

Local Anaesthetics

Local Anaesthetics

- Local anaesthetics (LAs) are drugs which upon topical application or local injection cause **reversible loss of sensory perception**, especially of pain, in restricted area of the body.
- When it is used on specific nerve pathways (nerve block), effects such as analgesia (loss of pain sensation) and paralysis (loss of muscle power) can be achieved.

History

- The first local anesthetic, **cocaine**, was serendipitously discovered in the late 19th century.
- Cocaine was first isolated in 1860 by **Albert Niemann**.
- Albert Niemann tasted his newly isolated compound and noted that it caused a numbing of the tongue.

Local anaesthetics can be classified into amide and ester type

Amide class

- Lignocaine
- Prilocaine
- Bupivacaine
- Dibucaine (Longest acting)
- Mepivacaine
- Etidocaine
- Ropivacaine

Ester class

- Cocaine
- Procaine
- Chlorprocaine (Shortest acting)
- Tetracaine (Amethocaine)
- Benzocaine

Hypersensitivity to Local Anesthetics

- The reaction may manifest itself as an
 - allergic dermatitis or
 - asthmatic attack
- It is important to distinguish allergic reactions from toxic side effects and from the effects of co-administered vasoconstrictors.

- Hypersensitivity seems to occur more frequently with local anesthetics of the **ester** type and frequently extends to chemically related compounds
- Although allergic responses to agents of the **amide** type are uncommon, solutions of such agents may contain preservatives such as **methyl-paraben** that may provoke an allergic reaction

- Local anesthetic preparations that contain a vasoconstrictor may elicit allergic responses
- This is due to the **sulfite** added as an antioxidant for the catecholamine/vasoconstrictor.

The side effects of lidocaine seen with increasing dose

- drowsiness
- tinnitus
- dysgeusia
- dizziness
- twitching
- cardiovascular depression
- seizures
- Coma
- respiratory depression and arrest

The metabolites **monoethyl-glycine xylidide** and **glycine xylidide** may contribute to some of these side effects.

Hypersensitive reactions

- Sulfite
- Methyl paraben
- Ester LAs

Toxicity

- Monoethyl glycine-xylidide
- Glycine- xylidide

Mechanism of Action

- All LAs are weak bases.
- Act by penetrating the axonal membrane (in unionized form) and blocking the voltage gated sodium channels from within (in ionized form).
- Local anesthetics block the voltage gated Na^+ Channels and consequently block the nerve conduction by reducing the permeability of Na^+ ions during depolarization.
- **Stabilize inactivated state** of sodium channels.

Local anesthetic binds more tightly to and stabilizes the inactivated state of the Na^+ channel

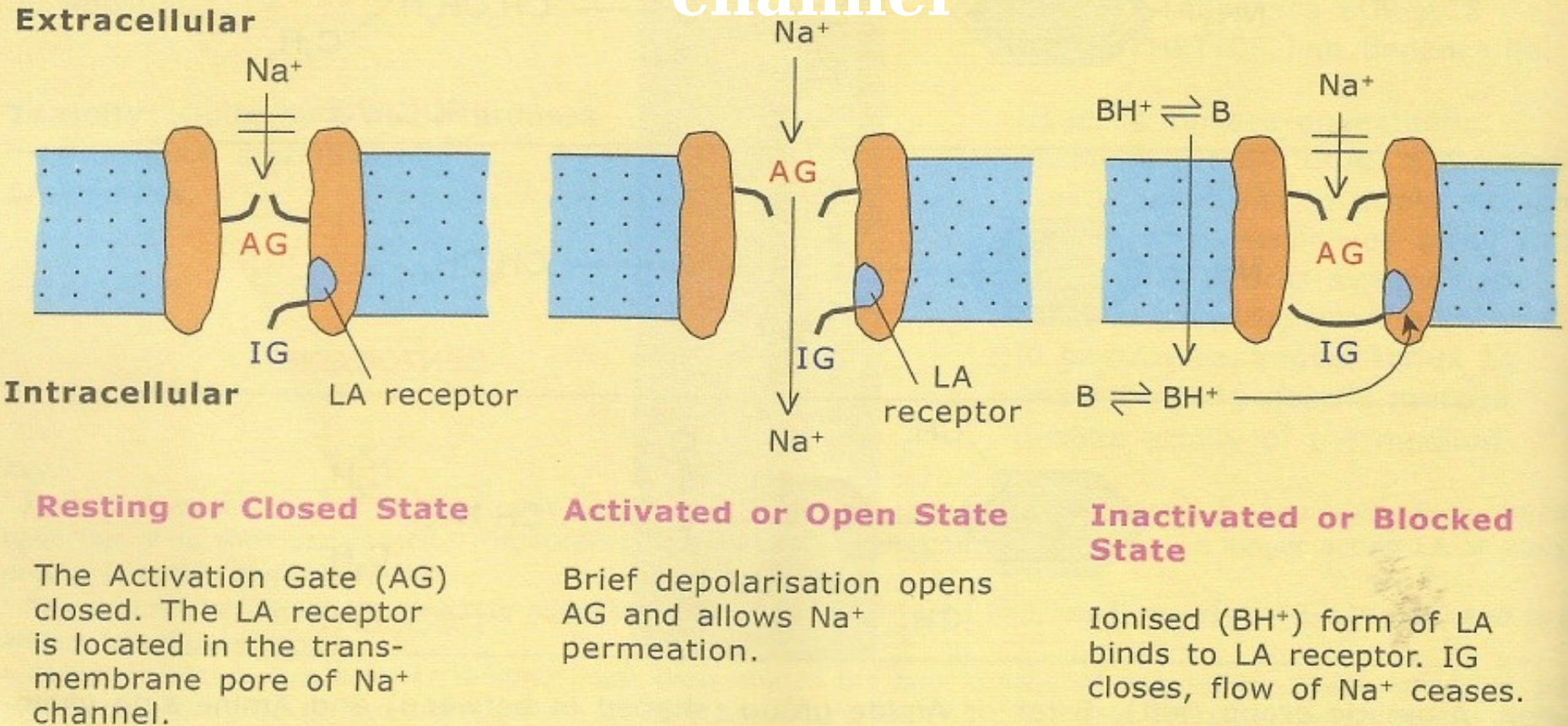


Fig 15.2

A Model of Voltage-Gated Na^+ Channel Depicting the Site and Mechanism of Local Anaesthetic Action.

Q. Sodium bicarbonate speeds the onset of action of LAs. How?

- by increasing the unionized form
- weak bases are unionized in the alkaline medium that can penetrate the axonal membrane.

PROPERTIES	AMINOESTERS	AMINOAMIDES
Metabolism	rapid by plasma cholinesterase	slow, hepatic
Systemic toxicity	less likely	more likely
Allergic reaction	possible - PABA derivatives form	very rare
Stability in solution	breaks down in ampules (heat,sun)	very stable chemically
Onset of action	slow as a general rule	moderate to fast
pKa's	higher than PH = 7.4 (8.5-8.9)	close to PH = 7.4 (7.6-8.1)

LIGNOCAINE

- Readily absorbed from mucous membranes and damaged skin.
- Rapidly absorbed from injection site .
- After IV, rapidly and widely distributed into highly perfused tissues followed by redistribution into skeletal muscle and adipose tissue.
- Onset of action- fast
- Duration of nerve block- 1-2 hrs.
- Used for infiltration anaesthesia, regional nerve block, surface, epidural, spinal anaesthesia.

BUPIVACAINE

- Potent
- Slow onset : 4-10 min.
- Long duration of action: 1.5 - 8.5 hours.
- Produces anaesthesia **without significant motor blockade** (**mother can actively cooperate in vaginal delivery**).
- Has high lipid solubility, distribute more in tissues than in blood.
- Indicated mainly for infiltration anaesthesia and epidural block.

USES OF LOCAL ANAESTHETICS

- 1. Surface anaesthesia**
- 2. Infiltration Anaesthesia**
- 3. Nerve Blocks**
- 4. Intravenous Regional Block (Bier's Block)**
- 5. Spinal Anaesthesia**
- 6. Epidural Anaesthesia**

Surface anaesthesia

- Topical application of LA to mucous membranes and abraded skin
- Superficial area is anaesthetised

Lignocaine commonly used for ear, nose, eye, mouth and pharynx.

It is also used for proctoscopy, catheterization and per rectal examination.

- **Lignocaine** is ineffective on intact skin.
- However a mixture of **2.5% prilocaine** and **2.5% lignocaine** in ratio of 1:1 can anaesthetize even unbroken skin.
- Combination of these 2 local anaesthetics lower the melting point of individual drugs and help to form a semi- solid ointment.
- This mixture is known as **Eutectic mixture**.
- **Oxethazaine (mucaine)** can be used to provide symptomatic relief in gastritis (it remains unionised in the acidic pH of stomach)

Spinal Anaesthesia

Lignocaine and Bupivacaine

Indications

- Orthopaedic surgery of lower limb and pelvis
- Surgery of lower abdomen
- Gynaecological and obstetrics surgeries

Complications

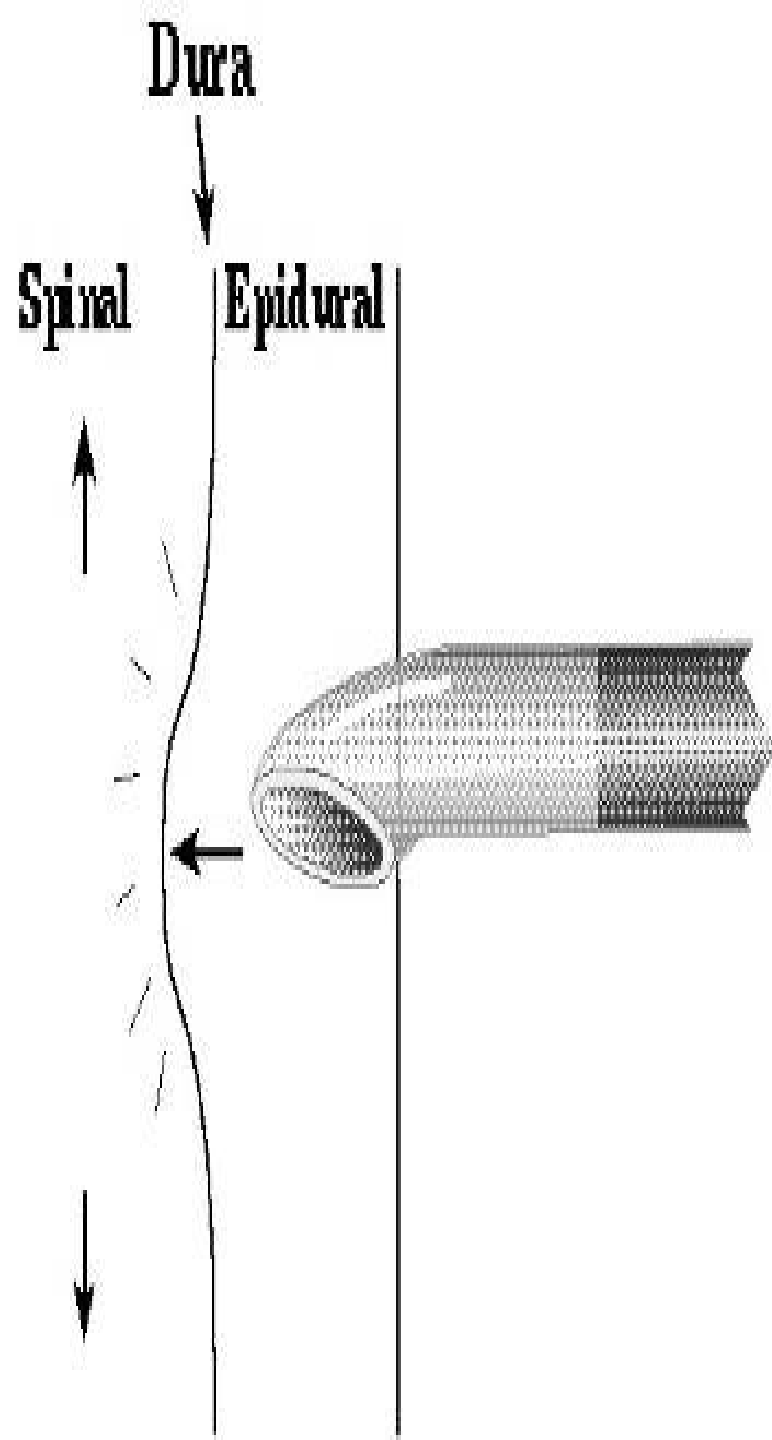
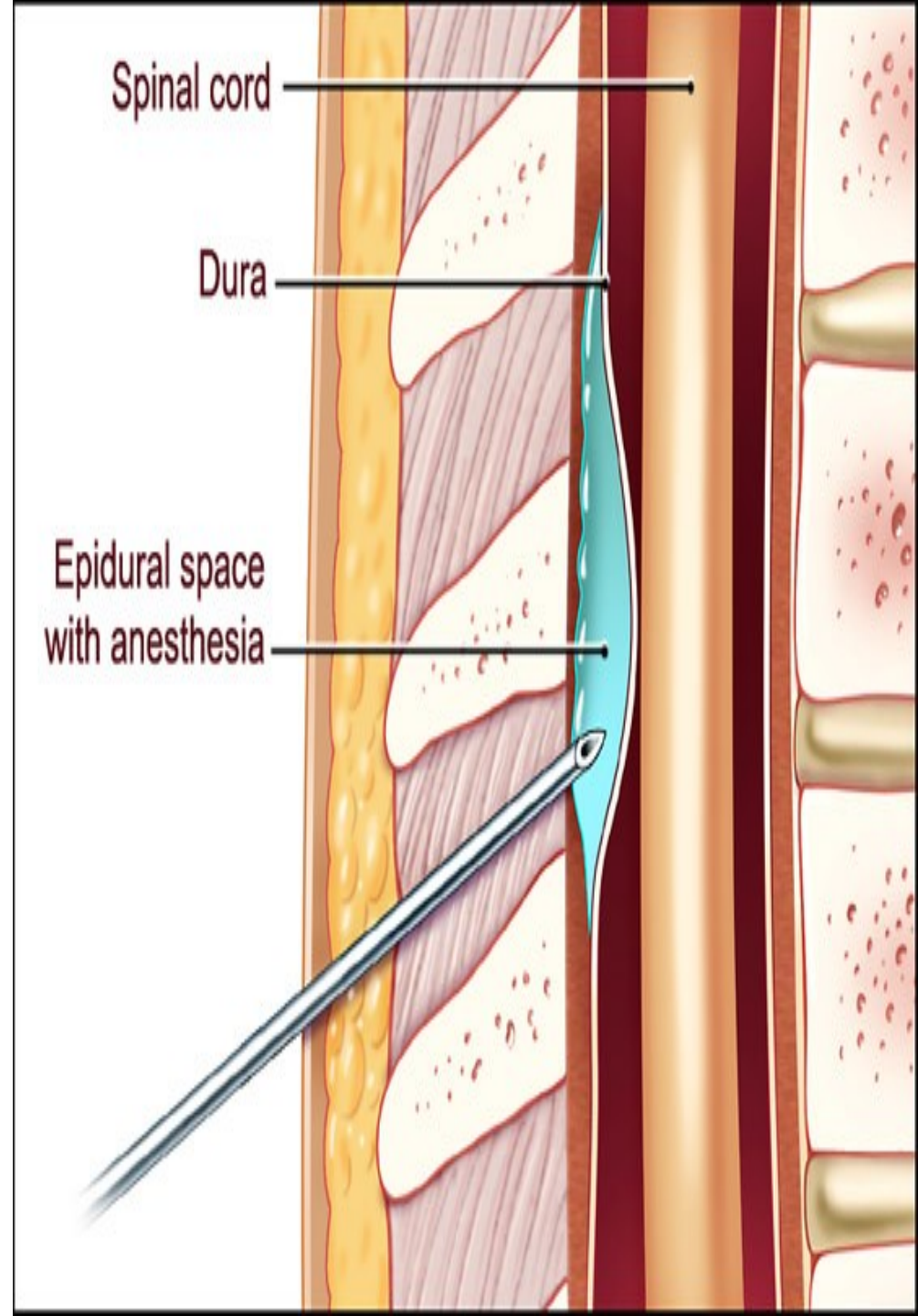
- **Hypotension** is the most common intraoperative complication
- Most common postoperative complication is headache, known as post dural puncture **headache** (PDPH).

POSITIONING



PROCEDURE





	Spinal anesthesia	Epidural anesthesia
Sites for puncture	Only below L2/3	Sacral, lumbar, thoracic and cervical
Injection site	Subarachnoid space (CSF)	Epidural space
Site of action	Subarachnoid space (nerves and spinal cord)	
Dose of LA	Small	Large
Onset of action	Quick	Slower
Motor block	Profound	Moderate
Complications	Cardiac arrest Postdural puncture syndrome (headache, hearing↓)	LA-intoxication Total spinal anesthesia Epidural hematoma

NOTES

- **Small** diameter axons are **more susceptible** to block than large diameter fibres.
- Small unmyelinated **C fibers (mediating pain sensations)**, and small myelinated **A λ fibers (mediating pain and temperature sensations)** are blocked before the larger myelinated **A γ , A β , and A α fibers (mediating postural, touch, pressure, and motor information)**
- In functional terms: Autonomic > Sensory > Motor.
- Among sensory fibres sequence of block is temperature(cold before heat) > pain > touch > deep pressure > proprioception.

- **All LA s are vasodilators except cocaine** (acts as sympathomimetic due to inhibition of nor-adrenaline reuptake). Therefore all LAs decrease BP except cocaine.
- **Cocaine** should **NEVER** be given by intravenous route or with adrenaline.
- **Cocaine** is the only ester which is not metabolized by pseudocholinesterase. It is metabolized in the liver.
- **Dibucaine** is the most potent, longest acting and most toxic LA whereas **chlorprocaine** is the shortest acting LA.

- **Bupivacaine** is the best drug for regional block but it is also the most cardiotoxic LA.
- **Lignocaine** is the most commonly used LA and is the drug of choice for ventricular tachycardia.
- **Chlorprocaine** is the shortest acting LA and is contraindicated in spinal anaesthesia (It may cause paraplegia due to the presence of sodium **metasulphite** as preservative, which is neurotoxic).

Q. Which sensation is blocked first by local anaesthetics?

- Temperature

- Cold

Q. Oxethazine is used for anaesthetizing gastric mucosa because

- It remain un-ionized in acidic medium

Q. To speed the onset of action of LA,
a substance is added to it. Name that
substance.

● Bicarbonate

Q. Eutectic lidocaine-prilocaine has the following unique property:

- a) causes motor blockade without sensory block
- b) can anaesthetize the unbroken skin on topical application
- c) strong vasoconstrictor action
- d) no effect on surface application

● Ans- b

Q. Local anaesthetics binds more tightly to and stabilizes the

- a) Activated state of sodium channel
- b) Inactivated state of sodium channel
- c) Resting state of sodium channel
- d) all states of sodium channel

Ans- b

Q. Most cardiotoxic LA is:

- Lignocaine
- Cocaine
- Prilicaine
- Bupivacaine

● Ans- **d**

Q. By using LA Bupivacaine, mother can actively cooperate in vaginal delivery. why?

- a) Bupivacaine causes motor blockade without sensory block
- b) Bupivacaine produces anaesthesia without motor blockade
- c) Bupivacaine is least cardiotoxic LA
- d) Bupivacaine produces prolonged anaesthesia

● **Ans-** b & d

Q. Adrenaline is added to LA Lignocaine.
Why?

- a) It decreases rate of absorption
- b) It decreases toxicity of LA
- c) Prolonged anaesthesia
- d) Transdermal patch of LA become more effective

● Ans- a b c

Bibliography

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***THANK
YOU***