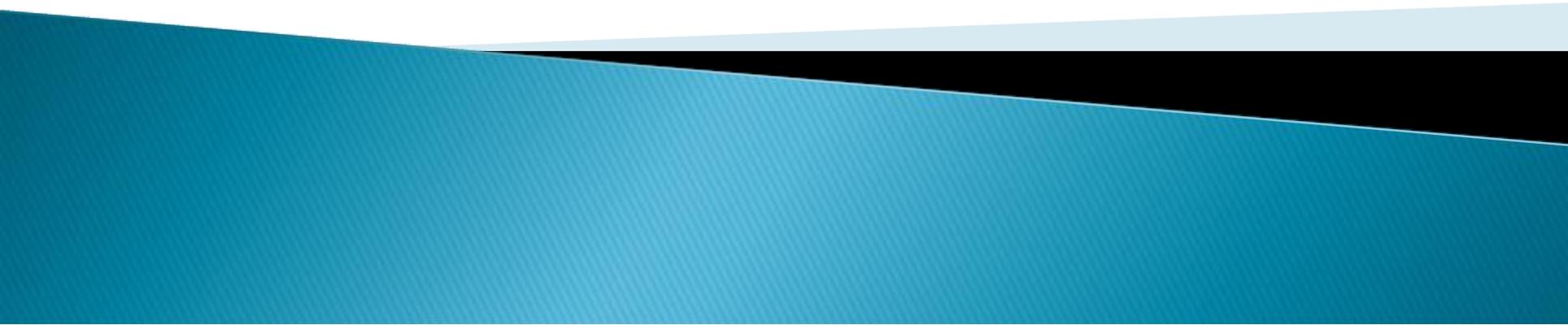


Local anesthesia



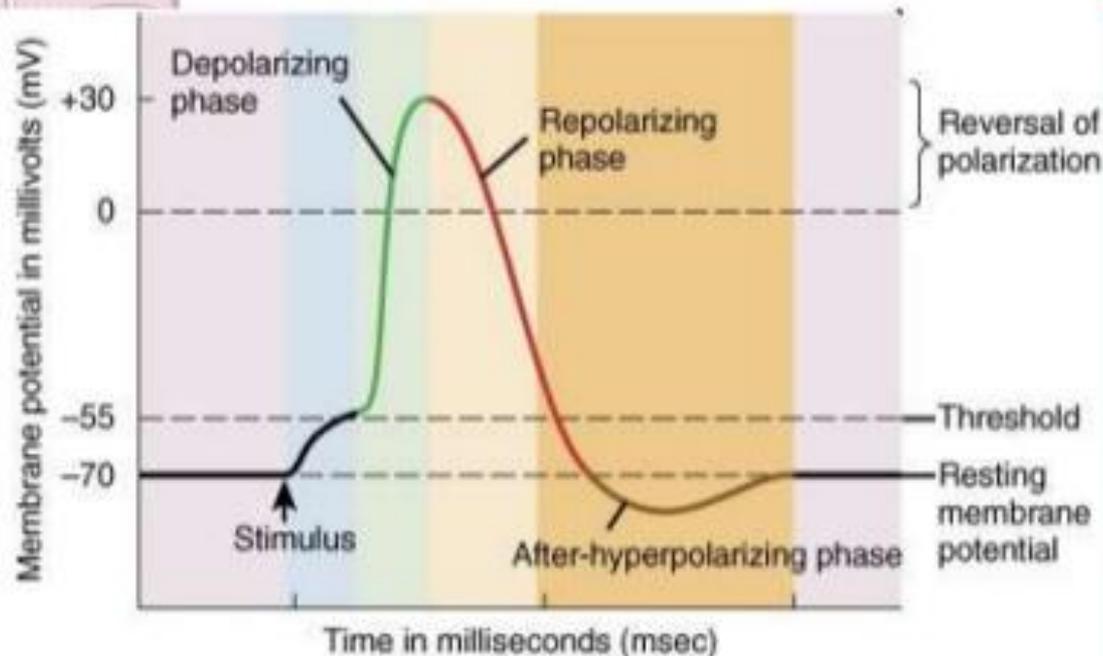
Definition

- ▶ 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 .

Mechanism of action

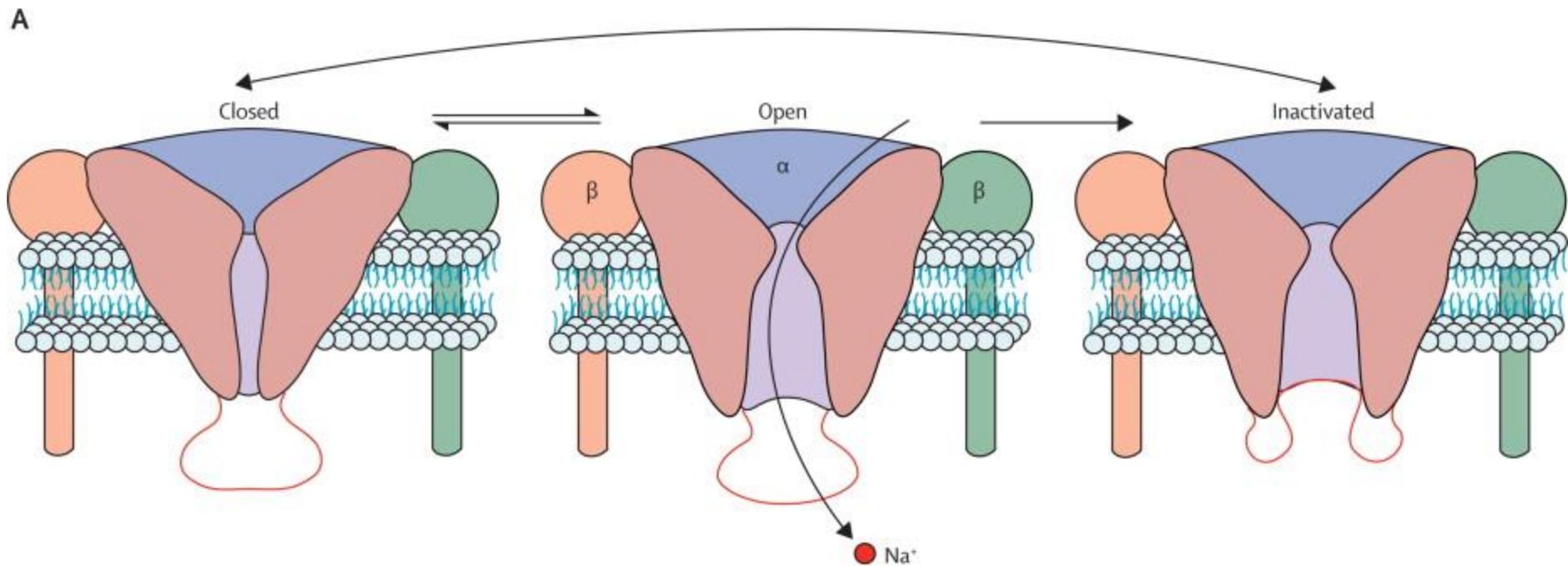
- ▶ An electrogenic Na⁺-K⁺-ATPase pump couples the transport of three Na⁺ ions out of the cell for every two K⁺ ions moves into the cell , this creates a concentration gradient that favors extracellular diffusion of K⁺ and intracellular diffusion of Na⁺ . This accounts for the negative resting potential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

Action Potential

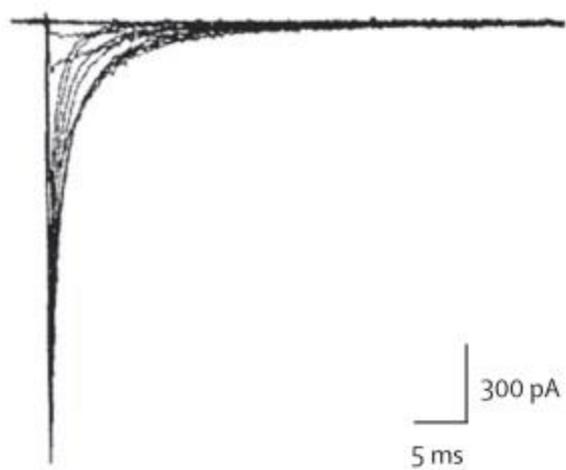


- Resting membrane potential is -70mV
- triggered when the membrane potential reaches a threshold usually -55 MV
- if the graded potential change exceeds that of threshold – Action Potential
- Depolarization is the change from -70mV to +30 mV
- Repolarization is the reversal from +30 mV back to -70 mV)

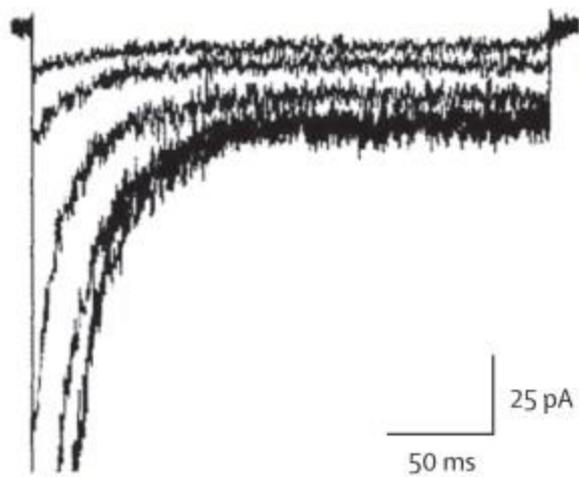
- action potential = nerve impulse
- takes place in two stages: **depolarizing phase** (more positive) and **repolarizing phase** (more negative - back toward resting potential)
- followed by a **hyperpolarizing phase** or refractory period in which no new AP can be generated



B Transient current



C Persistent current



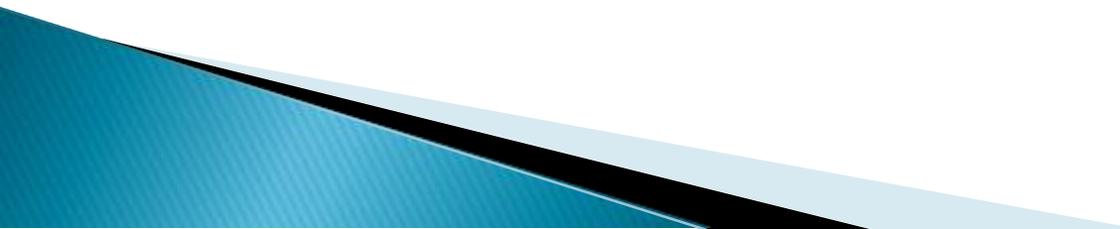
- ▶ Sensitivity to blockade is determined by axonal diameter and degree of myelination
 - ▶ In spinal nerves , the sensitivity to LA is autonomic > sensory > motor .
 - ▶ LA consist of benzene ring seperated from tertiary amine by intermediate chain that includes an ester or amide linkage .
- 

Table 2: Nerve Fiber Types and Nerve Blocking

Fiber Type	Function	Diameter (microns)	Myelination	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	++++

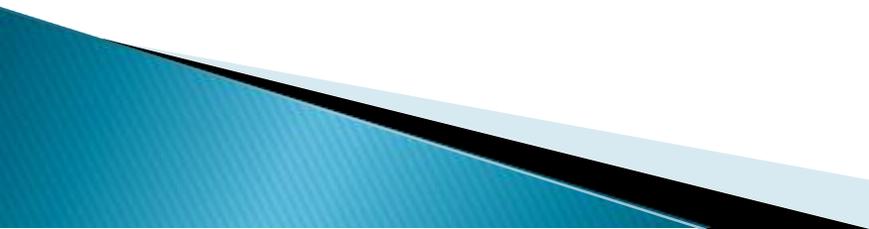
- Pain practitioners block the nerves transmitting pain impulses (Type A- δ , Type C)
- Lower concentrations of local anesthetic will only block the small unmyelinated and lightly myelinated (Type C and Type A- δ) fibers
- Middle-frequency currents (2,000-20,000 Hz) block smaller unmyelinated (Type C) 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 vasoconstrictors
 3. Local agent
- ▶ Metabolism :
 1. Ester LA metabolized by pseudocholinesterase
 2. Amide metabolized by P-450 in the liver .

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
Mepivacaine	7mg/kg	8mg/kg	---	---
Ropivacaine	3mg/kg	---	---	---

The systemic effect of LA (toxicity)

- ▶ CNS: early symptoms numbness , tongue paresthesia , dizziness, sensory complaints may include tinnitus and blurred vision , excitatory signs may precede CNS depression , muscle twitching and seizures , respiratory arrest often follows
 - ▶ RESPIRATORY : apnea can result from phrenic and intercostal nerve paralysis or depression of the medullary respiratory center
 - ▶ CARDIOVASCULAR :the cardiotoxic reaction from accidentally intravascular injection of bupivacaine include hypotension , AV block , arrhythmias
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The adjuncts to anesthesia

