University of Zambia School of Medicine

Local Anaesthetics and Spinal Anaesthesia

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Learning Objectives

- The classification of local anaesthetics
- The mechanism of action of local anaesthetics
- Anatomy of spinal cord
- Use and indications of spinal anaesthesia
- Basic principles of epidural anaesthesia

Common drugs

- Lignocaine
- Bupivocaine

- Complications of spinal anaesthesia and their management

Introduction

Local anaesthetics are agents that produce localized, reversible block to nerve conduction.

- They are administered locally.

Classification

- Local anesthetics are composed of an aromatic ring linked to an hydrophilic amine group via an intermediate link chain.
- It is the nature of this linking chain that is used to classify the local anesthetic as either
  an
- I . ester or
- II . amide.

Ester Local Anaesthetics

- Contains several less frequently used local anaesthetics. A good pneumonic to remember the ester LA':
- **CAPE**: Cocaine, Amethocaine, Procaine = Esters
- Esters are metabolised by hydrolysis by pseudocholinesterases found in the plasma

Amide Local Anaesthetics

All the amide local anaesthetics contain two

i's: lignocaine, bupivocaine, prilocaine, ropivocaine

They are broken down by hepatic amidases and therefore their metabolism is affected by conditions which affect hepatic blood flow

Mechanism of Action

- LA's act by blocking sodium channels.
- Sodium channels are found on the lipid bilayer of nerve axons.
- The aim of using local anaesthetics is typically to prevent the passage of afferent nerve action potentials.
- The drugs cross the neuronal membrane into the axoplasm.
- They then block the sodium channel from 'the inside'. This stabilises the membrane and prevents generation of further action potentials

Uses /indications

1. **Topical**

- Can be applied to skin as a cream to reduce pain at venepuncture/cannulation.

- Brands include EMLA and typically take 45min-60min to work.

- LA's can also be used topically as eye drops

2. **Infiltrative Anaesthesia**:

Most commonly this is to the skin. Surgeons may infiltrate a wound site at the end of an operation

3. **Nerve blocks:**

Include ring blocks (digital nerves for whole finger), femoral nerve blocks, brachial plexus blocks.

4. **Intravenous Blocks (Bier's Block)**

- These blocks require local anaesthetic drugs to be given

- intravenously whilst a tourniquet is in place inflated.

- As such there is a high risk of local anaesthetic toxicity and therefore they should only be undertaken by an experienced doctor.

5. **Spinal Anaesthesia**

- If LA is injected into the cerebrospinal fluid in the lumbar region a dense motor and sensory block below the level of injection can be achieved.

- used for obstetric (Csection) and lower limb surgery.

-However a greatly reduced dose is required and in overdose the
block can travel up the spinal sensory levels.

- In very high levels this can affect breathing and level of
consciousness – known as a ‘high spinal’ – an anaesthetic emergency

6. **Epidural Anaesthesia**:

- By placing a plastic catheter in the epidural space (the potential space that exists around the dura mater of the spinal cord) the LA can prevent conduction of the nerve roots arising from that level of the spinal.

- This creates a band of reduced sensation a the sensory level of
the injection (eg thoracic, lumbar).

Local Anaesthetic Drugs

- **Lignocaine**
  Lignocaine is an amide local anaesthetic.
- It comes as a clear colourless solution and has a shelf life of around two years.
- It may come as a 1%, 2% or 4% solution so be careful to check.
- It can be used via a variety of roots: topical, infiltration, intrathecally (spinal), epidurally. Its mechanism of action is to block sodium channels preventing the conduction of action potentials.

- **Properties:**
  - Fast onset (30s-1min)
  - Medium duration of action (1-3hrs)
  - Moderate vasodilation

  Dose:
  - 3mg/kg without adrenaline
  - 7mg/kg when given with adrenaline

Bupivocaine

- Bupivocaine is an amide local anaesthetic.
- It comes as a clear colourless solution.
- It may come as a 0.25% or 0.5% solution so be careful to check.
- Current max safe dose is
- It is a racemic mixture of 2mg/kg with or without adrenaline.
- R and S enantiomers but is also available as Levobupivocaine – an enatipure preparation of S bupivocaine alone which is less cardiotoxic.

- It can be used via a variety of roots: topical, infiltration, intrathecally (spinal), epidurally.
- Its mechanism of action is to block sodium channels preventing the conduction of action potentials.
  Properties:
  - Slower onset of action (5-15mins)
  - Longer duration of action (4-6 hrs)
  - Extremely cardiotoxic in overdose
  Dose:
  - 2mg/kg with or without adrenaline
  - Typical dose for spinal anaesthetic for adult 5mg – 15mg (1-3mls of 0.5%)

Spinal Anaesthesia

- Anatomy of the spinal cord
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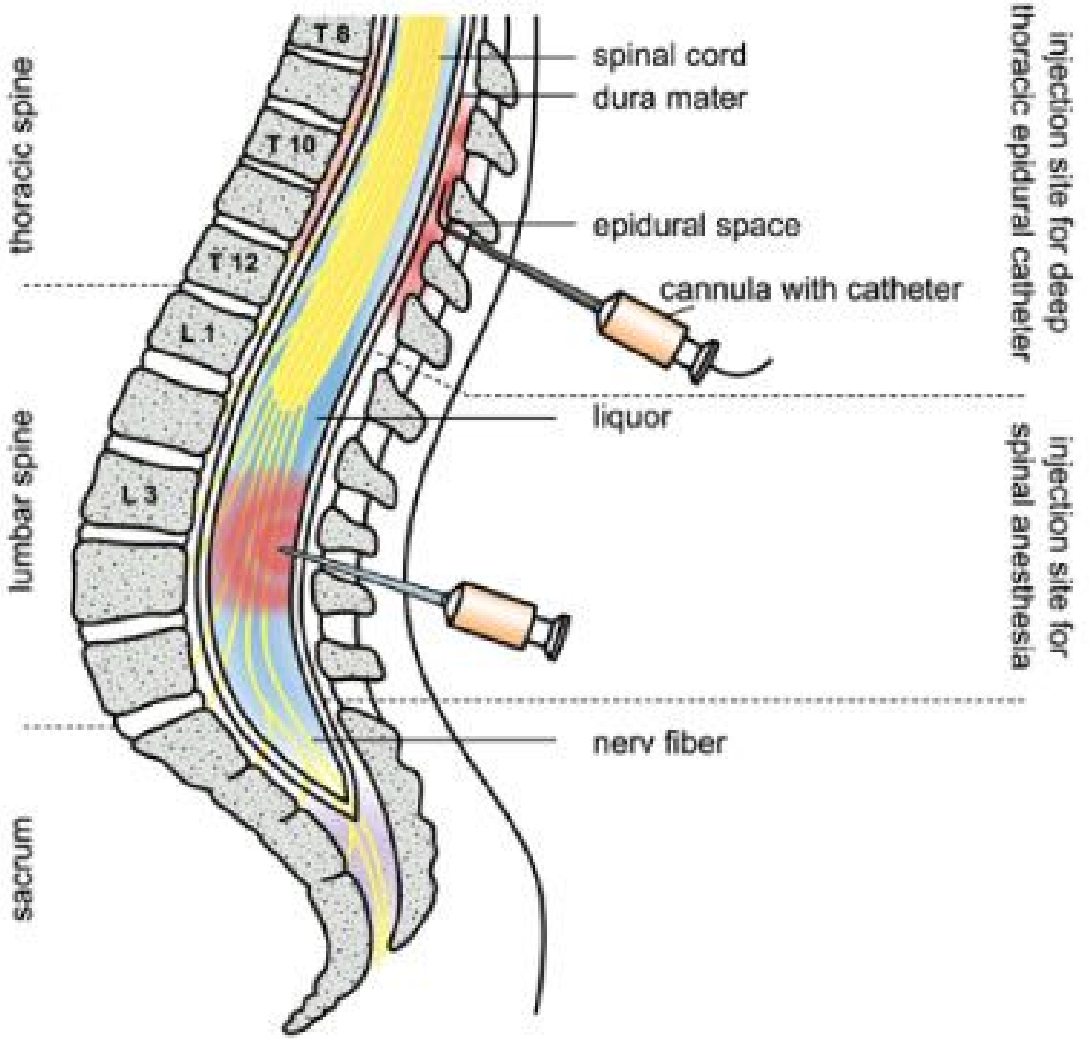
Figure 1 - Method of CSTEA.



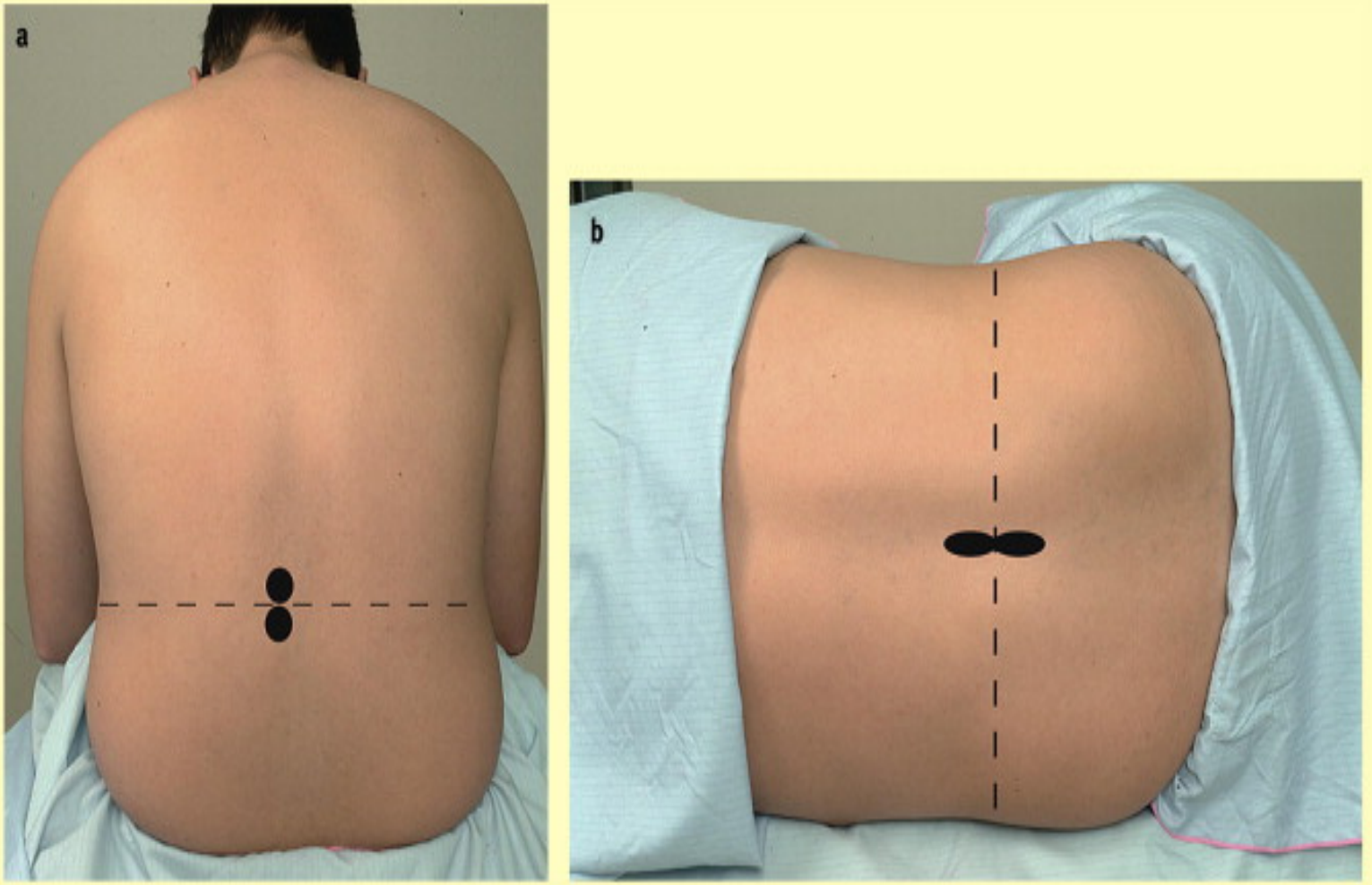
structures the needle will pierce

1. Skin
2. Subcutaneous fat
3. Supraspinous ligament
4. Interspinous ligament
5. Ligamentum flavum
6. Epidural space
7. Dura
8. Subarachnoid space

- injection of local anaesthetic will mix with the CSF and rapidly block the nerve roots with which it comes in contact.

- The spinal cord usually ends at the level of L2 in adults and L3 in children.
- Dural puncture above these levels is associated with a slight risk of damaging the spinal cord and is best avoided.
- An important landmark to remember is that a line joining the top of the iliac crests is at L3-L4 to L4-L5 (typically at the L4 spinous process). This is known as Tuffier's line

Patient positions for spinal and epidural block



Surface markings for spinal and epidural block. Sitting **(a)** and lateral **(b)** positions for the spinal and epidural block. The dotted line represents Tuffier's line, which joins the two iliac crests and passes through the L3/L4 interspace or across the spinous process of L4.

Indications

- Lower limb Orthopaedic surgery on the pelvis, femur, tibia and the ankle
  - Total Hip Replacement
  - Total Knee Replacement
  - Hip fracture surgery
  - Hernia (inguinal or epigastric)
  - Haemorrhoidectomy (Piles), fistulae and fissures
  - Transurethral resection of the prostate & Transurethral resection of Bladder Tumours
  - Abdominal & vaginal hysterectomies
  - Laparoscopy Assisted Vaginal Hysterectomies (LAVH) combined with general anaesthesia
  - Caesarean sections

CONTRA-INDICATIONS

- **Absolute contraindications**
- - bleeding disorders
- - septicemia
- - increased intracranial pressure
- - pt refusal
- - skin infection at puncture site
  - cardiorespiratory instability
  - prexisting spinal cord disease

- **Relative contraindications**
- - hemorrhage
- - psychotic pt
- - acute upper respiratory disease
- - back problems due to muscle strain, disc degeneration

Local Anaesthetic Toxicity

- While generally safe, local anaesthetic agents can be toxic if used in excessive doses or administered improperly.

Clinical Features

- These depend on the plasma concentration of local anaesthetic.
- Early symptoms include :

light headedness, tinnitus, circumoral tingling and tongue numbness.

Higher levels will lead to muscle twitching, agitation and visual disturbances, higher levels still will cause coma and respiratory suppression. At very high plasma levels cardiotoxicity will result leading to cardiovascular collapse and development of malignant arrhythmias

Management

- This is an anaesthetic emergency and you should call for senior anaesthetic support
  - Stop injecting LA
  - Maintain and if necessary secure the airway with a cuffed endotracheal tube
  - Administer 100% oxygen and ensure adequate lung ventilation
  - Confirm or establish iv access
  - Control seizures using a benzodiazepine (eg Lorazepam) or use small incremental doses of thiopental or propofol

- **Management of cardiac arrest**:
  - Commence CPR following ALS guidelines
  - Manage arrhythmias using ALS protocols, recognising that arrhythmias may be refractory to treatment and prolonged resuscitation may be necessary

  Treatment of cardiac arrest with lipid emulsion
  - Intravenous lipid emulsion has been shown to improve outcomes in cardiac arrest secondary to local anaesthetic toxicity
  - *Intralipid* is given as a rapid iv bolus followed by infusion as per guidelines

  Remember:
  - Continue CPR throughout treatment with lipid emulsion
  - Recovery from LA induced cardiac arrest may take >1hour

Complications of Spinal Anaesthesia

- **Immediate**
  - Hypotension
  - Nausea and vomiting
  - Broken needle
  - Total spinal block
  - Subdural/epidural hematoma
  - Systemic reaction to the injected local anesthetic

- **Later complications**:
  - Post-dural puncture headache
  - Backache
  - Retention of urine
  - Sepsis or infection
  - Meningism

- **Hypotension**
  Sympathetic blockade results in vasodilation of the peripheral blood vessels. This causes a fall in venous return and a drop in blood pressure. If the block reaches T1-T4 it can cause sympathetic blockade of the cardiac accelerator fibres – this results in bradycardia and a fall in the cardiac output.
  Treatment:
  - Head down posture and raised legs
  - Oxygen 100%
  - Initiate IV fluids – 1 L over 10-15 min
  - Ephedrine 10-15 mg IV or phenylephrine – 100 mcg prn
  - Atropine – 0.6-1.2 mg IV

- **Total Spinal**

  Defined as an excessive sensory and motor anesthesia associated with loss of consciousness. Apnea and profound hypotension often contributed. Typically manifested soon after injection of the local anesthetic into the subarachnoid space.

  Treatment:

  - Oxygen 100%, call for help
  - ABCD approach
  - Evaluate for possible intubation

- Head down posture
  - Circulatory support with sympathomimetics and IV fluids
  - Never head-up position, because it can jeopardize cerebral blood flow and thus may contribute to medullary ischemia

Post Dural Puncture Headache

- Features of a spinal headache:
  - Headache is different to any the patient has experienced before
  - It is worse on sitting up. It is relieved by lying down
  - Mainly occipital headache
  - It is relieved by abdominal pressure

Treatment:

The aim to restore CSF pressure.

- NSAID’s
- Bed rest

- **Advantages of LA**
  - Simple technique
  - Cheap (SA < GA)
  - Safe in proper hand
  - Minimal interference with physiological functions (patient is conscious and breathing spontaneously)
  - Good analgesic effect
  - Less postoperative chest complications
  - Body chemistry not interfered with

  Disadvantages of LA
  - Patient acceptability. Not all patients accept being awake.
  - The procedure is not without complications.

THE END