LOCAL ANAESTHETICS

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LOCAL ANAESTHETICS

- LA are drugs which when applied topically or injected locally, block nerve conduction and cause reversible loss of all sensations in the part supplied by the nerve. The order of blockade of nerve function preceeds in the following manner – pain, temperature, touch, pressure and finally skeletal-muscle power. Recovery is in the reverse order.

LOCAL ANAESTHETICS

- *PROPERTIES OF LA :-*
- Common properties
- Variable degree of H_2O / Lipid solubility
- Lipid Soluble – Migration of drug into neuronal fibre
- H_2O Soluble – Transport drug to the site of action
- Consists of 3 parts ;- (1) Hydrophilic Amino (ionized) Group (2) Lipophilic Aromatic (unionized) Group & (3) Intermediate Ester or Amide Linkage (Alkyl)

Properties of LA

- L.A.'s are Weak Bases
- Water Insoluble
- Prepared in Acidic Salt Solution
- Highly soluble
- Greater Stability
- (Lignocaine Hcl, Procaine Hcl)

CLASSIFICATION OF LA (Clinical)

- I) Surface Anaesthetics :
- Cocaine, Lignocaine,Tetracaine, Benzocaine, Oxethazaine
- 2) Injectable Anaesthetics :
- A) Short acting with Low Potency : Procaine
- B) Intermediate acting with intermediate Potency : Lignocaine, Prilocaine,Mepivacaine,
- C) Long Acting With High Potency : Tetracaine, Bupivacaine, Ropivacaine,Cinchocaine

CLASSIFICATION OF LA (Structure

- 1. **Esters:** Cocaine,Procaine, Benzocaine, Tetracaine, Oxethazaine
- 2. **Amides :**Lignocaine, Bupivacaine, Mepivacaine, Prilocaine ,Ropivacaine

NOTE : Esters have one 'i'

Amides have two 'i..i'

LOCAL ANAESTHETICS

ESTER LAs	**AMIDE LAs**
* Short acting	* Long acting
* Weak analgesia	* Strong analgesia
* Hypersensitivity risk	* Rare
Degraded by Pl.CHEs	* Hydrolysed by L.M.Enzymes
Usedon Mucous mem & Infiltration Block Anaes.	* Used for Nerve
Ex. Cocaine, Pocaine	* Lignocaine, Bupivacaine

QUALITIES OFAN IDEAL LA

- Safe, effective
- Quick onset, long duration
- Stable
- Easily sterilizable (repeated autoclave– spinal & epidural anaesthesia)
- Inexpensive

MECHANISM OF ACTION -LAs

- L.A.s
- Block Voltage–Gated Na+ Channels
- No entry on Na+ into the cell
- No Depolarization
- No generation of Action Potential
- No generation & conduction of impulses to CNS
- Local Anaesthesia Produced

ACTIONS OF LAs

I) **Local Action:-**

** Blocks sensory NEs,Nerve Trunks,NMJs,Synaptic endings.

** Blocks small (Non-myelinated fibres) than long (Myelinated fibres)

** Paralysis voluntary muscles

** Skin anaesthetised.

** Less effective in inflamed / infected area (pH < 7.4)

ACTIONS OF LAs

1) **Nervous Sysem:-**

(a) CNS :- Stimulates CNS – Excitement,Restlessness,Tremors,Twitching,Convulsions

** Depress CNS :- Respiratory Failure, Euphoria,Hallucination,Mental alertness (Cocaine)- Most Abused.

(b) PNS :- Order is Autonomic fibres, pain,touch,temperature,pressure & motor fibres.

ACTIONS OF LAs

II) **CVS Effect:-**

** Myocardium - Depression (Lignocaine, Procainamide - useful in cardiac arrhythmias)

↓ abnormal pacemaker activity, contractility, conductivity,excitability; HR, cardiac output, but ↑ Effective Refractory Period

* ?BP (Except Cocaine – Vasoconstriction)

** Ventricular fibrillation (Bupivacaine).

PHARMACOKINETICS OF LAs

- LA activity is pH dependent
- Increased penetrability at alkaline pH (unionized form)
- Poor penetrability at acidic pH, in infected tissue (ionized form)
- Less effective in inflamed & infected areas.
- Higher the pKa, more is the ionized fraction of drug at physiological pH – slow acting.
- Orally ineffective,due to 1st pass metabolism.

PHARMACOKINETICS OF LA

- **(Lignocaine + Adrenaline) (1:50000)**
- **<u>Advantages</u> :-**
- 1) Adrenaline produces local vasoconstriction
- 2) Reduces absorption of LA from local site – Prolongs duration of action of LA
- 3) Decreases bleeding in the surgical field
- 4) Slow absorption of LA reduces its systemic toxicity

PHARMACOKINETICS OF LA (**Disadvantages)**

- 1) Absorption of adrenaline causes systemic toxicity– Tachycardia, palpitation,rise of BP and precipitation of angina or cardiac arryhthmias. Hence, combination C/I in CVS patients with HBP, IHD, CCF, arryhthmias.

- 2) Intense vasospasm & ischemia in tissues– causing gangrene of the parts (fingers, toes, ear lobule, tip of the nose etc..)

- 3) Delays wound healing by reducing blood flow.

PHARMACOKINETICS OF LA)

(Metabolism)

- Ester-linked LA s metabolzed by Plasma cholinesterase (Procaine)
- Amide-linked LA s metabolized by Liver Metabolizing Enzymes.

ADVERSE EFFECTS OF LAs

Adverse Effects		Measures to Control
Convulsions	.....	I.V. diazepam,Na-pentothal
Resp. Failure	.....	Art. Ventilation,Oxygenation
Hypotension	.....	Vasoconstrictors (NE, Ephedrine)
Arryhthmias	.....	Anti – arryhthmics
CVS collapse	.....	Mouth to Mouth respiration Cardiac massage
Anaphylactic shock	.....	Adrenaline, O_2, Corticosteroids, Antihistaminics,

EPIDURAL ANAESTHESIA

—Inject in spinal dural space,acts on spinal nerve roots.

3 categories :-

1) **Thoracic** – Mid thoracic inj.

-- Pain relief

Eg. Thoracic & upper Abdominal surgery

2) **Lumbar** – large volume in lumber region

Eg. Lower abdominal, pelvic & lower limb surgery

3) **Caudal** - Injection in sacral region

Eg. Pelvic-vaginal delivery, Perineal– anorectal surgery, genitourinary operations.

EPIDURAL ANAESTHESIA

- Lignocaine, Bupivacaine used.
- Safer but difficult technique than spinal
- Slower in onset than spinal
- Requires large quantity of drug.
- Mainly useful as obstetric analgesia.

DRUG INTERACTIONS OF LAs

- Lignocaine + Propranolol :
- Propranolol reduces hepatic blood flow
- Impairs clearance of Lignocaine
- Results in Lignocaine Toxicity

- Procaine + Sulfonamide :
- Procaine hydrolysed to PABA
- Reduces the effect of Sulfonamides.

LIGNOCAINE

- Amide derivative LA
- Commonly employed LA as :
  - ** Surface anaesthesia
  - ** Injection

ADVANTAGES :

Stable, stored at room temperature

Autoclaved repeatedly

Rapid absorption (Parenterally)

LIGNOCAINE (ADVANTAGES)

- Quick onset of action
- High degree of penetration
- Long lasting (30-60 mins)
- Action prolonged with Adrenaline
- Produces more intense anaesthesia
- Used in subjects allergic to Procaine
- Minimum local irritation
- Used as : Surface anaesthesia, Infiltration, Topical Nerve Block,Epidural

USES OF LIGNOCAINE

1) **SURFACE ANAESTHESIA :**

- Topical application to Mucous membrane,skin
- Superfacial layer anaesthetized
- **Eg.** 2-4% drops,spray,ointment,cream,jelly.
- **Uses :-** Painful lesions of ENT, Stomatitis, Tonsillectomy, Endotracheal intubation, Bronchoscopy, Endoscopy,Catheterization, Piles, Fissures, Proctoscopy, Surgery.

USES OF LIGNOCAINE

II) **INFILTRATION ANAESTHESIA :**

- Infiltrated under skin – blocks sensory N/endings
- Immediate onset, shorter duration (30 – 60 min)
- **Uses :-**
- Minor operations
- Incision, Excision
- Hydrocoels
- Herniorraphy.

USES OF LIGNOCAINE

III) <u>CONDUCTION NERVE BLOCK :</u>

- Injected around localized nerve trunk, N. plexus
- larger area anaesthetized
- **Eg.** -- Intercostal N.Block – Within 3 seconds
  -- Brachial Plexus block – 15 seconds
  -- Ulnar, Sciatica, Femoral, Phrenic Nerves

<u>Uses :-</u>

* Tooth extraction, Operation on eyes, limbs, abdomen
- Fracture settings, Trauma to ribs
- Neuralgias, Persistent hiccups.

USES OF LIGNOCAINE

- **IV) <u>SPINAL ANAESTHESIA :</u>**
- Injected into subarachnoid spaces between L2-L3, L3-L4, lower end of spinal cord
- Lower abdomen, Hind limbs … Anaesthetized & Paralyzed
- Level of anaesthesia is influenced by :-
- (i) siteof inj.,(ii) amount of fluid inj.(iii) force of inj. (iv) sp.gr. of drug soln [Hyperbaric.. In 10% glucose ; Hypobaric ..in distilled water] , (v) position of patient– lying prone/lateral or tilted with head– down position.

USES OF SPINAL ANAESTHESIA

- Lower limbs surgery, Pelvic surgery,
- Lower abdomen surgery , Prostatectomy,
- Obstetric procedures, caesarian section
- Appendicectomy
- ***Commonly Used Spinal LA s :***
- Lignocaine, Bupivacaine, Tetracaine.
- **(Addition of adrenaline to spinal anaesthetic increases the duration or intensity of block).**

ADVANTAGES OF SPINAL ANAESTHESIA

- No loss of conciousness
- Complete relaxation and good analgesia
- Cardiac, pulmonary, renal disease or diabetic patients tolerate spinal anaesthesia better than GA.

COMPLICATIONS OF SPINAL ANAESTHESIA

- Severe Headache
- Hypotension
- Reduced venous return to the heart
- Respiratory paralysis
- Septic Meningitis & nerve injury
- Postoperative urinary retention
- Cauda Equina Syndrome
- Hiccups.

CONTRAINDICATIONS TO SPINAL ANAESTHESIA

- Young children
- Vertebral abnormalities
- Sepsis in the region of lumbar puncture site
- Hypotension and Shock

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I.V. REGIONAL BLOCK ANAESTHESIA

- IV LA in tornequet occluded limb
- Regional anaesthesia within 2 min,DOA-10 min
- **Uses :** 1) Upper limb surgery
- 2) Orthopedic procedures
- (80 ml--- 0.25% lignocaine IV)

LIGNOCAINE IN CARDIAC ARRYHTHMIAS

- 1) Severe ventricular arryhthmias
- 2) Digitalis – induced ventricular tachycardia
- 3) Emergency termination of V.T. following * Recent MI, Cardiac surgery & Cardiac catheterization
- 4) Prophylactically to prevent VT during Electroversion

LIGNOCAINE IN CARDIAC ARRYHTHMIAS

- Dose :
- 1) Single large initial I.V. Bolus dose
  (1-2 mg/kg in 30 secs)
  2) Followed by continuous I.V. infusion :

*** immediate action

*** short duration – 10 min

*** minimal plasma protein binding

*** rapidly metabolized by liver

ACTION OF LIGNOCAINE IN CARDIAC ARRYHTHMIAS

- Depresses diastolic depolarization,automaticity, excitability, conduction
- Shortens ventricular action potential – prolong ERF
- Selective electrophysiological effect on ventricular myocardium --- (Abolishes ventricular arryhthmias)
- Lack of action on A.V. node, Nodal conduction velocity (Hence, useful in Digital – induced ventricular arryhthmias)

ACTION OF LIGNOCAINE IN CARDIAC ARRYHTHMIAS

—Unlike, Quinidine,Procainamide :

- No effect on conduction velocity
- No effect on surface ECG
- Abolishes Ventricular arryhthmias
- S/Es : Drowsiness, Muscle twitchings, convulsions, disorientation, BP, HR, COP
- Precautions : 1) Keep Diazepam, Barbiturates Inj ready
- 2) Lignocaine IV should not contain preservative, vasoconstrictor