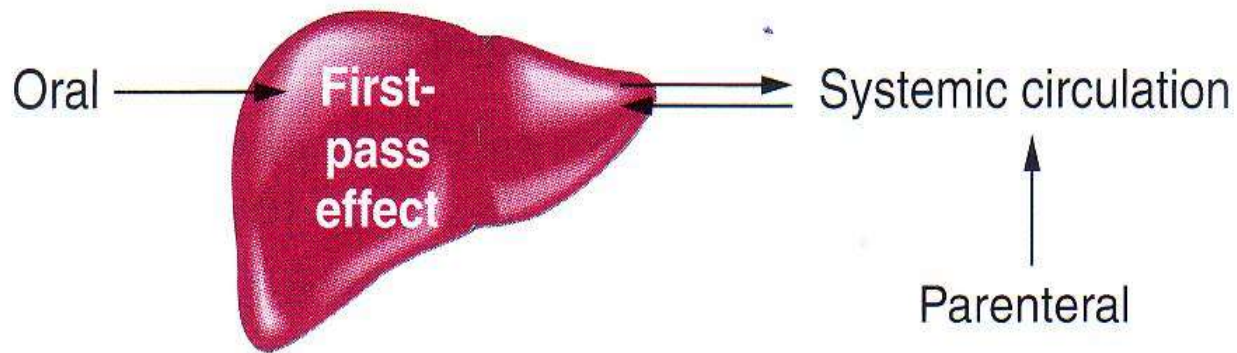


# Tissue compartments

**Table 8-4** Body Tissue Compartments

<b>Compartment</b>	<b>Body Mass (% of a 70-kg Adult)</b>	<b>Blood Flow (% of Cardiac Output)</b>
Vessel-rich group	10	75
Muscle group	50	19
Fat group	20	5
Vessel-poor group	20	1

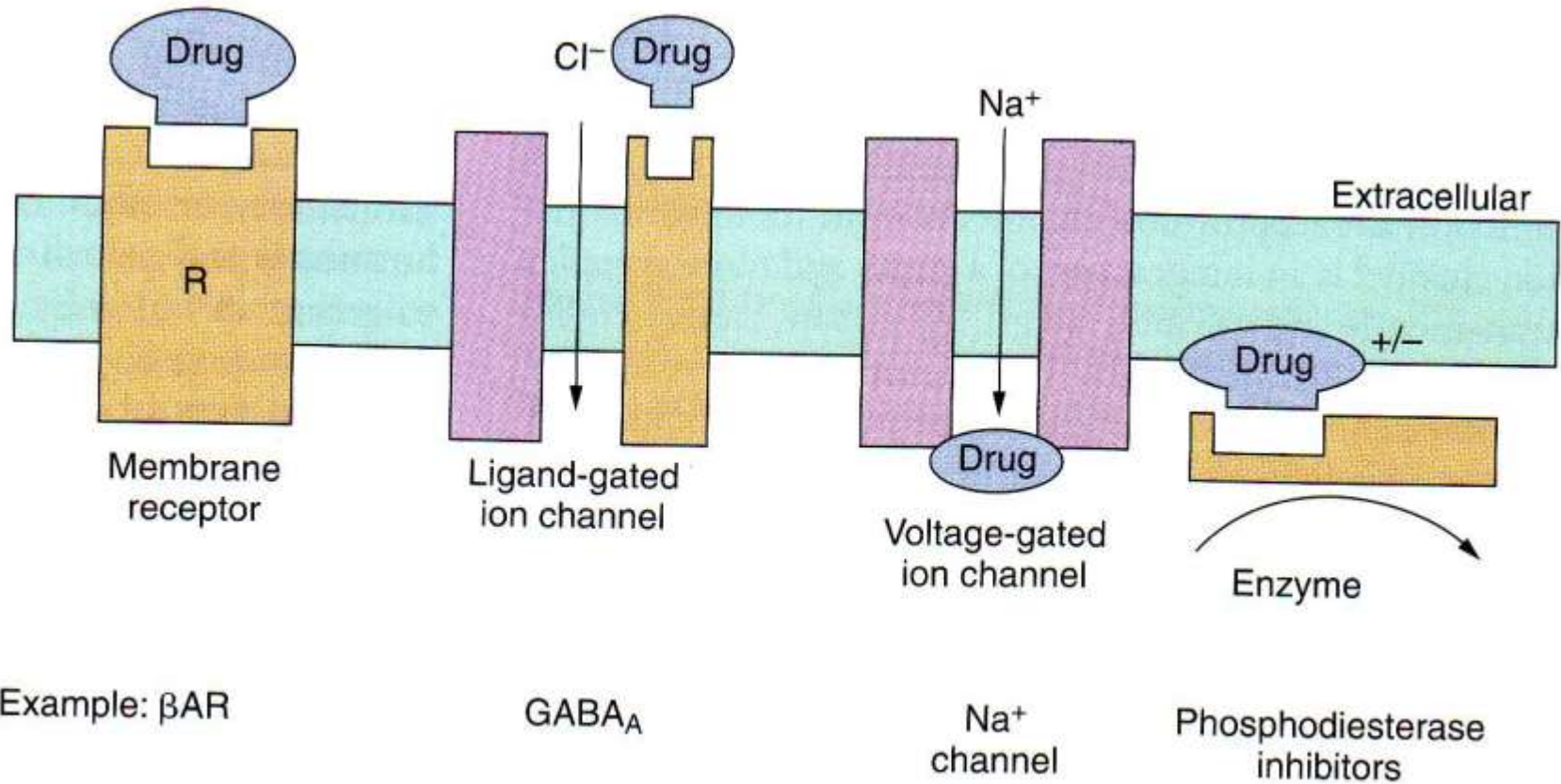




**Table 5-2 Body Tissue Compartments**

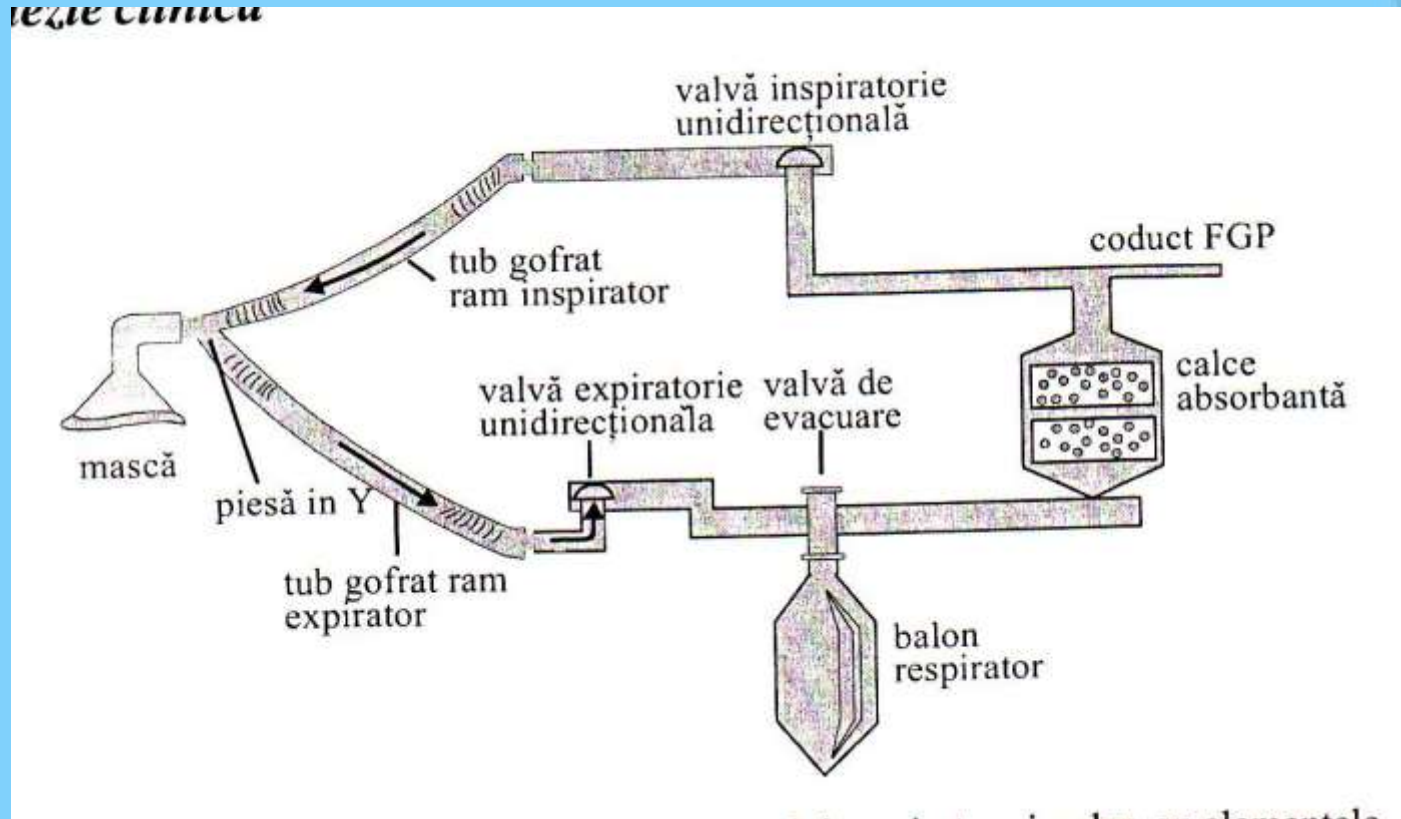
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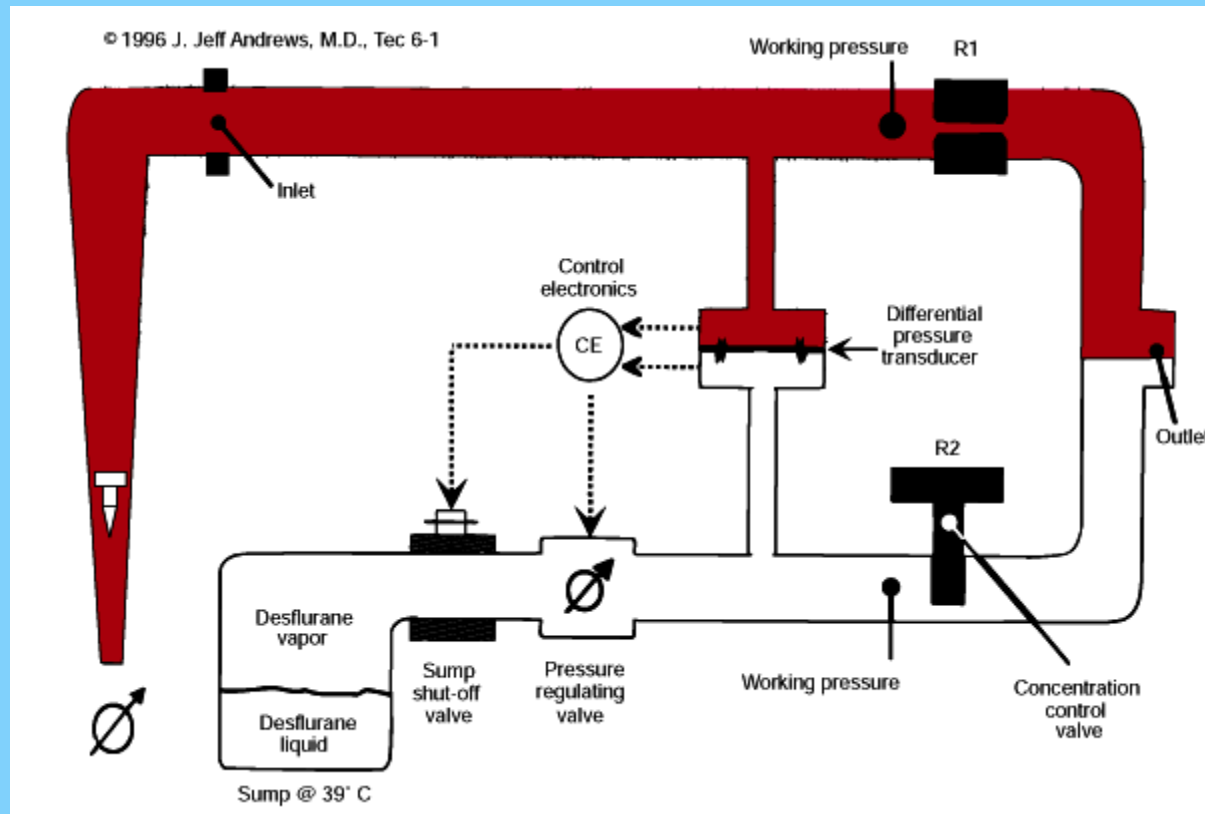
# Receptors and anesthetics





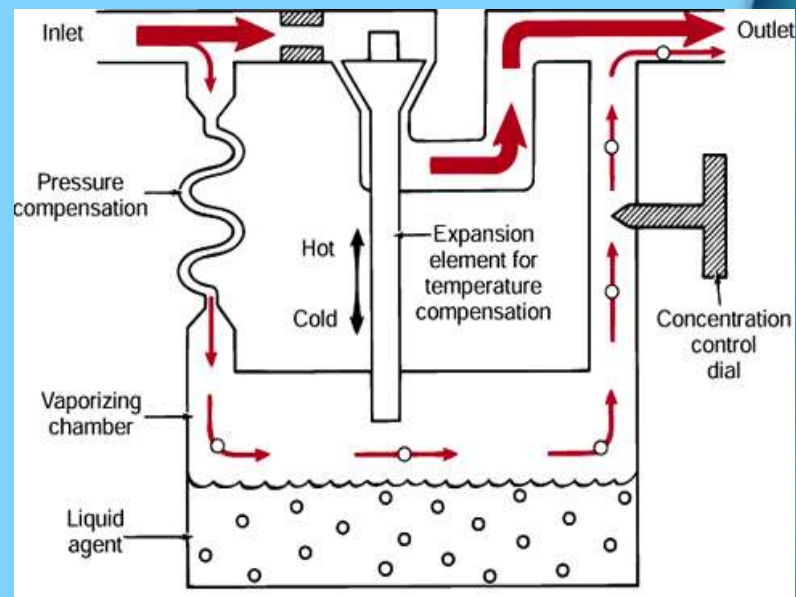
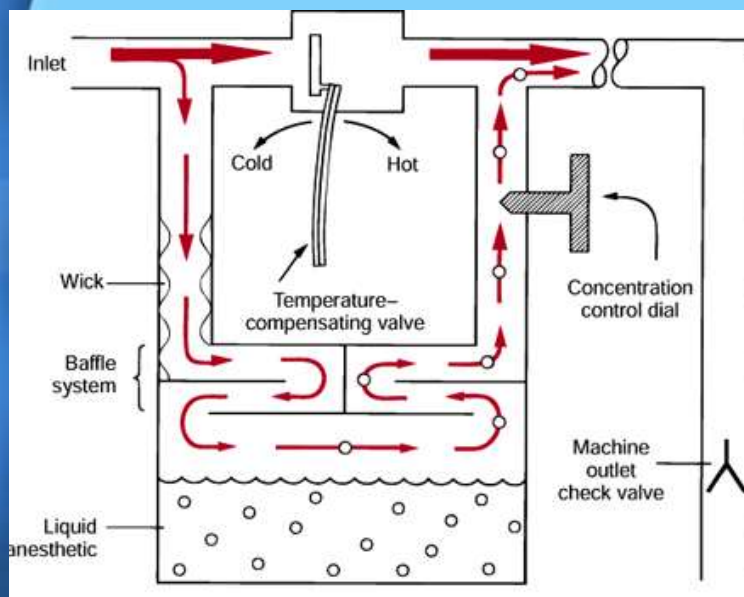
# Circle respiratory system(Sword)





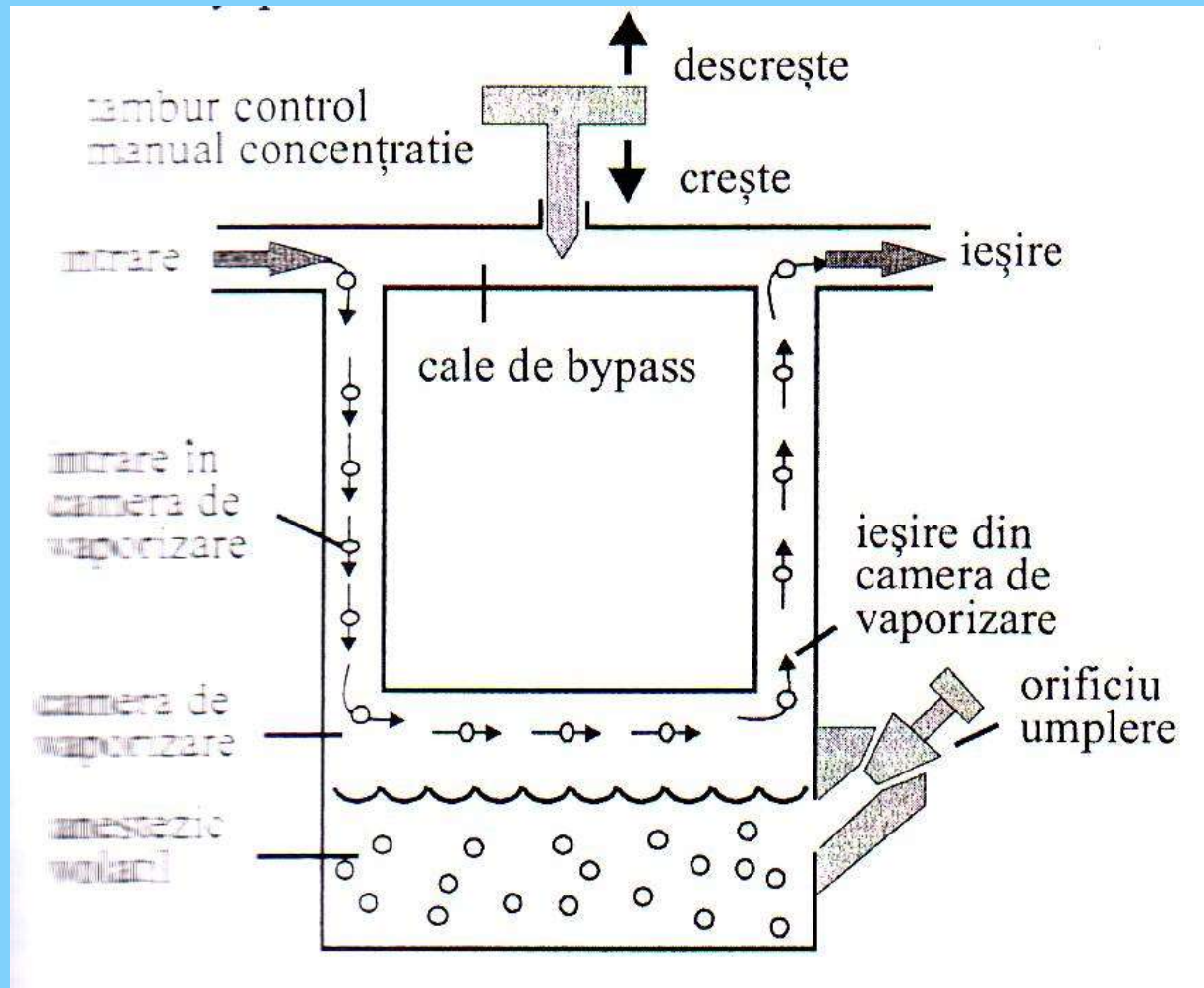


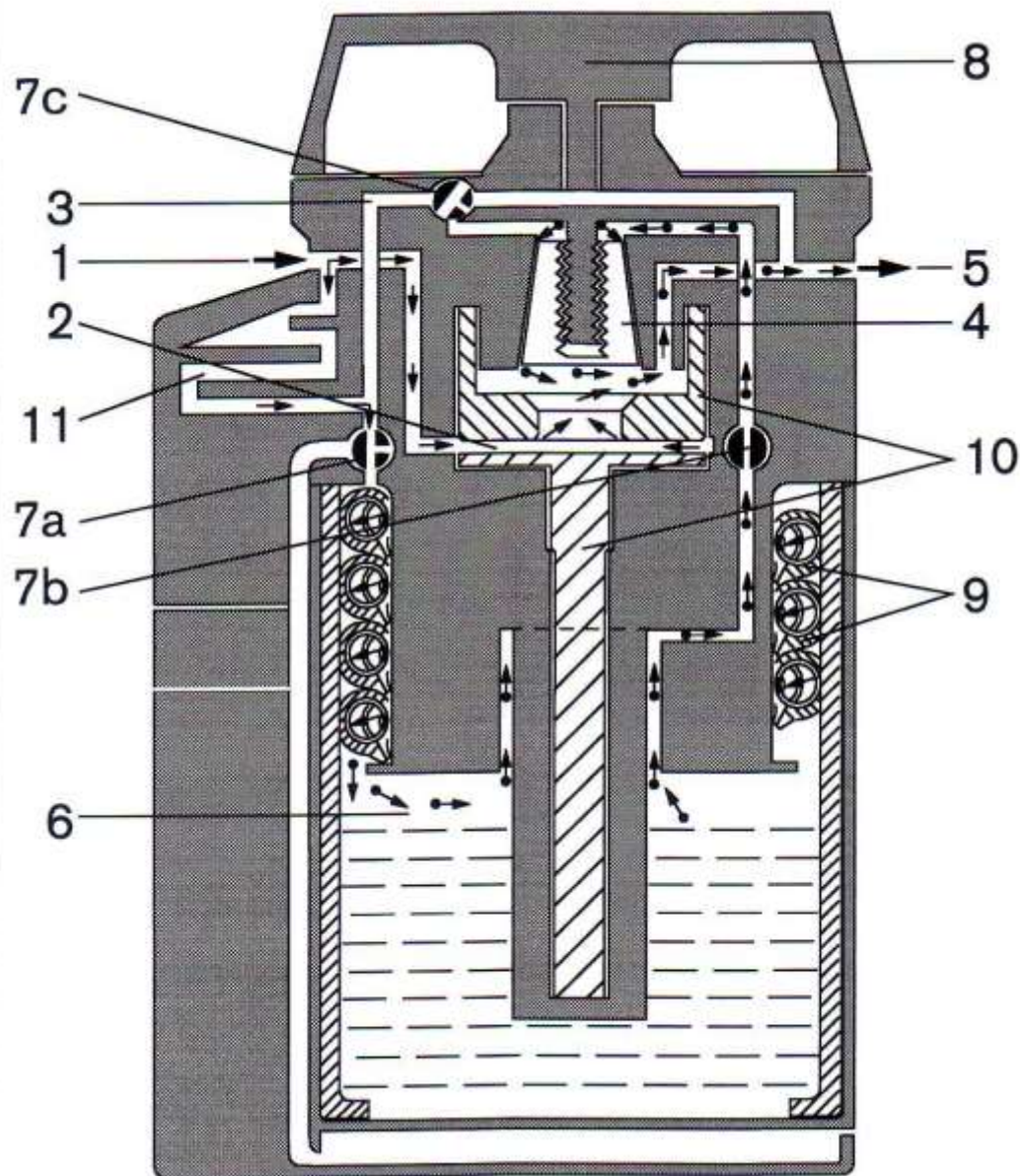




# Vaporizers

## Plenum with variable by-pass



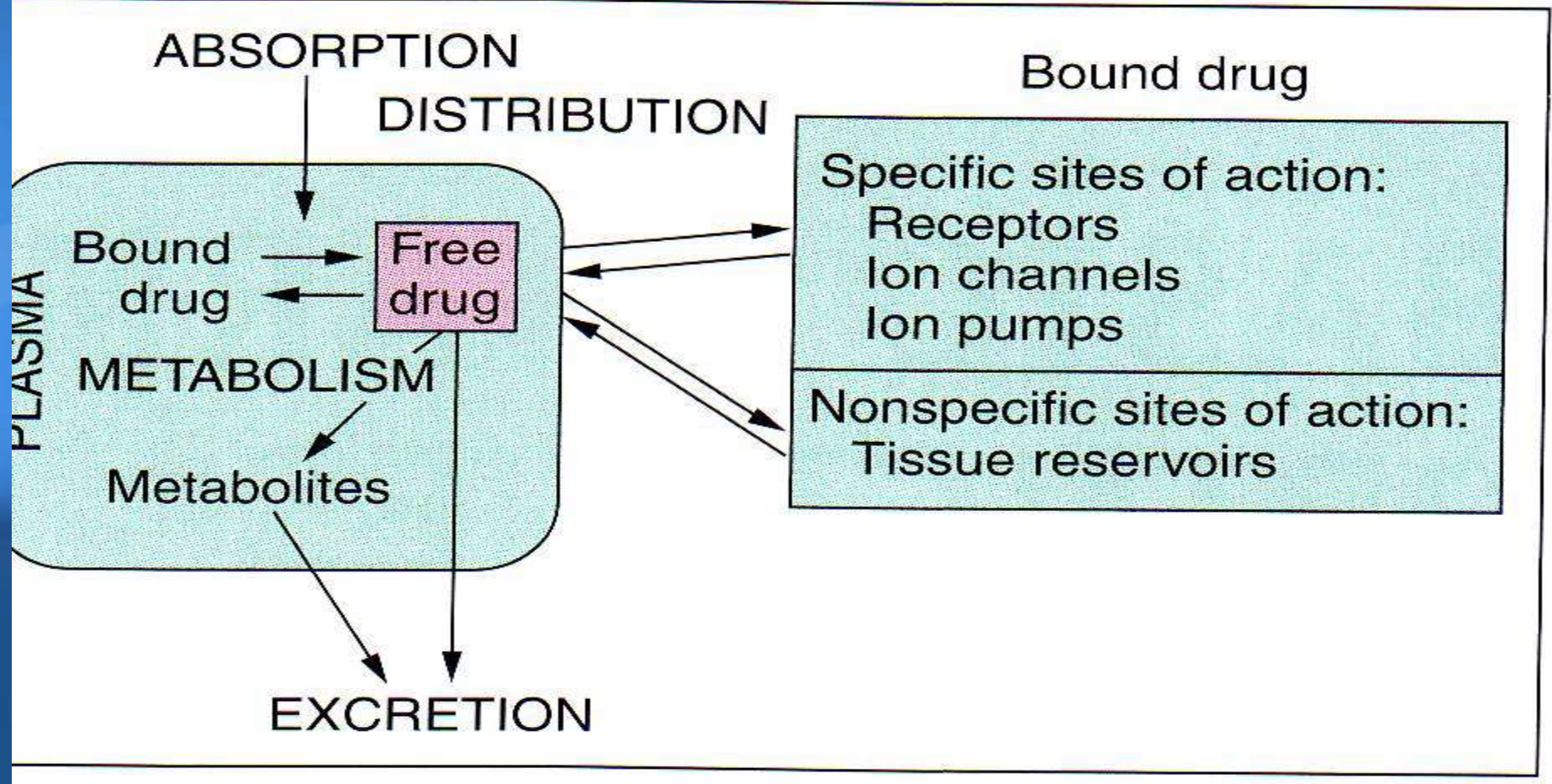


# Anesthetic breathing systems

Type	Reservoir bag	Air source	rebreathing	Name, category
open	No	Environmental air	No	Bag and bottle
Semi-open	No	Air+O <sub>2</sub> from external source	partial	Bag and bottle +occlusive packing
Semi-closed without absorption	yes	Air+O <sub>2</sub> from external source	No	Bain, Modified Jackson-Rees, Ayre's T piece, Lack, Magill
Semi-closed with absorption	yes	Air+O <sub>2</sub> from external source	partial	Co <sub>2</sub> absorbers with leak
Closed	yes	Air+O <sub>2</sub> from external source	complete	Co <sub>2</sub> absorbers, no leak

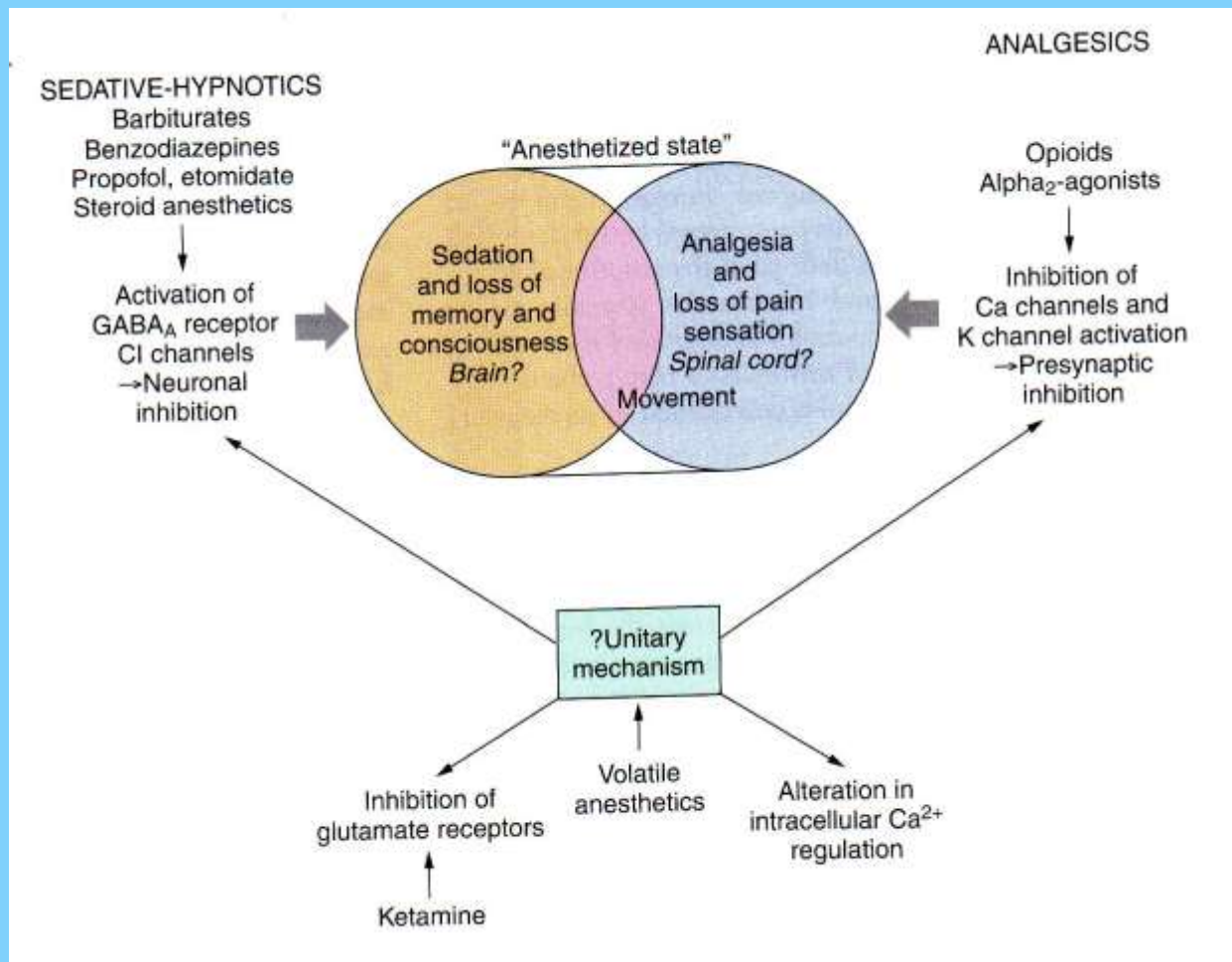


# Absorbtion, metabolism, excretion

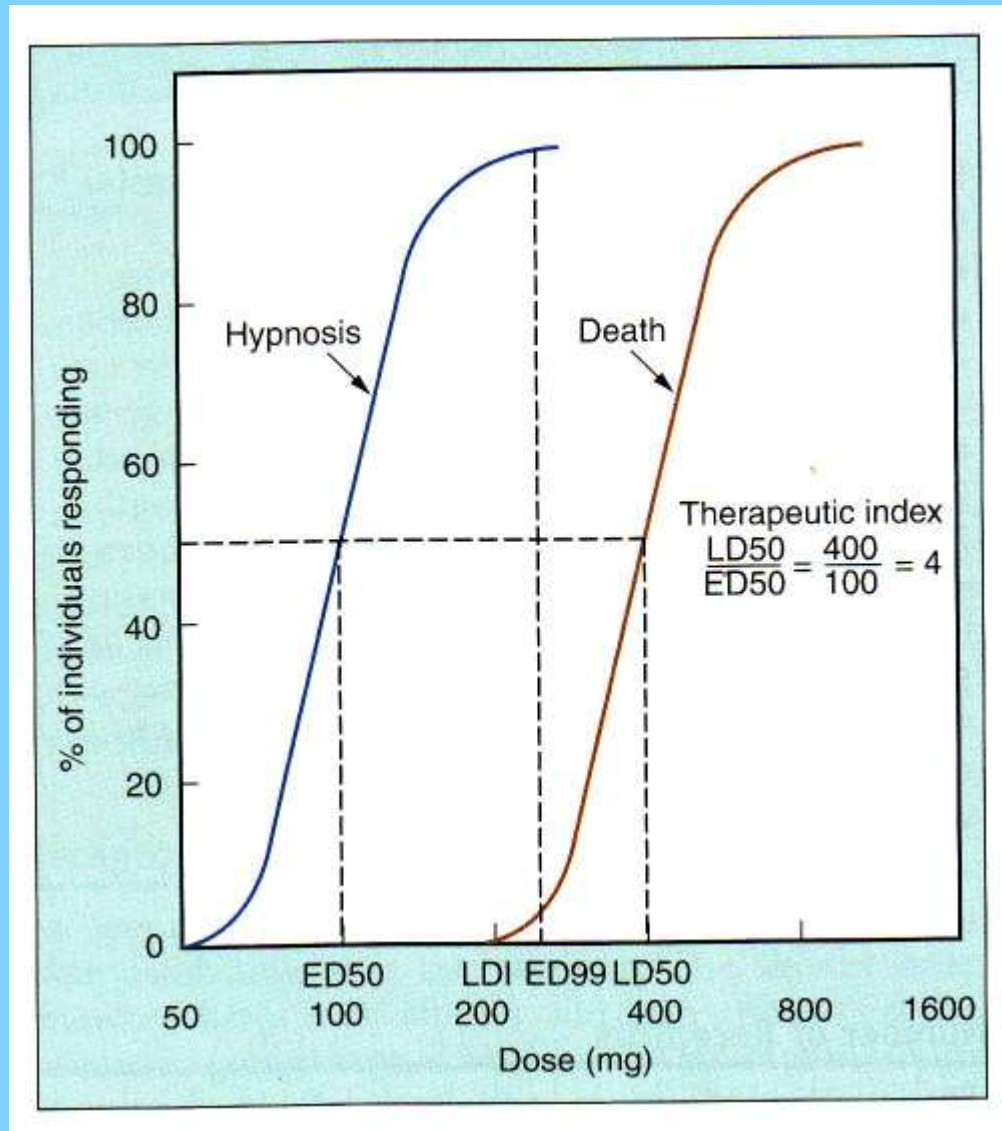




## Major routes of action of sedatives, hypnotics and analgesics specific for volatile anesthetics



# Volatile, BNM



## **Altitude effect on vaporizers**

**↑ pressures**

- **Vaporizoare calibrate în concentrație**
  - **Gas density alterations → ↑ resistance to flow in the vaporization chamber**
  - **↓ vaporizer output and concentration in vol% ↓**  
**Eg:  $p = 2 \text{ atm} \rightarrow \text{conc vol\%} \downarrow \text{ to } 1/2$**
- **Vaporizers with flow measurement**
  - **↓ conc vol% or partial pressure**

# Basic principles in anesthesia

## Farmacokinetics:

- Absorbction
- Distribution
- Metabolization
- Inhaled or PEV administered drugs

$$P_A \leftrightarrow P_a \leftrightarrow P_{cr}$$



# Basic principles in anesthesia<sub>cont</sub>

## Pharmacodynamics

- **Receptors' response to drugs**
- **Effects of mechanisms Eg: drug power**
  - **Agonism**
  - **Antagonism – competitive or noncompetitive**
  - **Additive effect**
  - **Sinergism**

**$P_A$  Alveolar pressure**

**The amount of alveolar anesthetic depends on:**

- **$P_i$  partial pressure in the inspired air**
- **Alveolar ventilation**
- **Ventilatory characteristics of the anesthesia machine**

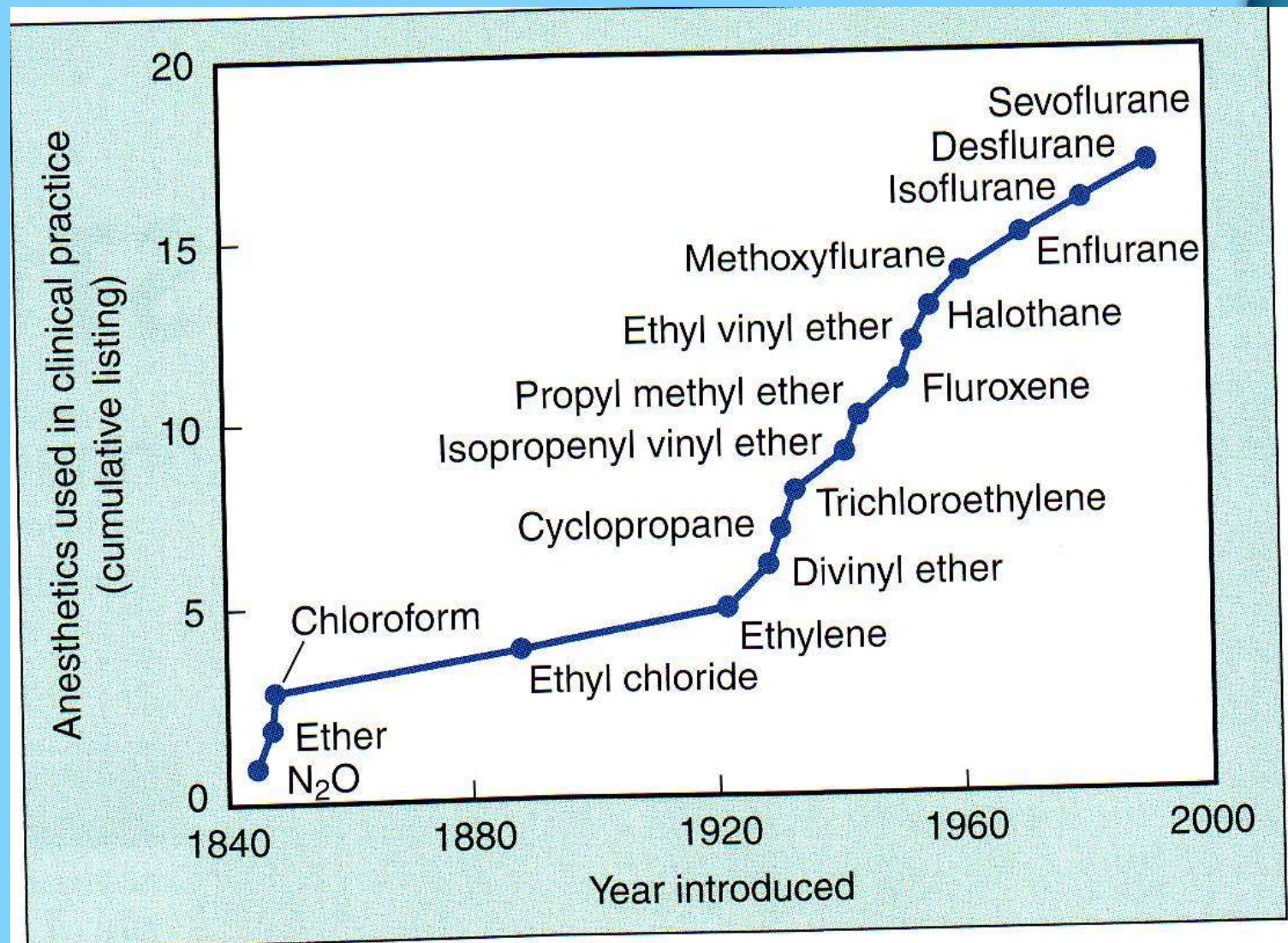
**The amount of anesthetic in the arterial blood depends on:**

- **Anesthetic solubility**
- **Cardiac output**
- **Alveolo-venous gradient**

# **Pi anaesthetic gas effects**

- **Concentration effect- High Pi at induction**
- **2nd gas effect**

# Volatile anesthetics

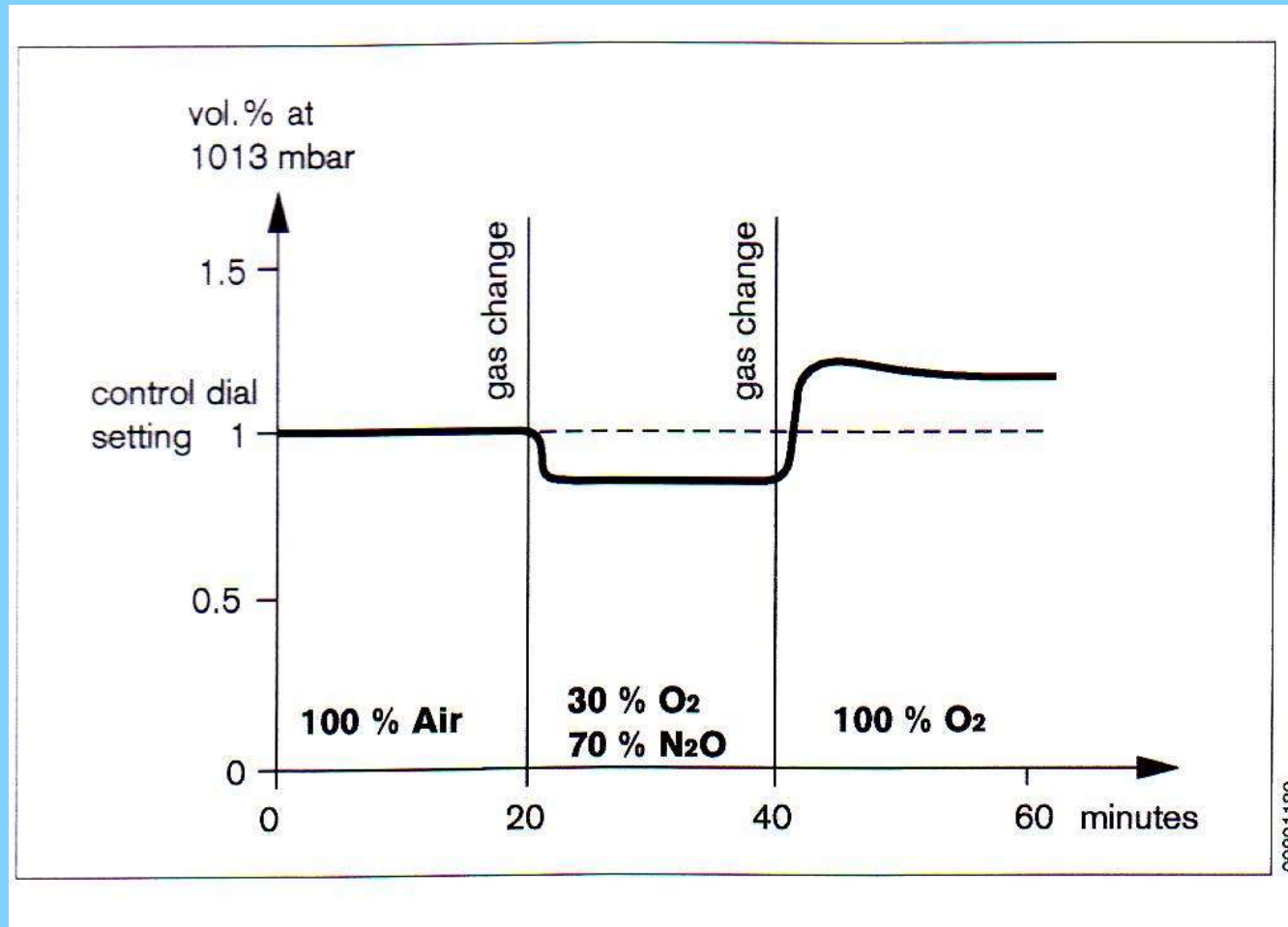




## **$P_A$ & $P_{br}$ determinants**

- $P_A$  = Alveolar offer – overtakes from alveoli to venous pulmonary blood
- Offer:
  - $P_I$
  - $V_A$
  - Respiratory system characteristics
- Overtake:
  - Solubility
  - Cardiac output
  - $D_{A-v}$

# Carrier gas composition and the vaporizer output



# MAC

Factors increasing MAC	Factors decreasing MAC
Drugs: ephedrine, amphetamines, cocaine, ethanol	Benzodiazepines, iv anesthetics, opioids, lithium
Age	Age - increasingly
Hyper, hypothermia	Anemia, hypercarbia, hypothermia

# MAC / MAC awake

**Table 1.** Structured Interview

- 
1. What is the last thing you remember before going to sleep?
  2. What is the first thing you remember waking up?
  3. Do you remember anything between going to sleep and waking up?
  4. Did you dream during your procedure?
  5. What was the worst thing about your operation?
- 

**Table 2.** Awareness Categorization

- 
1. No awareness: no reported awareness or a vague description, or what had been reported had a high probability of occurring in the immediate pre- or postoperative period; i.e., music, people talking, dressing application
  2. Dreaming, possibly associated with awareness
  3. Possible awareness: patient unable to recall any event definitely indicative of awareness
  4. Awareness: recalled event was confirmed by attending personnel, or the investigators were convinced that the memory was real, but no confirmation could be obtained
-



# MAC / MAC awake

Table 1. Structured Interview

1. What is the last thing you remember before going to sleep?
2. What is the first thing you remember waking up?
3. Do you remember anything between going to sleep and waking up?
4. Did you follow any procedure?
5. What about your operation?

**BIS  
ETAG**

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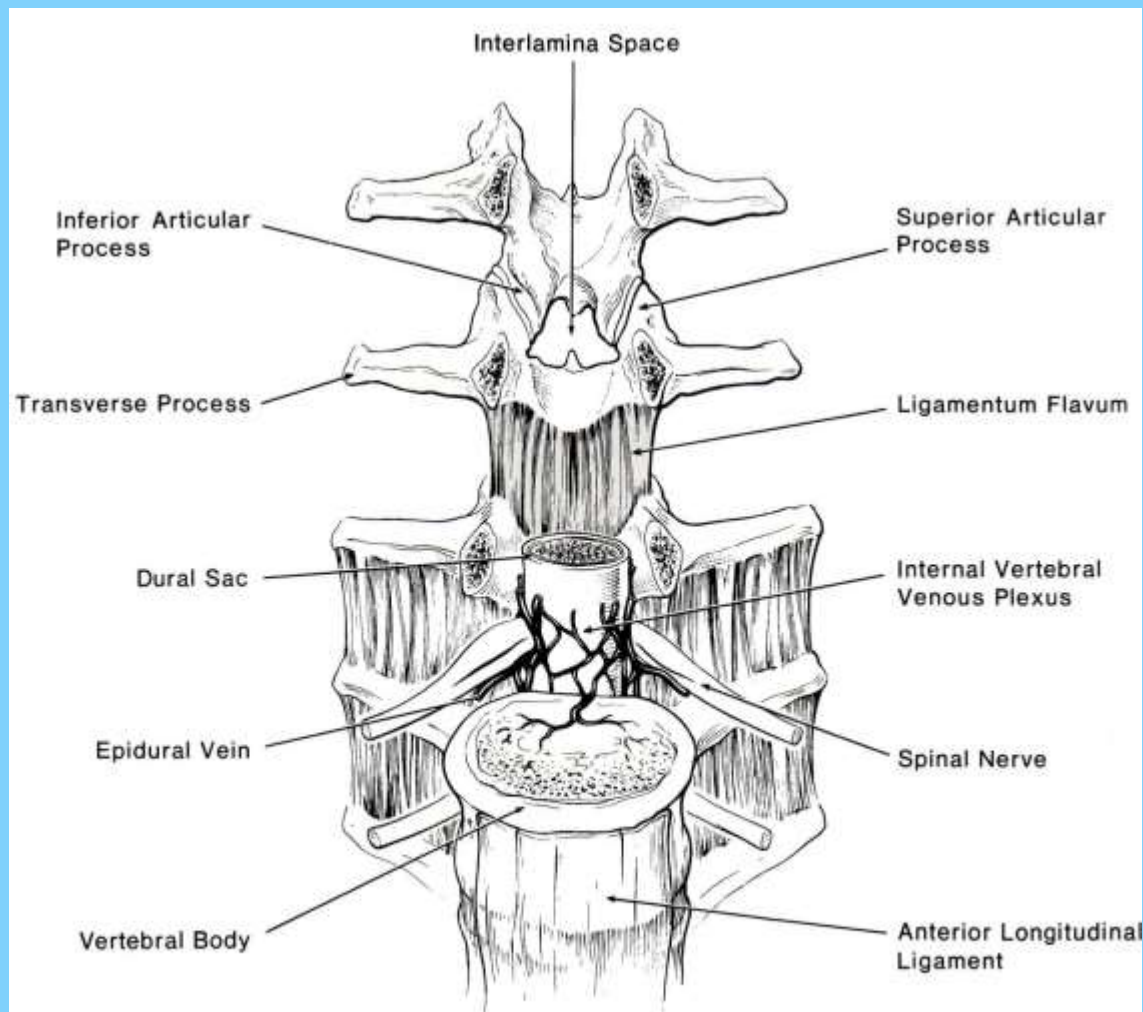


**Table 5–1** Characteristics of Nonionized and Ionized Drug Molecules

<b>Characteristic</b>	<b>Nonionized</b>	<b>Ionized</b>
Pharmacologic effect	Active	Inactive
Solubility	Lipids	Water
Cross lipid barriers (renal tubules, gastrointestinal tract, placenta, blood-brain barrier)	Yes	No
Renal excretion	No	Yes
Hepatic metabolism	Yes	No

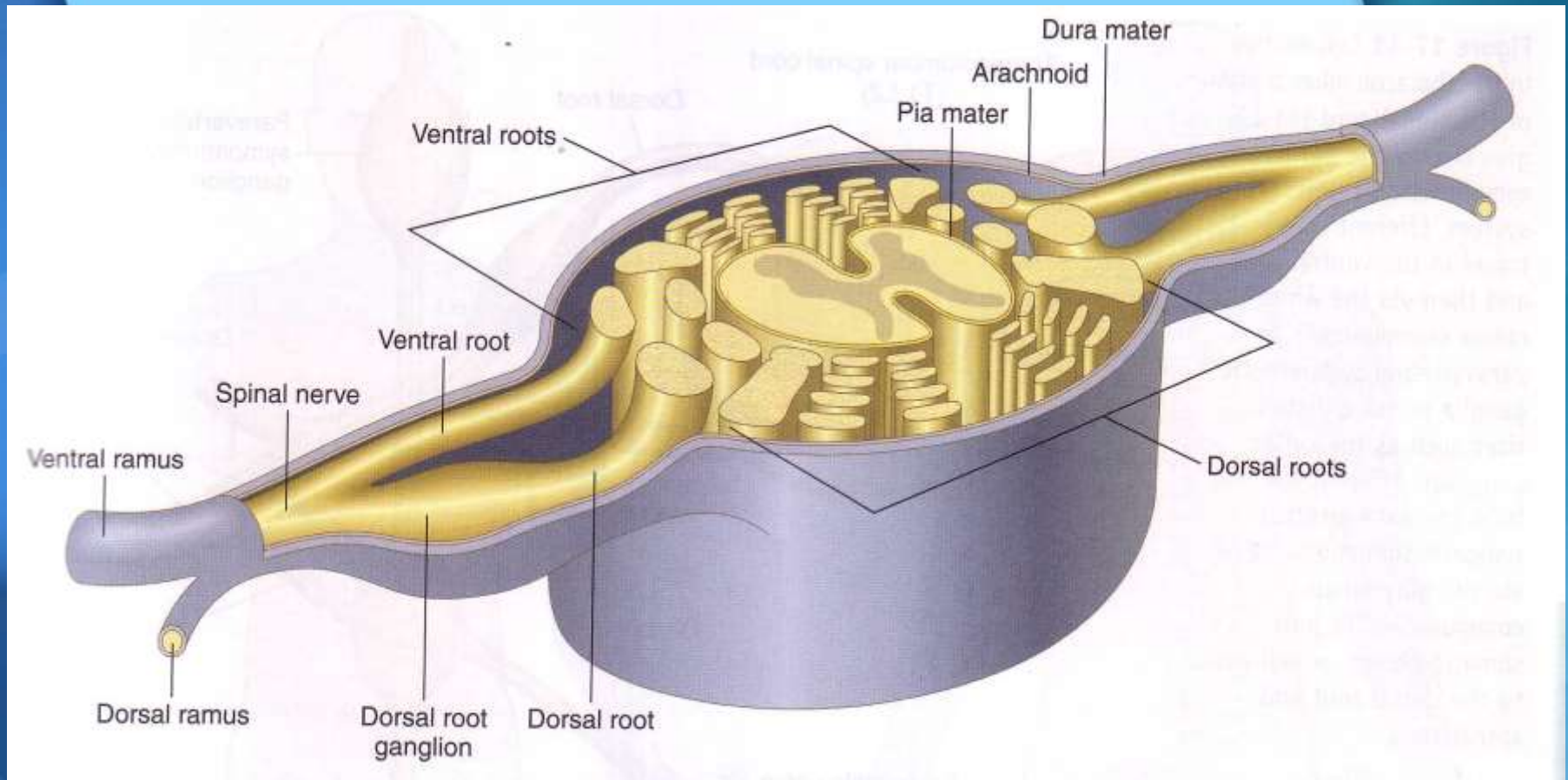


# Spinal anesthesia

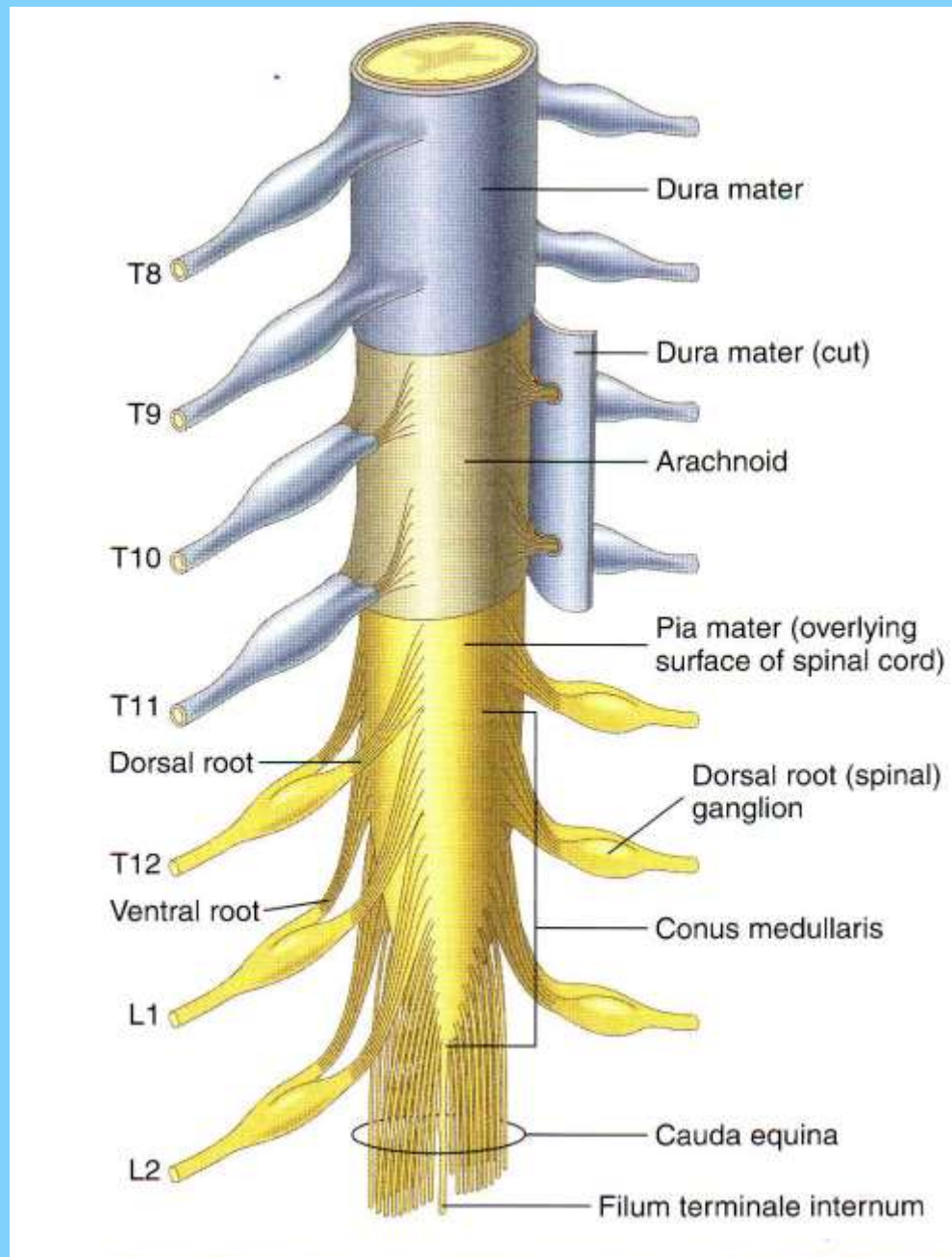


*Fig. 8-6. Epidural space, relationships from anterior view. Note "interlaminar space" at one level and covered by ligamentum flavum at the level below. Epidural veins are in continuity with veins draining vertebral body ("internal vertebral venous plexus"). (Macintosh, R.R.: Lumbar Puncture and Spinal Analgesia. Edinburgh, E. & S. Livingstone, 1957)*

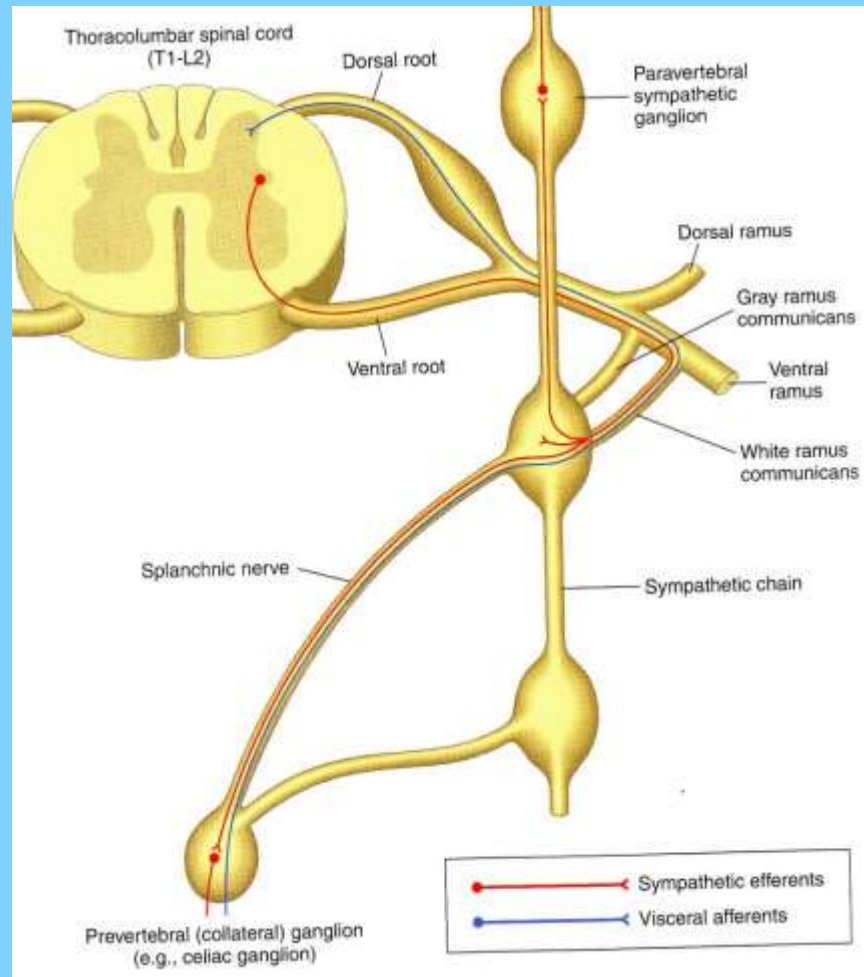
# The spine



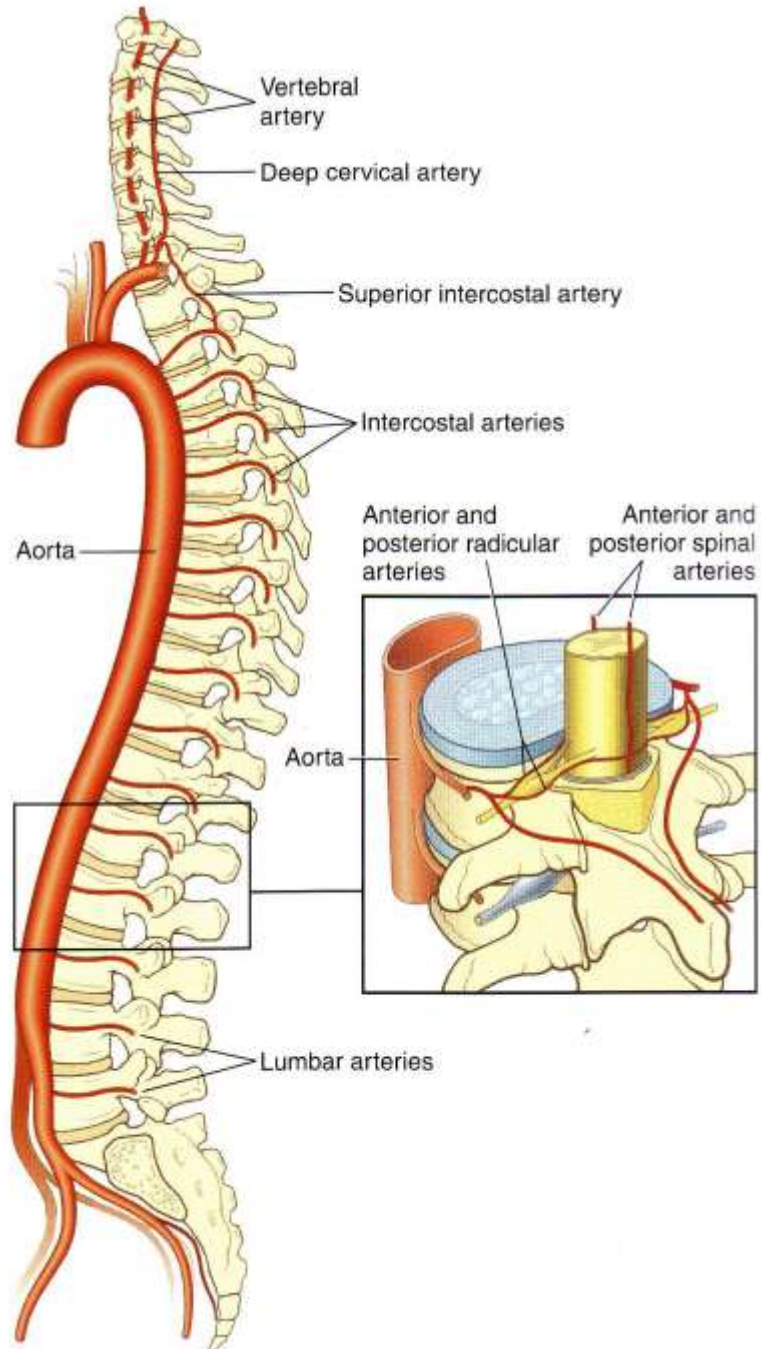




# The spine

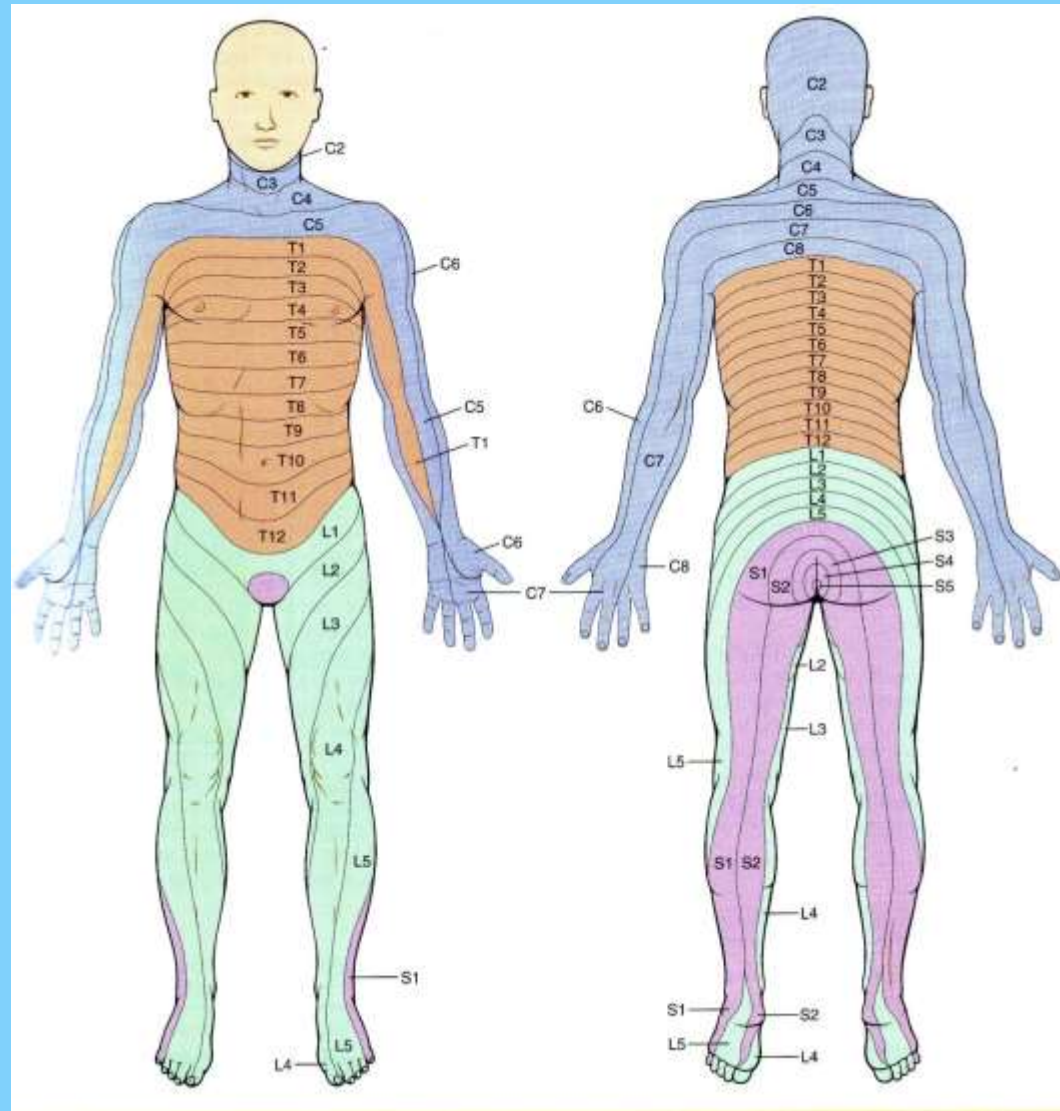


# Spine vessels



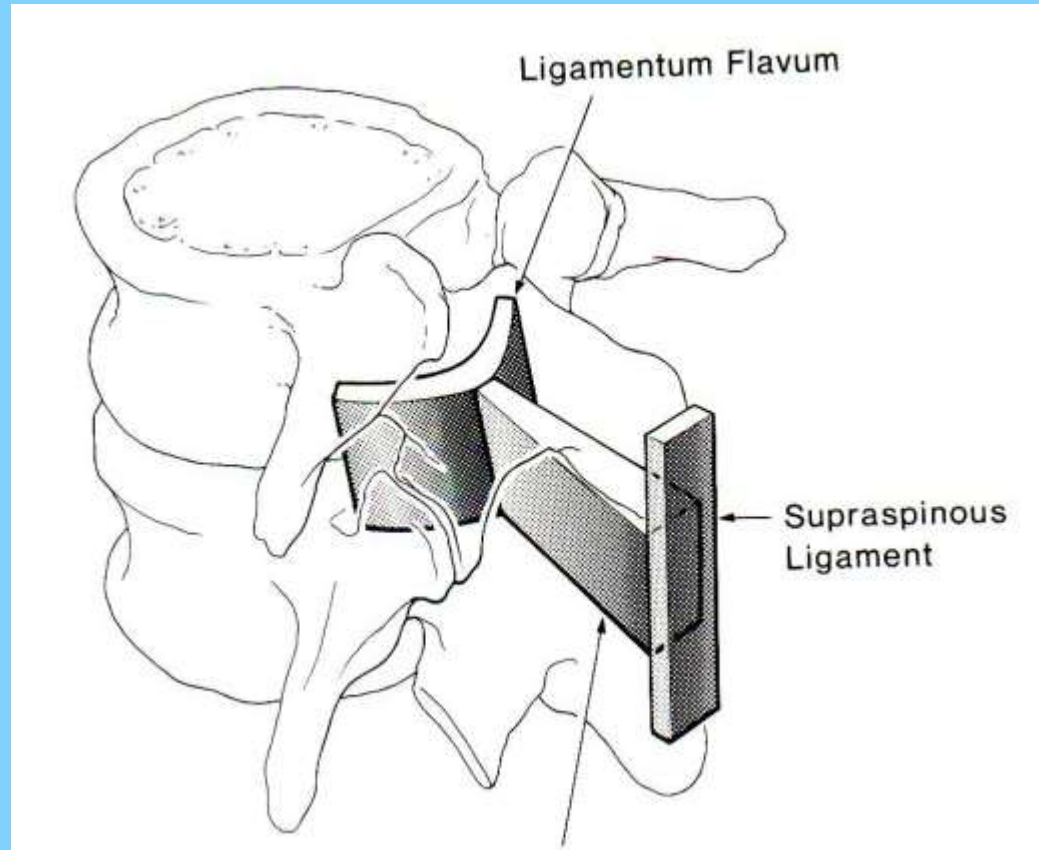
# Dermatomes

## Spinal sensorial innervation areas



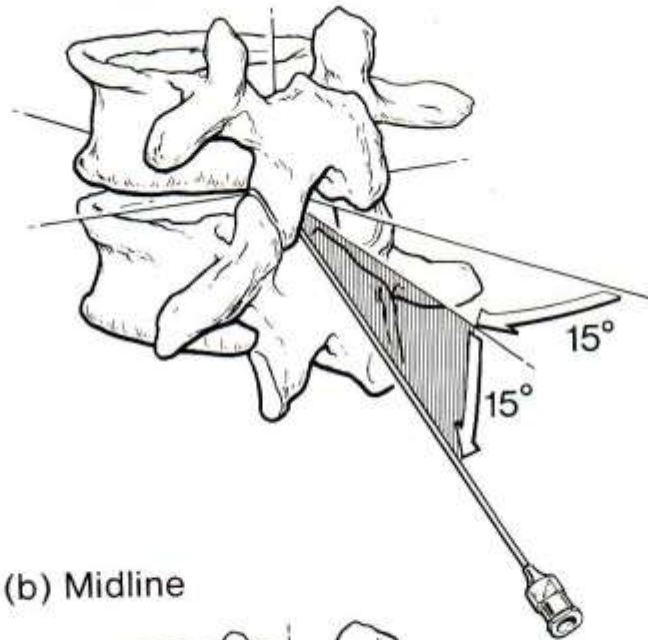


# Anatomy of the vertebral ligg

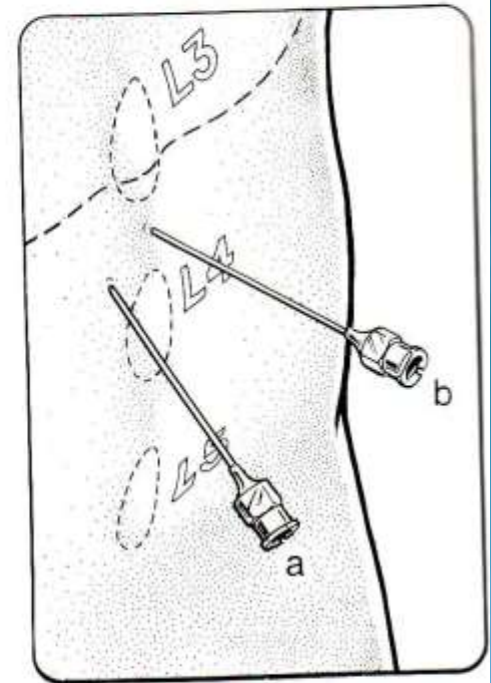
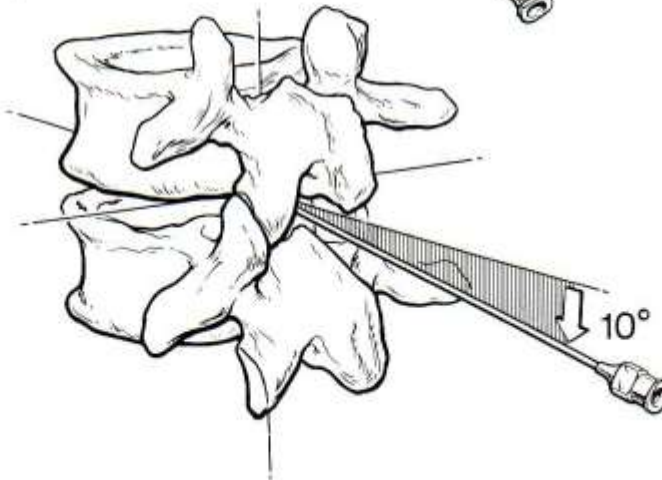


# Median and paramedian (lateral) approach

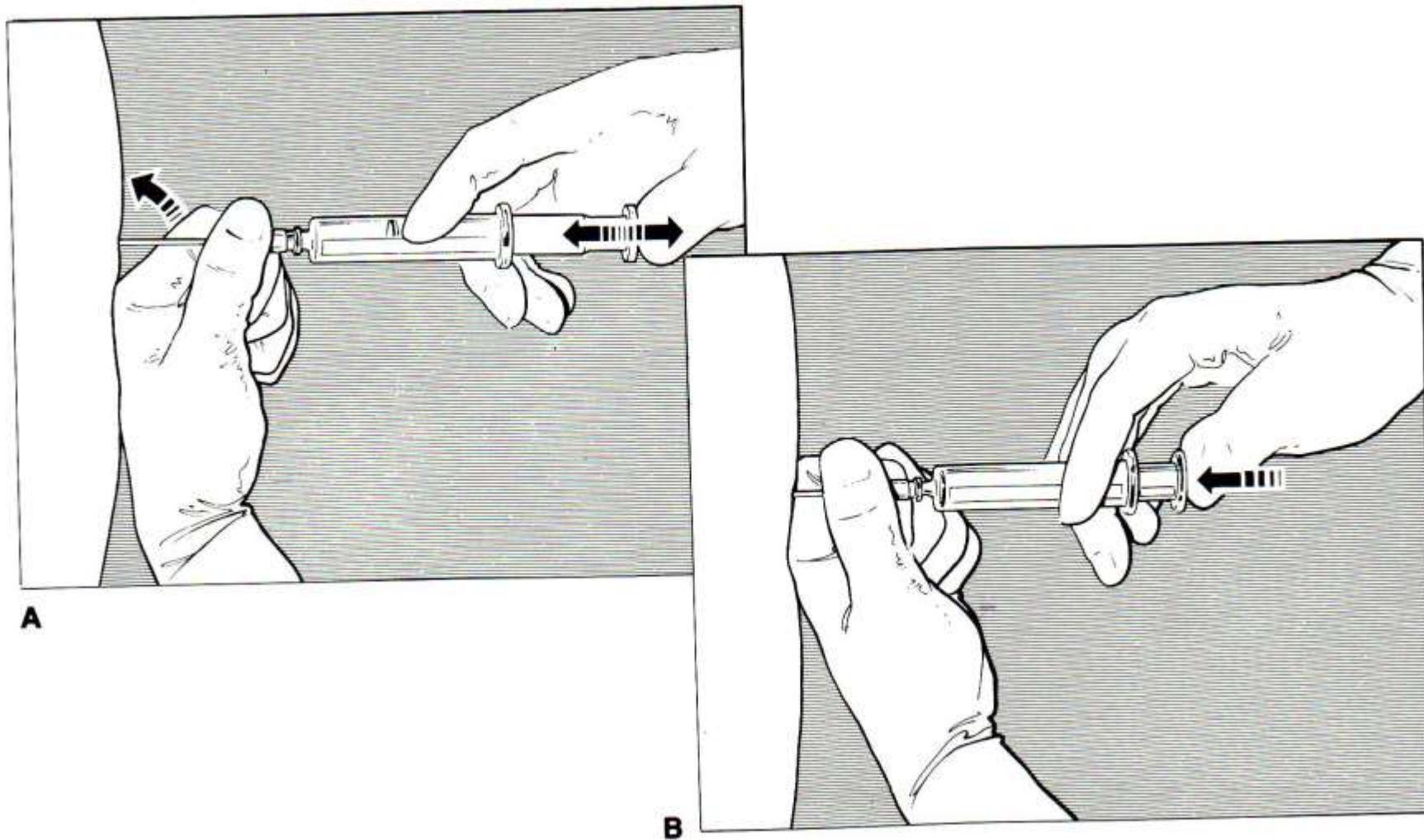
(a) Paraspinous



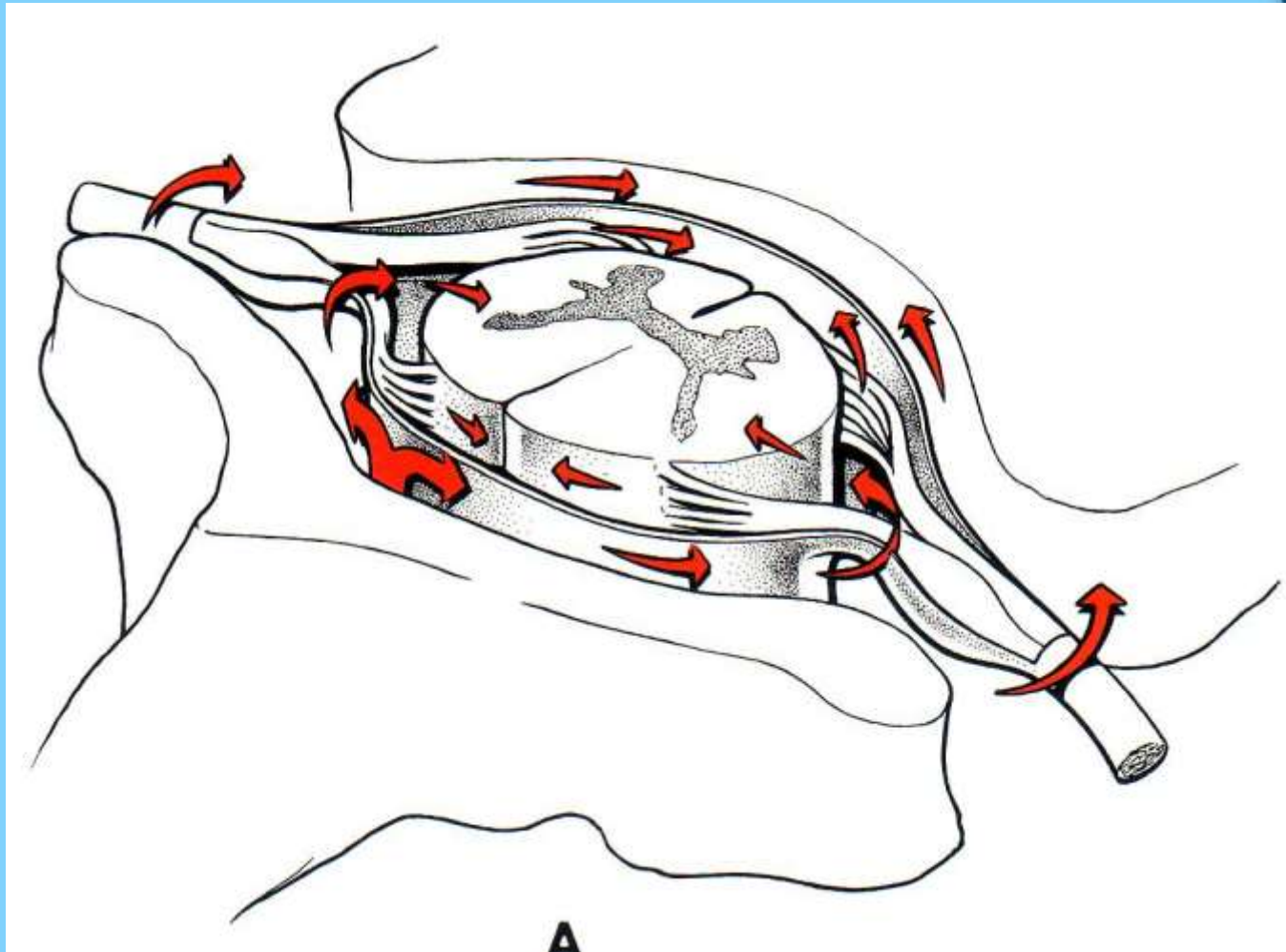
(b) Midline



# Epidural anesthesia–Bromage



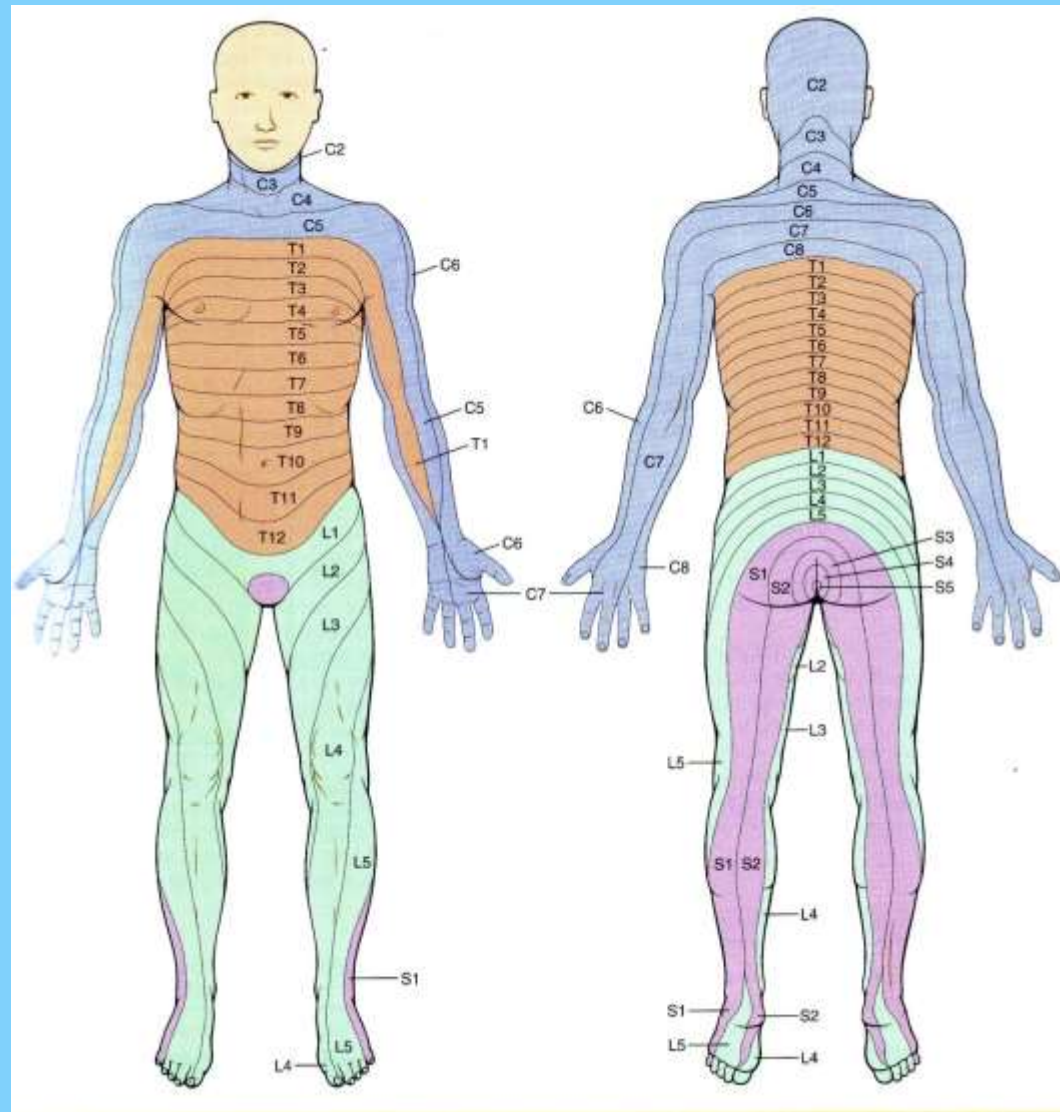
# Horizontal diffusion of local anesthetic during epidural injection



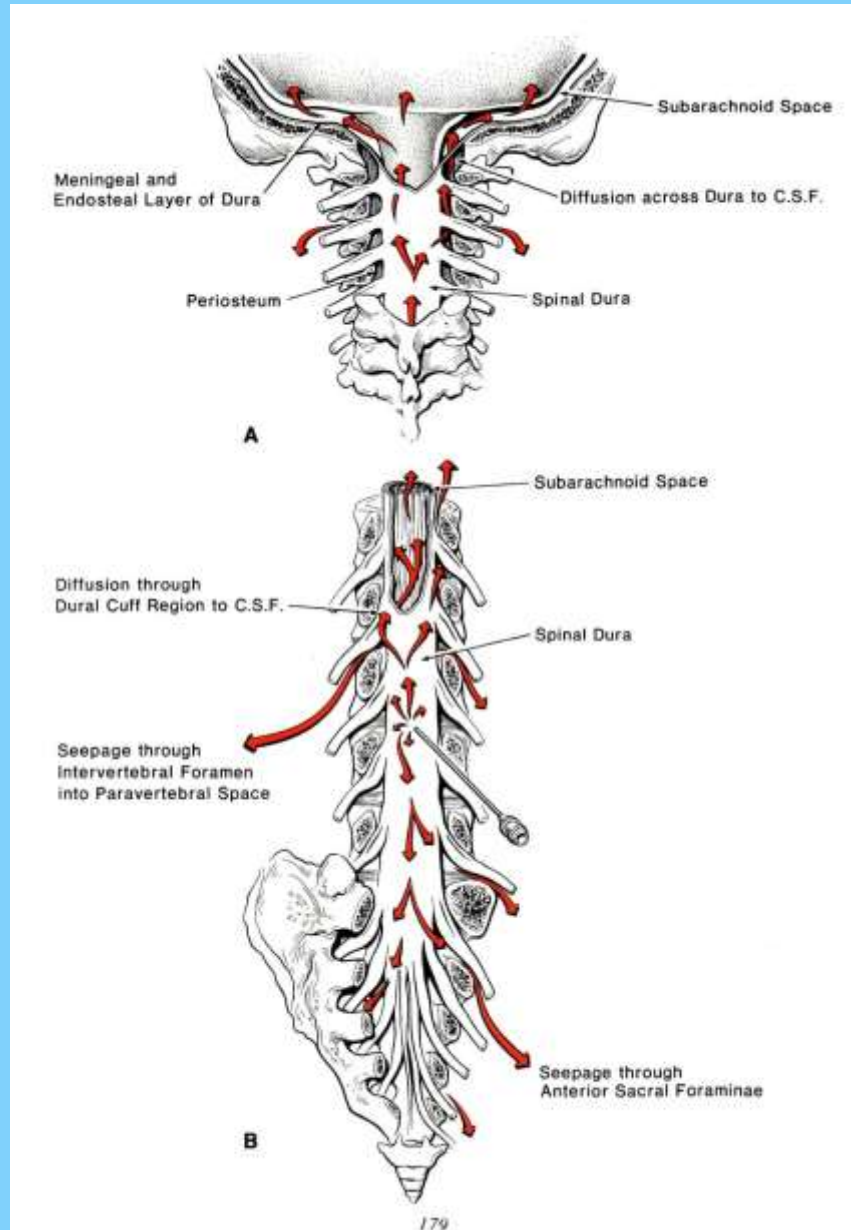


# Dermatomes

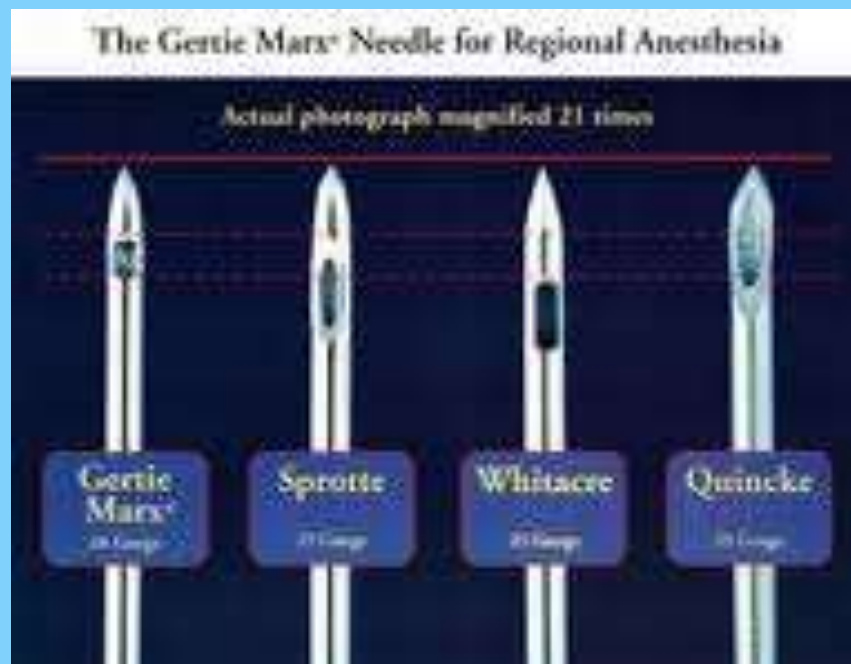
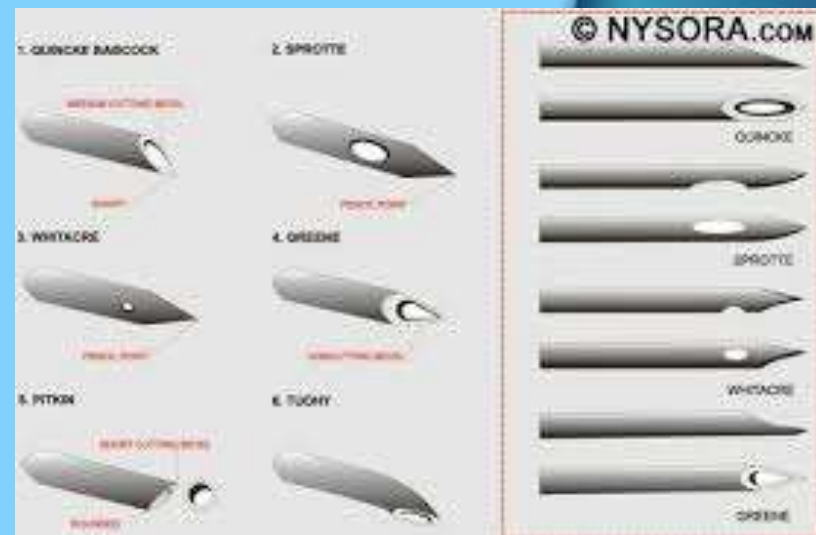
## Sensorial innervation areas



# Vertical epidural diffusion of LA



# Spinal needles' tips



# LA characteristics

- **Strong and efficient in small concentrations**
- **Good penetrability**
- **Rapid action installation**
- **Long duration of action**
- **Reduced systemic toxicity**
- **Nonirritant, non neurogenic injuries**
- **Reversible**
- **Easy to sterilize**



**Karl Koller, 1894, cocaine**



# LA

## Weak bases

**Esthers** : procaine, cocaine, clorprocaine, tetracaine

T1/2 pl minuts

Plasma Colinestheraze

Metabolized to PAB

**Amides**: lidocaine, mepivacaine, bupivacaine, etidocaine, ropivacaine

N-dazalkilation, liver hydrolisis

T1/2: several hrs

# LA action mechanism

- **Block the nervous conduction by lowering the AP that cannot reach the threshold value**
- **Direct interaction with Na<sup>+</sup>channel receptors; passive diffusion in neutral state (more rapid), ionized - linkage to Na<sup>+</sup>channels**

# **Installation speed , duration & intensityAL**

- **Liposolubility: increases power (easily traverse of nervous membranes)**
- **Linkage to plasmatic proteins prolongs effects**
- **Small PKa = more rapid effect (electroneutralitaty favors diffusion)**
- **Acidity delays installation by reducing the nr of nonionized molecules**



# Power and toxicity

<b>LA</b>	<b>Anesthetic power</b>	<b>CNS toxicity</b>	<b>Maximal doses mg</b>	<b>Maximal dosis with epinefrine mg</b>
<b>Procaine</b>	<b>1</b>	<b>1</b>	<b>400</b>	<b>600</b>
<b>Lidocaine</b>	<b>2</b>	<b>3</b>	<b>300</b>	<b>500</b>
<b>Mepivacaine</b>		<b>2</b>	<b>300</b>	<b>500</b>
<b>Bupivacaine</b>	<b>14</b>	<b>12</b>	<b>175</b>	<b>200</b>

# LA' effects on nervous fibers

Type	Myelinisation	Diameter $\mu$	Function
<b>A-<math>\alpha</math></b>	<b>++</b>	<b>6-22</b>	<b>Motor efferents, proprioceptor afferents</b>
<b>A-<math>\beta</math></b>	<b>++</b>	<b>6-22</b>	<b>Motor efferents, proprioceptor afferents</b>
<b>A-<math>\gamma</math></b>	<b>++</b>	<b>3-6</b>	<b>Muscular spin effecrents</b>
<b>A-<math>\delta</math></b>	<b>++</b>	<b>1-4</b>	<b>Pain, touch, temperature afferents</b>
<b>B</b>	<b>+</b>	<b>&lt; 3</b>	<b>Preganglia autonomous</b>
<b>C</b>	<b>-</b>	<b>0,3-1,3</b>	<b>Motor efferents, proprioceptor afferents autonomous postganglia</b>

# **Clinical sequence of conduction anesthesia**

- 1. Sympathetic blockade: sympathetic vasodilation, ↑ skin temperature**
- 2. Loss of pain and thermal sensation**
- 3. Loss of proprioception**
- 4. Tactile and pressure sensations lost**
- 5. Motor paralysis**

# **Complications - severity**

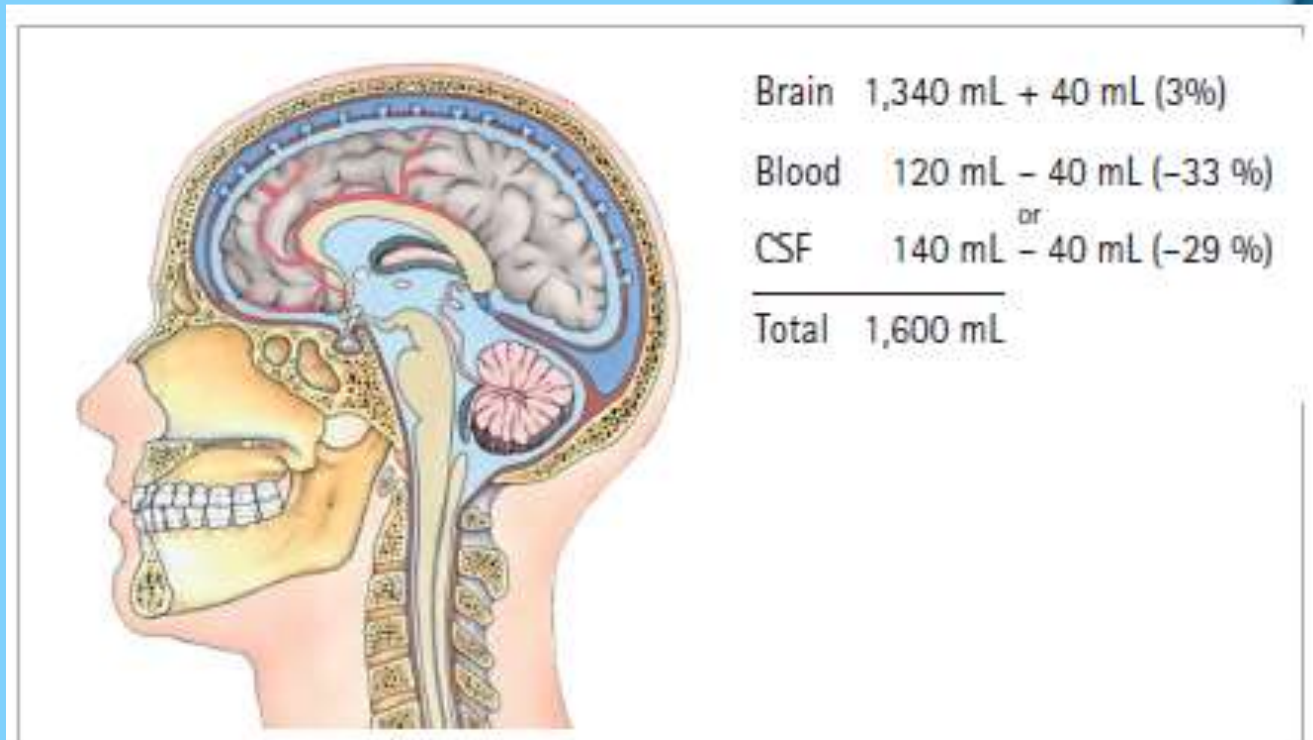
- **Accidents**
- **Incidents**
- **Complications**
- **Pre**
- **Intra**
- **Postoperative**





*High Position on Wall Street*

# What is the normal plasma osmolality??



*Intracranial compartment responses to a change in plasma osmolality: A decrease in plasma osmolality by approximately 3%, say, from 288 to 280 mosmol/kg H<sub>2</sub>O, invariably results in an increase in brain volume by 3%, causing a decrease in blood and/or CSF volume by as much as 30%.*

## Osmolarity vs. osmolality

	Plasma Electrolytes (mmol/l)	Osmotically active species (mosmol/l)	Ringer's acetate (mmol/l)	0.9 % NaCl (mmol/l)
Na <sup>+</sup>	142	142	130	154
K <sup>+</sup>	4,5	4,5	5	
Ca <sup>2+</sup>	2,5	1,3*	1	
Mg <sup>2+</sup>	1,25	0,7*	1	
CL <sup>-</sup>	103	103	112	154
HCO <sub>3</sub> <sup>-</sup>	24	24		
Phosphate <sup>2-</sup>	1	1		
Sulfate <sup>2-</sup>	0,5	0,5		
Organic acids	1,5	1,5	27	
Proteinate <sup>-</sup>	20	1		
Glucose		5		
Urea		5		
Σ	Σ = 291		Σ = 276	Σ = 308
Theoretical osmolarity (mosmol/l)	291		276	308
Water content (%)	94		99,7	99,7
Theoretical osmolality (mosmol/kg H <sub>2</sub> O)	310		276	308
Osmotic coefficient	0,926		0,926	0,926
Actual osmolality (mosmol/kg H <sub>2</sub> O)	287		256	286
Measured osmolality** (mosmol/kg H <sub>2</sub> O)	288		256	286

\* Because of protein binding

\*\* Freezing point depression