LOCAL ANAESTHESIA

Definition: Loss of all forms of sensation - pain, touch, temperature & proprioception. Analgesia is only loss of pain sensation.

History: Hypodermic syringe first invented in 1827
Cocaine first isolated in 1860
Cocaine first used in UK 1886
Adrenaline added as vasoconstrictor in 1901
Novocaine - first synthetic local anaesthetic - synthesised in 1905
Lignocaine first synthesised in 1943 & used in clinical practice in 1946

Contents:

Local anaesthetic
Lignocaine is commonest - amide linkage - greatest depth of anaesthesia.

Vasoconstrictor
Prolongs anaesthetic time, reduces systemic absorption, aids haemostasis. Adrenaline commonest - also noradrenaline and felypressin. Only real contraindication to adrenaline & noradrenaline are tricyclic antidepressants.

Reducing Agent
Sodium metabisulphate acts as antioxidant

Preservative
Capryhydrocuprienotoxin is commonest. May be allergen in those sensitive to local anaesthetics.

Fungicide
Thymol

Vehicle
Correct dilution obtained by adding modified Ringer's solution.

Properties:

Efficacy
Good depth of anaesthesia especially with lignocaine & adrenaline - adequate for most procedures up to 45 minutes. Predictable & rapid onset of anaesthesia. 98% of injections effective with mean onset time of 1.5 minutes. Duration about 3 hours less for other agents and if no vasoconstrictor.

Convenient
Simple and low cost technique - avoids morbidity and mortality of general anaesthesia - allows for patient co-operation - avoids need for inpatient and hospitalisation. However, many patients reluctant to undergo treatment under local anaesthetic. In view of proven efficacy main reason for resistance is poor technique resulting in pain and "bad experience". Old myths perpetuated by patients resulting in lower uptake of LA in UK than Europe or USA. With increasing need to reduce NHS costs and

implications of Poswillo report more treatment will need to be done under LA. Patient education and good technique is vital to achieve this.

Safety

Very few contraindications - safe in pregnancy. With cardiovascular disease the better depth of anaesthesia obtained by using lignocaine & adrenaline results in less endogenous adrenaline & noradrenaline being secreted than if another less effective agent is used. Avoid local infiltration's in areas of acute infection - use regional blocks. Avoid regional blocks in bleeding diatheses - use local infiltration +/- intraligamentous injections.

Therapeutic ratio(TR) = LD(50)/ED(50) higher value is safer. Of all solutions available lignocaine has lowest TR. Maximum adult dose is 500mg (20ml) if vasoconstrictor added or 200mg plain. In overdose effect on myocardium results in bradycardia, hyopotension and cardiac arrest.

Metabolism

Esters - Procaine (Novocaine) broken down by esterases in blood and liver to benzoic acid and ethanol.

Amides - Lignocaine and most other common agents. Hydrolysed and conjugated with glucuronic acid in liver. Excreted by kidney in both conjugated and unconjugated forms. Therefore use reduced dose in renal & hepatic disease.

Mode of Action

Combination of weak base and strong acid. Hydrolysis in tissues at weak alkaline pH results in liberation of active free base which is then taken up by lipid around nerve. Basic action is to stabilise nerve membrane. Reduces Na+ permeability and thus prevents rise in intracellular Na+ needed to propagate action potential.

$$B.HCL + NaHCo_3 \xrightarrow{pH\ 7.4} B. + NaCl + H_2Co_3$$

Methods:

Topical Surface contact.

Paste, EMLA, ethyl chloride. May be adequate for simple incision and drainage, pre-injection, & simple soft tissue work (EMLA).

Infiltration Deposition of solution at or close to site of surgery.

a) Sub mucous - for simple soft tissue surgery - includes long buccal infiltration. Not suitable for pulpal anaesthesia.

b) Supraperiosteal - the commonest technique - solution diffuses through cortical bone into apical area. Usually adequate especially in maxilla but adult mandibles to thick in posterior buccal cortex.

c) Subperiosteal - painful! - use if (b) fails.

d) Intraosseous - very painful! again use if (b) fails. Drill small access hole over appropriate tooth apex and deposit 0.25ml of local anaesthetic.

e) Intraseptal - variation of (d) - similar indications but inject through softer crestal bone to reach apex.

f) Intraligamentous - painful but occasionally very useful especially for acute pulpitis where regional block fails to give adequate depth of anaesthesia. Must use special syringe to avoid breaking cartridge. Push needle along root surface to apex - inject small volume of solution - effect is rapid so proceed with surgery immediately.

Regional Block: Remote from site of surgery.

Contraindicated in patients with bleeding diatheses even if controlled! Success depends on knowledge of local anatomy and good technique.

a) Mental - suitable for lower anteriors and first (? second) premolars. Mental foramen variable position but usually below and between apices of premolars.

b) Inferior Dental - foramen at level of occlusal plane in adults approximately 2cm distal to internal oblique ridge of mandible. In children foramen is below occlusal plane while in elderly and/or

edentulous it is above it. Modify technique accordingly. Failure often due to anatomical variation. Check OPT if available for position of foramen.

c) Posterior superior alveolar block - usually needle is not positioned at the nerve to avoid potential damage to pterygoid plexus and maxillary artery. Is actually an infiltration above apices of second molars followed by massaging solution postero-superiorly. Deep injection may cause vascular damage and sometimes ocular problems due to solution entering inferior orbital fissure. Very occasional blindness - beware!

d) Infra orbital - rarely needed in routine practice. May be useful if acute infection locally or for extensive bone surgery. Palpate infra orbital foramen - insert needle vertically above root of upper second premolar to lie over foramen - deposit solution at foramen which can be felt by palpating finger. Extraoral approach is described but seldom needed.

Complications:

a) Local
b) General

Local

1) Failure to obtain anaesthesia

Commonest problem but 98% of injections give adequate result.
Poor technique - abnormal anatomy - local infection with low pH - out of date solution - rarely individual patient resistance.

2) Pain

Major cause of patient anxiety and resistance to local anaesthesia. Vital that operator minimises pain at all times.
Sharp disposable needle at right angles to stretched mucosa - slow injection - warm solution - ? topical before injection - anaesthetise palate *via* buccal papillae first.

3) Haematoma

Inadvertent laceration of blood vessels occurs in 2 - 11% of injections. Morbidity (rarely mortality!) depends on area involved. Commonly medial pterygoid and pterygoid plexus. Avoid regional blocks in patients with bleeding diatheses or on anticoagulants as paraphayngeal haematoma may compromise airway as well as resulting in excessive blood loss. If minor reassure and prescribe antibiotics otherwise refer urgently.

4) Intravascular injection

Minimise by using aspirating syringe at all times. Intravascular injection increases toxic effect of drug. Both lignocaine and adrenaline in overdose are potentially lethal. Commonest side effect is tachycardia, fainting and anxiety. May produce hypertension especially if on tricyclics which can lead to headache which is usually self limiting or rarely intracranial haemorrhage and/or cardiac failure.

5) Blanching

Locally results from increased tissue tension and vasoconstriction. Remote from injection due to intravascular injection - blocking of autonomics to vessels. Results in transient ischaemia but underlies advice to use plain local anaesthetics in patients at risk from osteoradionecrosis where infiltration's are necessary. Regional blocks should be OK if aspirating technique used.

6) Trismus

Difficulty in opening mouth. Usually from intramuscular haematoma in medial pterygoid. If delayed then may be due to infection especially retromandibular, submasseteric and subtemporal spaces. Prescribe antibiotics and analgesics - if severe with systemic upset and not resolving rapidly refer.

7) Facial paralysis

Not uncommon complication. Due to injection of LA into parotid capsule and involvement of facial nerve. Almost always from ID block when needle passes to far posteriorly. Avoid by correct technique (syringe over opposite premolars). Reassure patient that will resolve in 3 - 4 hours. MUST provide protection for eye if unable to close it. Failure to do so may lead to corneal ulceration - blindness and an indefensible claim for negligence!

8) Prolonged anaesthesia

Results from nerve damage either direct from intraneuronal injection (very sharp pain in area supplied by nerve) of indirect from haemorrhage, infection, oedema or contaminated solution. Record area of reduced sensation in notes accurately for baseline and to asses progress. Usually resolves rapidly if no improvement in 3 months then refer. Note that agents like endomethasone are neurotoxic. If come into contact with ID nerve from poor RCT then paraesthesia is likely to be permanent! Do not use them.

9) Broken needles

Rare now that disposable needles are universally available. Faulty technique - don't bend needle or exert excessive lateral force while injecting. If fractures keep tissue under tension and grasp end with clip etc. If end invisible DO NOT attempt to find it. Refer patient immediately and prescribe antibiotics. Keep broken needle stub - your medical defence association may be able to show that there was a manufacturing fault.

10) Infection

Fairly rare. May result from contaminated needle or solution if disposables not used. Presents as trismus with or without systemic signs and symptoms. Refer.

11) Lip trauma

Ensure full warnings and advice given to patients and parents about dangers of lip biting and thermal damage while anaesthetised.

12) Visual disturbances

Very rarely diplopia and blindness follows injection. Probably due to inadvertent intra-arterial injection around maxilla and orbit. Should resolve within 3 hours - if not need urgent referral to hospital.

General

1) Fainting

Maybe due to injection more likely just fear and anxiety. Lay flat with head down (not women in last trimester otherwise get venacaval compression - lie on side). Should recover in < 1minute. If not unlikely to be a faint and need to consider other causes of collapse.

2) Drug interactions

Main group to look out for and avoid is tricyclics. Vast number on market with various trade names - if in any doubt look up in BNF. MAOI's are not a contraindication. Theoretical problem of Citanest and Octapressin inducing labour in late last trimester. Rare conditions may contraindicate local anaesthetic porphyria is a good example where lignocaine & adrenaline can trigger an attack. LA often used as haemostatic agent under GA. Halothane and lignocaine can interact to produce sever cardiac arrhythmia's. Always discuss with anaesthetist before injecting.

3) Transmission of viral infections

Hepatitis B and HIV are both transmitted by instruments contaminated with infected blood - hepatitis more readily than HIV. Prevention is only option. All patients should be treated as if they have a transmissible infection because only then will your aseptic technique and cross infection measures be adequate to protect yourself and your patients. Remember, the patients that tell you that they are hepatitis or HIV positive are not the problem. It is the "routine" patient who you don't take an adequate history on and on who you allow a breakdown in aseptic technique to occur while treating who poses the greatest threat.

4) Sensitivity Reactions

Fairly uncommon. May vary from local urticaria and oedema to laryngospasm and anaphylaxis. Avoid by careful history. Send "allergic" patients for skin testing if in doubt. Local, mild reactions respond to antihistamines such as Chlorpheniramine (piriton) 4 mg tds for 3 days. Refer if in doubt. More sever reactions may need Hydrocortisone 100mg iv and adrenaline 1ml of 1:1000 solution im at 5 minute intervals up to 5 times. Continued support with oxygen at 15L/min and prepare for CPR if needed. Urgent referral to hospital *via* ambulance for all but the mildest reactions.

5) Cardio-respiratory emergencies

One of numerous causes of "collapse in the dental chair". Basic life support (ABC) theory and practice MUST be second nature to anyone operating on and prescribing drugs for (especially injecting powerful agents like lignocaine and adrenaline). This is a lecture in itself and is covered elsewhere in the course.