Local Anesthesia

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Definition:

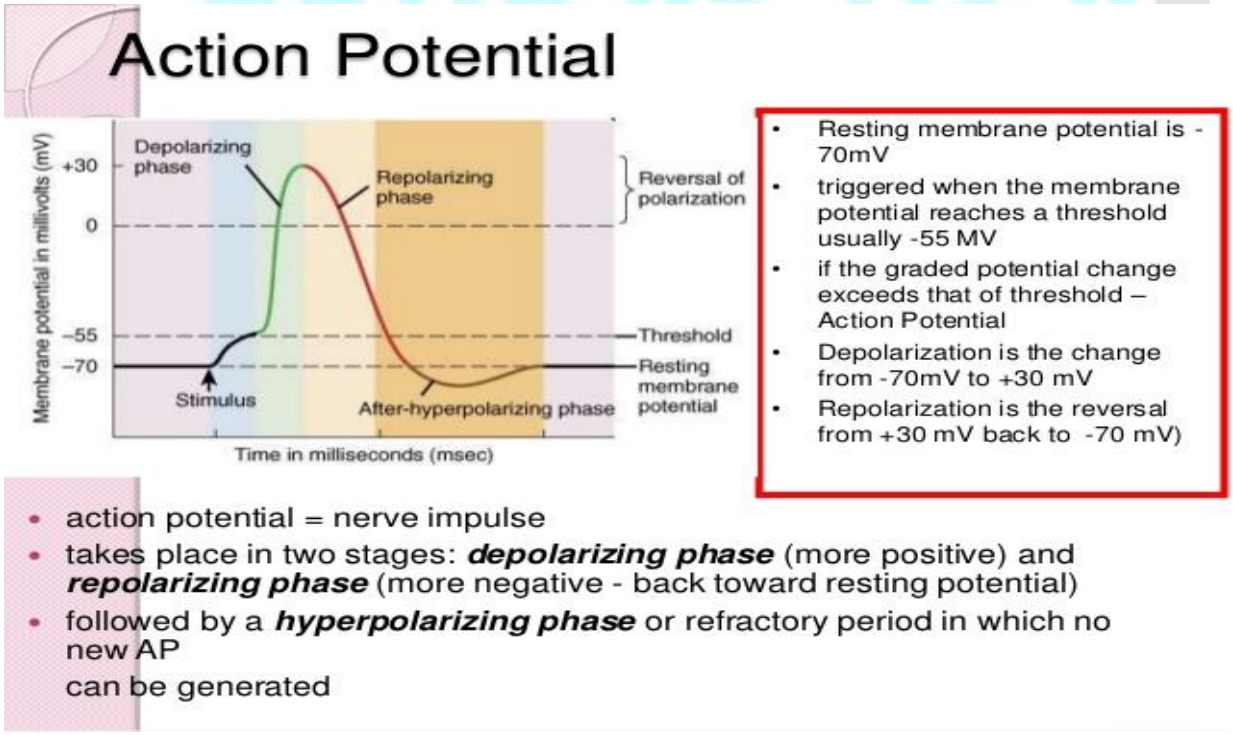
Techniques depend on a group of drugs that produces transient loss of sensory , motor , and autonomic function when the drugs are injected or applied in proximity to neural tissue . (nerve endings)

Mechanism of action

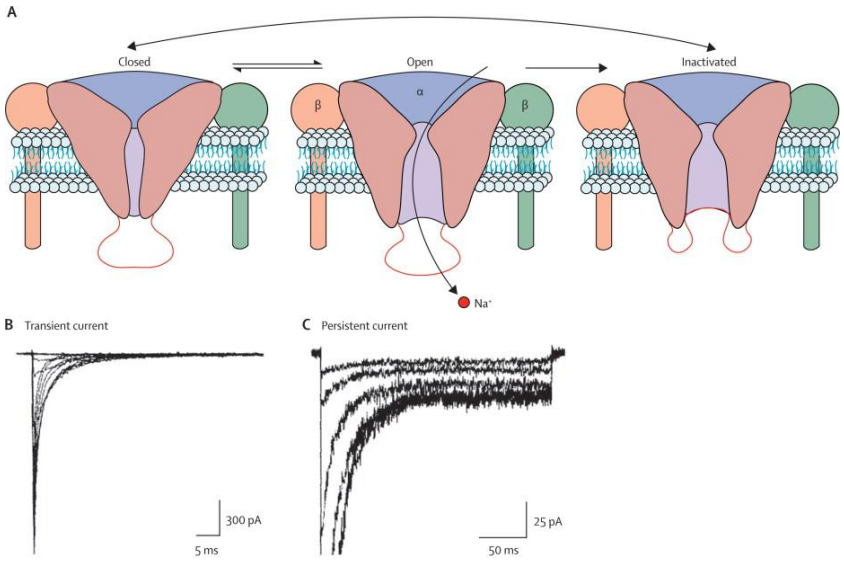
An electrogenic Na- K-ATPase pump couples the transport of three Na ions out of the cell for every two K ions moves into the cell , this creates a concentration gradient that favors extracellular diffusion of K and intracellular diffusion of Na .

This accounts for the negative resting potential difference (-70 mV polarization).

If the depolarization exceeds a threshold level (-55mV), sodium channels are activated allowing a sudden influx of Na ions and generating action potential .



*** Na-K pump to sustain resting membrane potential 3Na out 2K in to the cell**



- Na-K pump consists of one large α subunit responsible for transferring Na ion and 2 beta subunits responsible for transferring k ion

MOF LA: blocks Na-K pump from inside so even if the membrane potential reach -55 there is no Na influx.

- Sensitivity to blockade is determined by axonal diameter and degree of myelination.

- In spinal nerves , the sensitivity to LA is autonomic> sensory > motor .

LA consist of benzene ring separated from tertiary amine by intermediate chain that includes an ester or amide linkage .

-Motor fiber : highly myelinated and has a large diameter so its more resistant to LA

-Autonomic fiber : unmyelinated and has a small diameter so its the most sensitive to LA

so that the first question to post-spinal anesthesia patient is (حاسس بدفى برجليك)

because the autonomic innervations were blocked first

- Sometimes in the normal delivery we give the patient epidural anesthesia in a lower doses that don't affect the motor function (walking epidural)

Table 2: Nerve Fiber Types and Nerve Blocking					
Fiber Type	**Function**	**Diameter (microns)**	**Mystification**	**Conduction Velocity (m/s)**	**Sensitivity to Nerve Block**
Type A					
Alpha (α)	Proprioception, motor	12-20	Heavy	70-120	+
Beta (β)	Touch, pressure	5-12	Heavy	30-70	++
Gamma (γ)	Muscle spindles	3-6	Heavy	15-30	++
Delta (δ)	Pain, temperature	2-5	Heavy	12-30	+++
Type B	Preganglionic autonomic	<3	Light	3-15	++++
Type C					
Dorsal root	Pain	0.4-12	None	0.5-2.3	++++
Sympathetic	Postganglionic	0.3-1.3	None	0.7-2.3	++++

- Pain practitioners block the nerves transmitting pain impulses (Type A-δ, Type C)
- Lower concentrations of local anesthetic will only block the small unmyelinated and lightly myelinated (Type C and Type A-δ) fibers
- Middle-frequency currents (2,000-20,000 Hz) block smaller unmyelinated (Type C) and small myelinated (Type A-δ) fibers
- Larger fibers (Type A-α, β, γ) require high-amplitude currents and are usually spared in electrical, low-dose chemical (eg, labor epidural) blocks

Clinical pharmacology

Absorption : systemic absorption of LA depends on blood flow which is determined by factors:

1- Site of injection : IV > Tracheal> intercostal > caudal > paracervical > epidural > brachial plexus > sciatic > subcutaneous .

2- Presence of vasocontrictors (like epinephrine)

- to avoid the systemic disadvantage of LA

- to decrease the absorption

- prolongation of the effect (by decreasing the blood flow & increasing the acidity)

3- Local agent

Metabolism :

- Ester LA metabolized by pseudocholinesterase

S.E: Histamine release

- Amide metabolized by P-450 in the liver (longer onset & duration of action)

Agent	Max Dose w/o Epi	Max Dose w/ Epi	Duration of Action	Notes
Lidocaine	5mg/kg	7mg/kg	30 - 90 min	1% = 10mg/mL 2% = 20mg/mL
Bupivacaine	2.5mg/kg	3mg/kg	6 - 8 hrs	0.5% = 5mg/mL
Mepivicaine	7mg/kg	8mg/kg	---	---
Ropivacaine	3mg/kg	---	---	---

- Lidocaine : LA injected peripherally

Archive Questions

Written:

Nerve fibers type - table (page 4) مع فراغات

MCQs:

1)What is the correct order for absorption of local anesthesia according to the site of injection?

a. Brachial>sciatic>subcutaneous>epidural

b. Tracheal>paracervical>intercosal>brachial

c. Epidural>brachial>intercostals>paracervical

d. Tracheal>paracervical>brachial>subcutaneous

e. Intravenous>intercostals>brachial>epidural

Ans: d

2)About function of the nerve fibers, which one is true?

a. A alpha > proprioception, pressure

b. A delta >temperature, pain, pressure

c. C > pain, preganglionic sympathetic,reflexes

d. B > preganglionic, sympathetic

Ans: d

3)Wrong regarding LA: sensory is more sensitive than autonomic.

Oral:

1)Nerve block depend on.

2)Function of type B nerve fibers.

3)Factors affect local anesthesia.

4)Local anaesthesia conjugates.

5)Local anaesthesia distribution/uptake/absorption depends on what.

6)Amide local anesthetic.

7)Additive to local anaesthesia (epinephrine, vasopressor e, antihistamine,خمسه لازم)

Adjuncts-to-Anesthesia chapter :

https://www.msc-mu.com/file_download?file=-16688670451796199945.pdf&&id=10405