REGIONAL ANAESTHESIA

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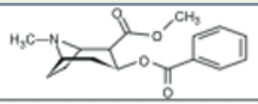
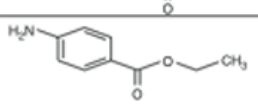
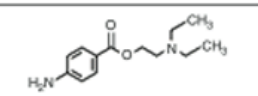
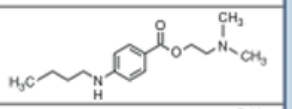
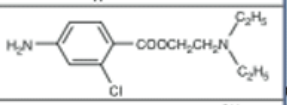
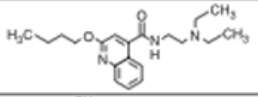
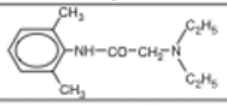
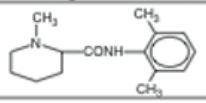
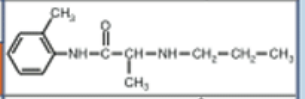
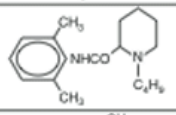
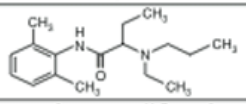
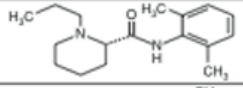
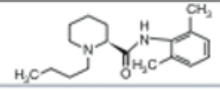
- Local anaesthetics
- Regional anesthesia
  - Types
  - Uses and benefits
  - Video

History

- 1860 cocaine isolation– Niemann
- 1884 clinical use – Koller
- 1905 synthesis of procaine – Einhorn
- 1943 synthesis of lidocaine – Löfgren
- 50-th – trimekaine (CSSR)
- 1950 bupivacaine synthesis – Ekenstam
- 1963 clinical use of bupivacaine - Widman

LOCAL ANESTHETIC	CHEMICAL STRUCTURE	CLASS	DATE
COCAINE		ESTERS	1884
BENZOCAINE			1900
PROCAINE			1905
TETRACAINE			1930
CHLOROPROCAINE			1932
CINCHOCAINE		AMIDES	1952
LIDOCAINE			1947
MEPIVACAINE			1957
PRILOCAINE			1960
BUPIVACAINE			1963
ETIDOCAINE			1972
ROPIVACAINE			1997
LEVOBUPIVACAINE			1935

Local anaesthetics

- Block transmission of action potentials in nerve fibers
- LA blocks somatic sensory, autonomic and motor nerve conduction
- Weak bases

What does the block of nerves lead to?

- Somato-sensory nerves - loss of cutaneous sensation (numbness), proprioception
- Motor nerve - loss of movement
  - (if it is a motor nerve) in the distribution of the peripheral nerve
- Autonomic nerves - vasodilation and warmth

Regional anesthesia

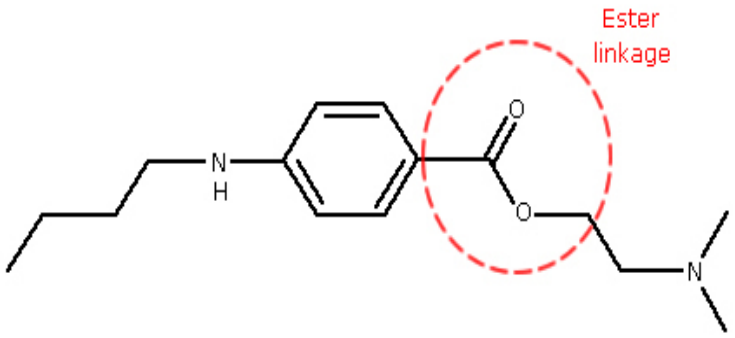
- Surgery can proceed without pain
- Postoperative analgesia dependent on the choice of LA and the anatomical location of the block
- Possible use of catheter – prolonged analgesia
- RA can be placed awake, with sedation or under general anaesthesia

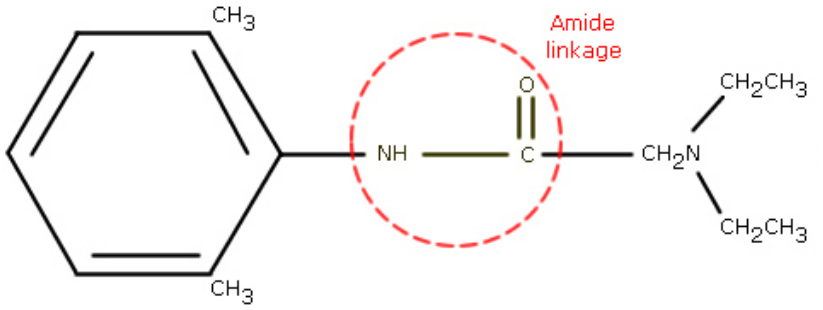
Use of RA

- Analgesia, e.g. fractured femur, fractured ribs
- As the sole anaesthetic for surgery with or without sedation, e.g. hand surgery
- In combination with GA, e.g. total knee replacement
- For postoperative analgesia

LA – structure

Esters	Amides
procaine	lidocaine
chlorprocaine	bupivacaine
tetracaine	ropivacaine
amethocaine	trimecaine





Pharmacokinetics

Esters

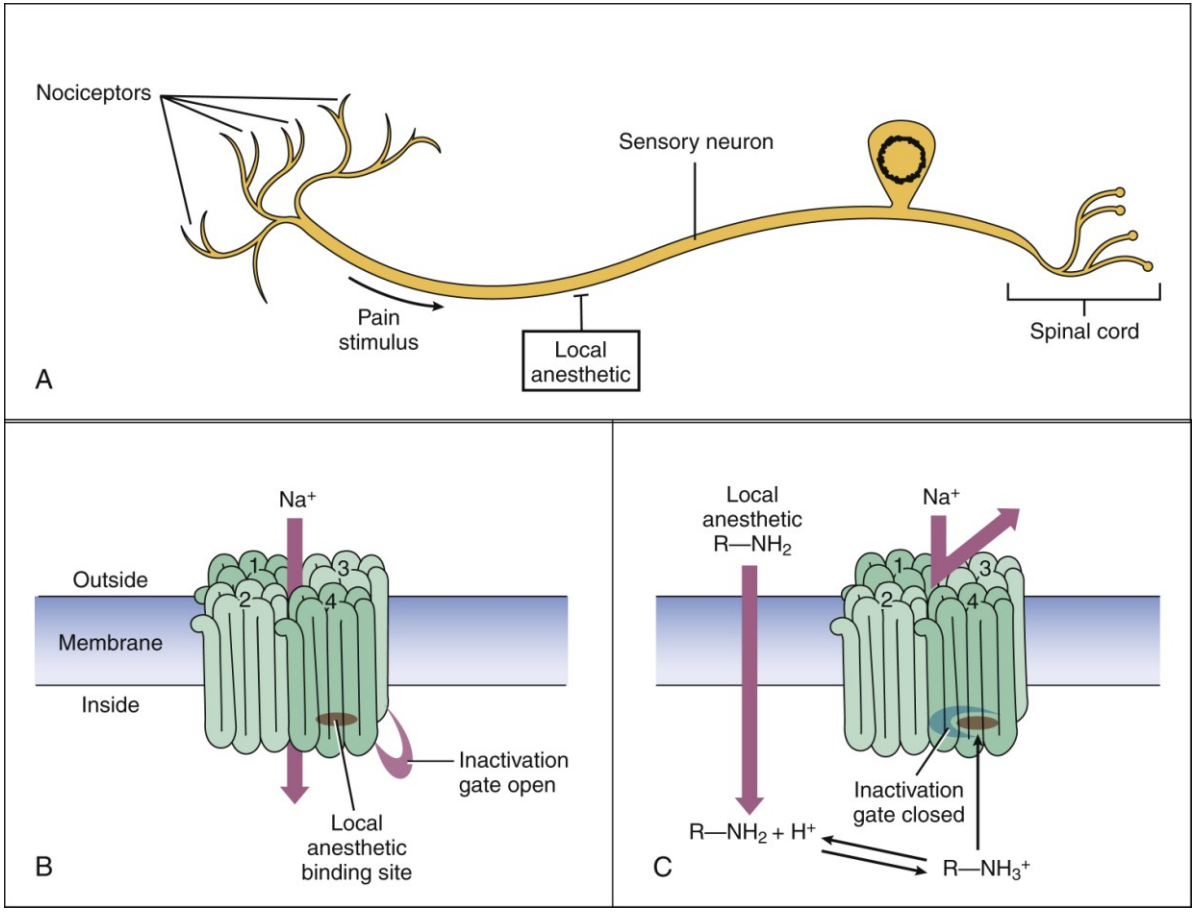
- Poorly protein bound – shorter duration of action
- Broken down by esterases
- Allergic reaction

Amides

- Highly protein bound – longer duration of action
- Metabolised by amidases in the liver
- Rarely allergic reactions

Mechanism of action

- reversible blockade of Na channels



Choice of LA

- Potency
- Speed of onset
- Duration of action
- Toxicity

Potency

- Lipid solubility
  - bupivacaine is more lipid soluble than lidocaine by a factor of about nine

Lidocaine	Bupivacaine
150	1000

Speed of onset

What determines the proportion of any drug in the ionized form compared with the unionized form?

Three factors:

- whether the drug is a weak acid or a weak base
- the pKa of the drug - pH at which the ionized and unionized forms are present in equal amounts
- the pH of the environment

Speed of onset - pKa

- The higher the proportion of unionized drug, the more rapid the passage across the membrane and the faster the onset of block.

Lidocaine	Bupivacaine
7.7	8.1

Can you think of a situation when tissue pH is low and local anaesthesia may be indicated?

Duration of action

- Protein binding
- Rate of removal from the site and subsequent metabolism
- Drug's inherent vasodilator property
- Additives - epinephrine

	Lidocaine	Bupivacaine
Protein binding	70 %	95 %
Metabolism	liver	liver

Local anaesthetics - additives

- **Epinephrine = adrenaline** – decreased absorption, metabolism, toxicity
  - CAVE: do not use for terminal part of extremity
- **Bicarbonate** – faster onset of action
- **Clonidine** or **dexmedetomidine** - α2 adrenergic agonist, prolongs duration of sensory and motor block
- **Opiods** – spinal/peripheral opiates receptors
- **Ketamine** – NMDA receptor agonist, weak LA properties
- **Dexamethasone** - prolong duration, reduce inflammation

LA - complications

- Bleeding
- Infection / gangrene – with additives
- Block failure
- Allergic reactions – anaphylaxis
- Nerve injury - very rare
- Toxicity – cardiac and neuro

- Technique related

LAST = local anesthetic systemic toxicity

Cardiotoxicity

- Block of Na cardiac channels
- Direct myocardial depressant effect - CV collapse
- Tachycardia may enhance frequency - dependent blockade

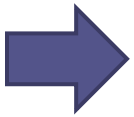
- Bupivacaine > ropivacaine > lidocaine

Toxicity of LA

Neurotoxicity

- Biphasic effect
- Inhibitory neurons are blocked – excitatory effects
- Central neurones are then depressed

- Circumoral tingling
- Visual disturbance
- Tremors
- Dizziness

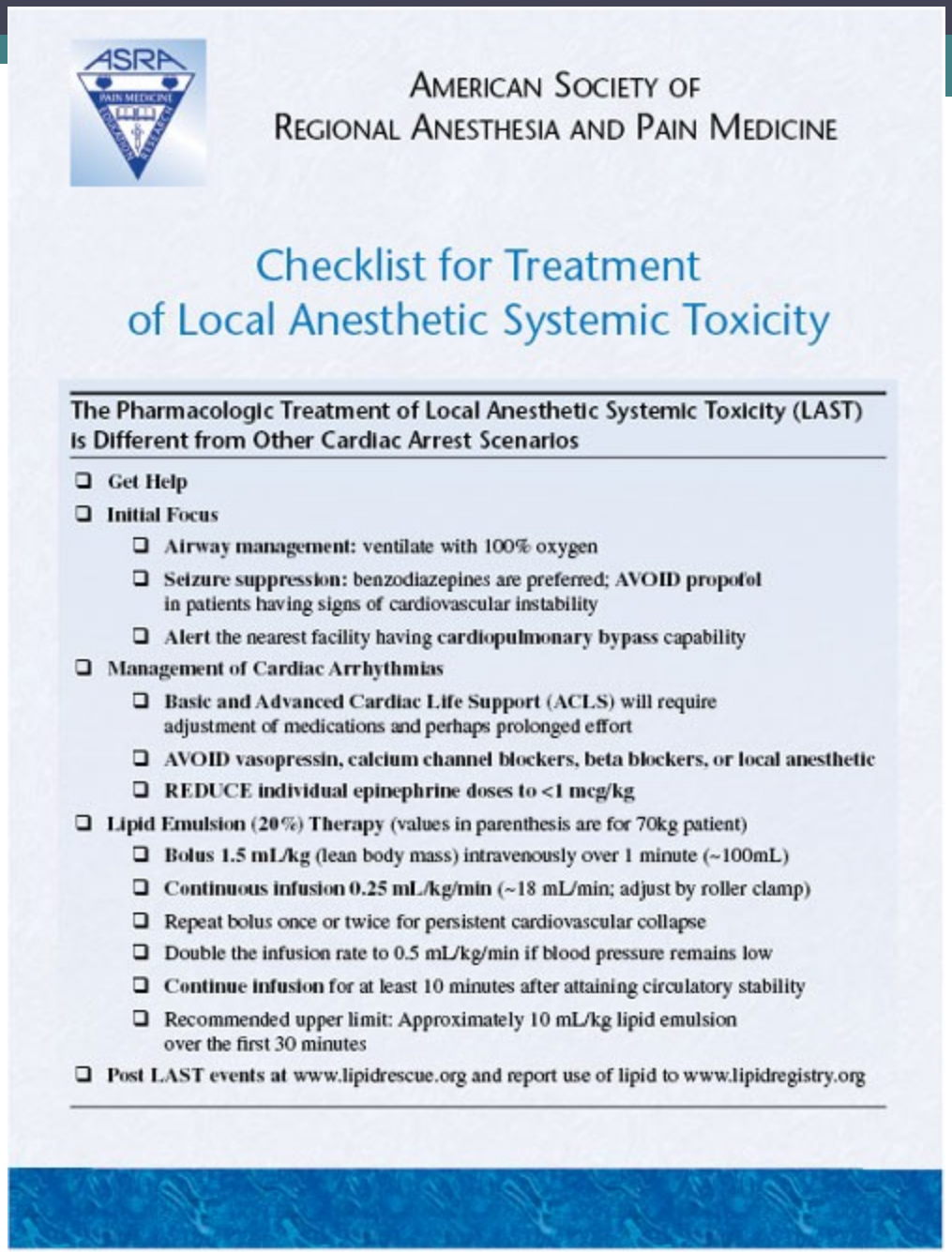


- Convulsions
- Arrhythmias
- Coma
- Apnoea
- Death

Management of LAST

- ABC approach
- 100% Oxygen
- Treat convulsions - BZD or thiopental
- Treat arrhythmias - amiodarone
- Lipid emulsion (20% Intralipid)

- If cardiovascular collapse – start CPR



AMERICAN SOCIETY OF
REGIONAL ANESTHESIA AND PAIN MEDICINE

Checklist for Treatment of Local Anesthetic Systemic Toxicity

The Pharmacologic Treatment of Local Anesthetic Systemic Toxicity (LAST) is Different from Other Cardiac Arrest Scenarios

- ❑ **Get Help**
- ❑ **Initial Focus**
  - ❑ **Airway management:** ventilate with 100% oxygen
  - ❑ **Seizure suppression:** benzodiazepines are preferred; **AVOID propofol** in patients having signs of cardiovascular instability
  - ❑ **Alert** the nearest facility having **cardiopulmonary bypass capability**
- ❑ **Management of Cardiac Arrhythmias**
  - ❑ **Basic and Advanced Cardiac Life Support (ACLS)** will require adjustment of medications and perhaps prolonged effort
  - ❑ **AVOID vasopressin, calcium channel blockers, beta blockers, or local anesthetic**
  - ❑ **REDUCE individual epinephrine doses to <1 mcg/kg**
- ❑ **Lipid Emulsion (20%) Therapy** (values in parenthesis are for 70kg patient)
  - ❑ **Bolus 1.5 mL/kg** (lean body mass) intravenously over 1 minute (~100mL)
  - ❑ **Continuous infusion 0.25 mL/kg/min** (~18 mL/min; adjust by roller clamp)
  - ❑ Repeat bolus once or twice for persistent cardiovascular collapse
  - ❑ Double the infusion rate to 0.5 mL/kg/min if blood pressure remains low
  - ❑ **Continue infusion** for at least 10 minutes after attaining circulatory stability
  - ❑ Recommended upper limit: Approximately 10 mL/kg lipid emulsion over the first 30 minutes
- ❑ **Post LAST events at** www.lipidrescue.org and report use of lipid to www.lipidregistry.org

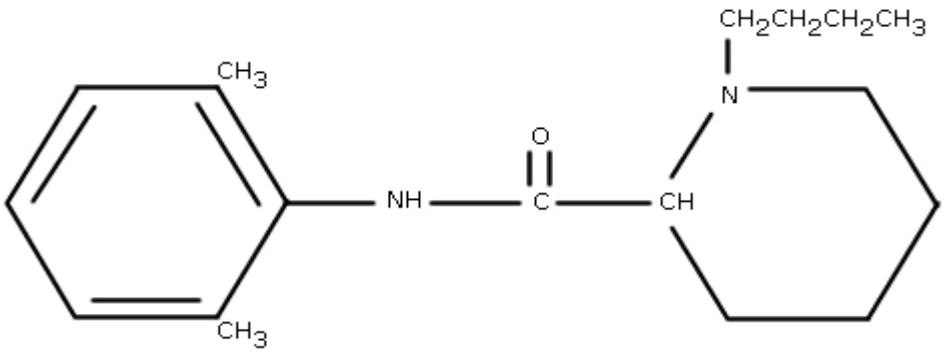
Figure 1. Used with permission of ASRA.

Lidocaine, Trimecaine

- Low level of toxicity
- Lidocaine – class Ib anti-arrhytmic
- Max doses lidocaine
  - 3mg/kg without adrenaline
  - 7 mg /kg with adrenaline
- Concentrations
  - Topical 10%, 2%
  - Nerve blockade 0.5 – 1%

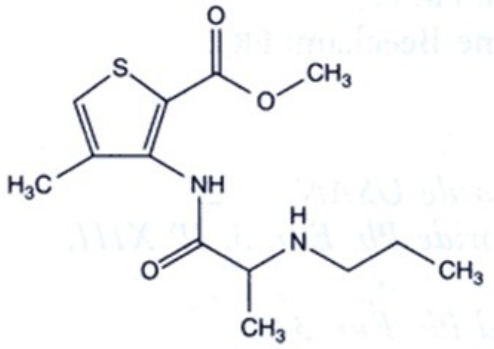
Bupivacaine

- Slower onset
- Longer duration of action
- More toxic
- Racemic mixture
- 0.25 % and 0.5 % concentrations
- Also in combination with glucose 80 mg/ml
- Max dose 2mg/kg



Articaine

- Fast onset
- Moderate duration of action
- Used in dentistry with adrenaline
- Concentrations - 1 - 2 %



EMLA cream

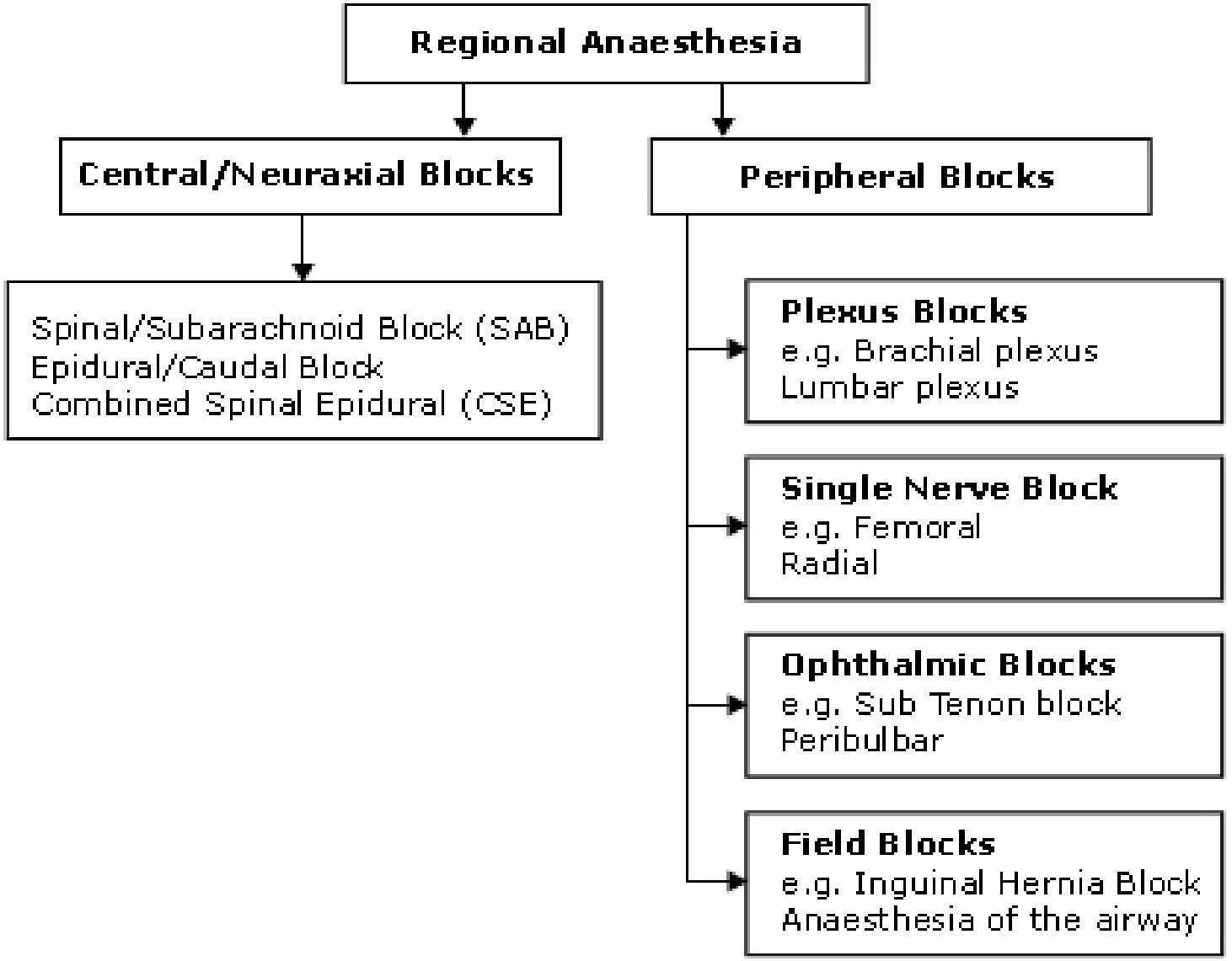
- Eutectic mixtute of local anaesthetic in cream
- 2.5 % lidocaine + 2.5 % prilocaine
- Topical anaesthesia prior cannulation

Local anaesthetics - summary

- Esters and amides
- Onset of action – pH and pKa
- Duration of action – protein binding, vascularity
- Potency – lipid solubility
- Used with additives
- Side effects – neuro and cardiac toxicity, alllergic reaction (esters)

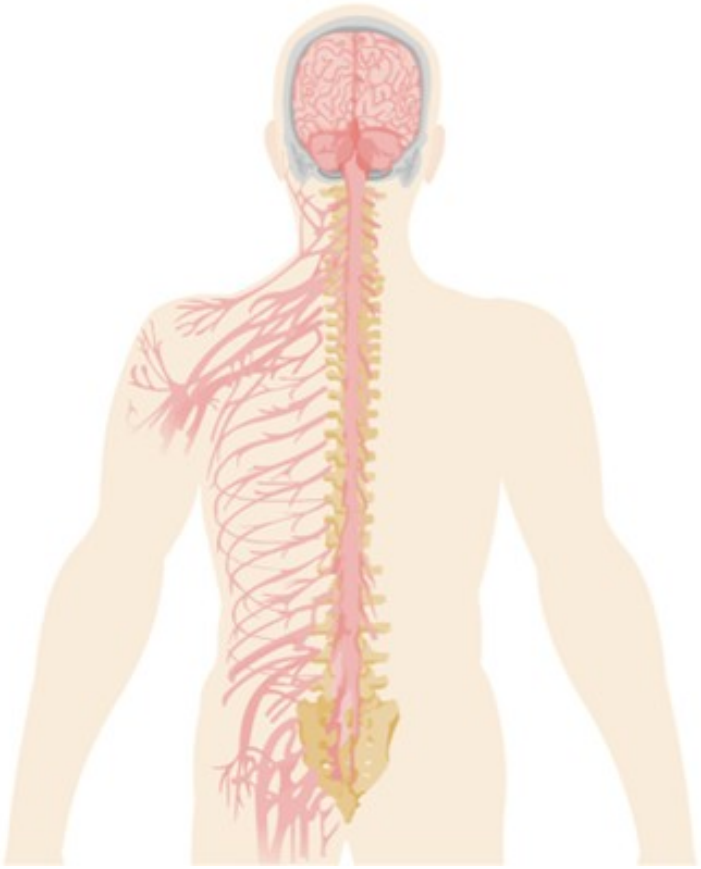
Use of Local Anaesthetic agent

- Topically: skin, mucous membranes, gel, cream, spray
- Infiltration: for field-blocks where superficial nerves are blocked locally
- Intravenously: for intravenous regional anaesthesia (IVRA) – lidocain only
- Epidural or subarachnoid: for regional anaesthesia blocking spinal nerves


Regional Anaesthesia
Central/Neuraxial Blocks
Peripheral Blocks
Spinal/Subarachnoid Block (SAB)
Epidural/Caudal Block
Combined Spinal Epidural (CSE)
Plexus Blocks
e.g. Brachial plexus
Lumbar plexus
Single Nerve Block
e.g. Femoral
Radial
Ophthalmic Blocks
e.g. Sub Tenon block
Peribulbar
Field Blocks
e.g. Inguinal Hernia Block
Anaesthesia of the airway

When to use regional techinques

1. Patient safety
2. Patient satisfaction
3. Surgical outcome



1. Patient safety

- A frail elderly diabetic patient with severe COPD, requires an amputation of the fifth toe.

- Ring block
- Ankle block
- Popliteal block
- Sciatic block
- Spinal or epidural

1. Patient safety

- A frail elderly diabetic patient with severe COPD, requires an amputation of the fifth toe.

- Ring block
- **Ankle block**
- Popliteal block
- Sciatic block
- Spinal or epidural

2. Patient satisfaction

- Very low incidence of postoperative nausea or vomiting (PONV)
- Rapid resumption of oral intake
- No sore throat
- Good initial post operative analgesia
- Early ambulation/discharge
- Increased 'control'

3.Surgical outcome

- Any measure that improves safety will improve surgical outcome.

  - 'awake' **carotid endarterectomy**
  - 'awake' **craniotomy**
    - assess the patient's neurological status during surgery

Other benefits

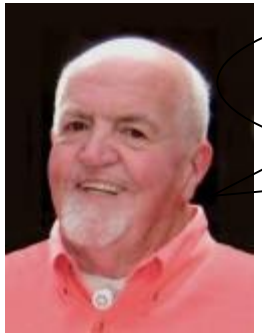
- Supression of stress response
  - Vasodilation
    - improved delivery of O2
    - Better tissue perfusion
- Analgesia – low dose or no opioids
  - GA + epidural analgesia / fascial block

Prerequisites for the RA

- Informed patient consent incl. risks/benefits
- Discussion with the operating surgeon
- Check no contraindications to block
- Skilled assistance available
- Intravenous access
- Full patient monitoring
- Immediate access to emergency drugs / defibrillator
- Fasted patient

Golden rules

- 1. Know the anatomy, the technique and the possible complications
- 2. Be prepared to fail – have a back up plan



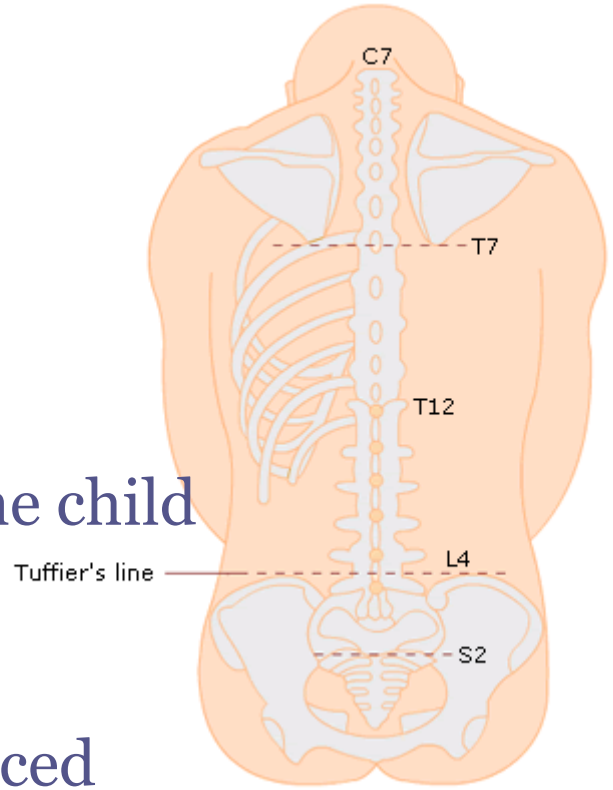
Regional anaesthesia is simply an exercise in applied anatomy

Alon Winnie

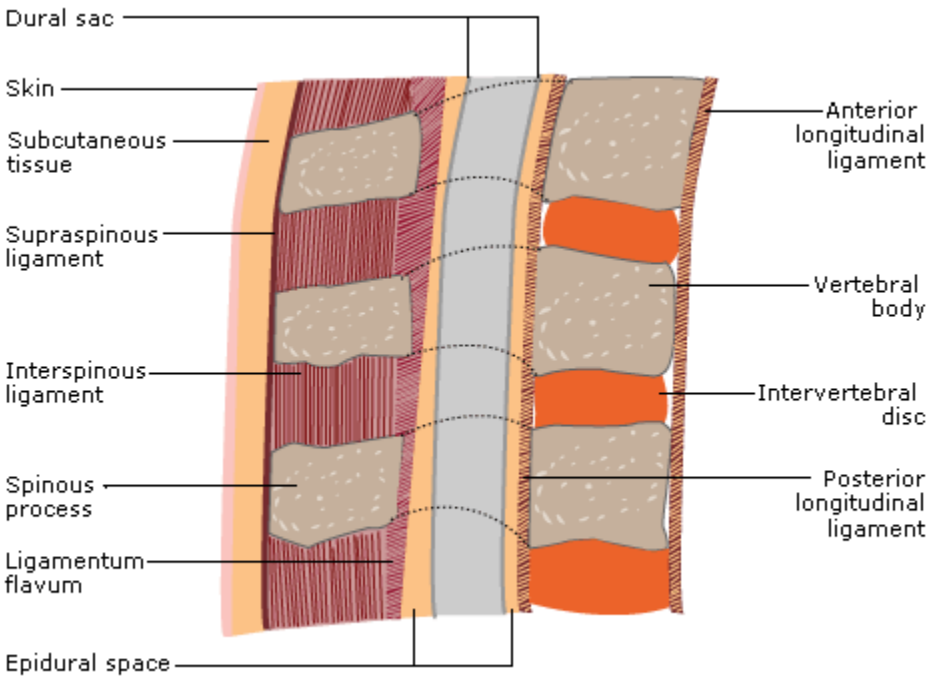
Most common regional anaesthesia

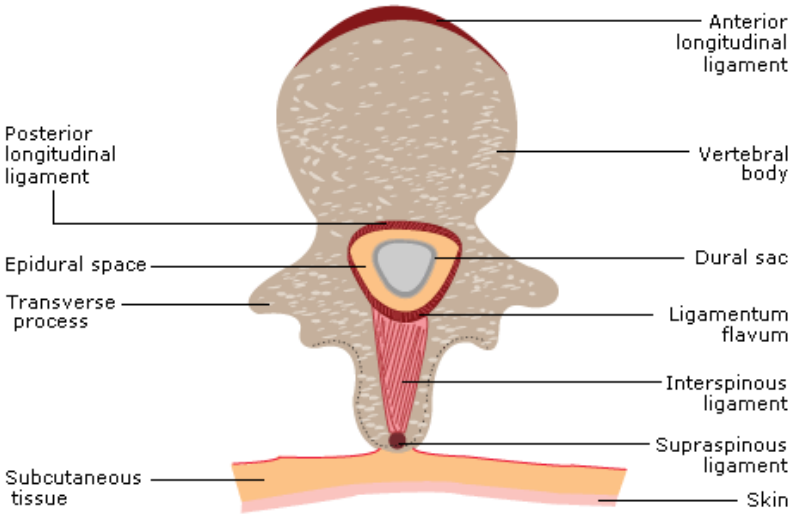
Caesarian section

- Patient safety
  - Control of airway
- Patient satisfaction
  - Awake during the delivery of the child
  - Presence of partner
- Surgical outcome
  - Intraoperative bleeding is reduced
  - Reduced stress response



Neuroaxial blocks





RA combined with GA

- Typically, blocks are performed in the awake or sedated patient **before** inducing general anaesthesia.
  - Able to respond to severe pain and paraesthesia
  - Verbal contact – LA toxicity signs, side effects related to blocks / intrathecal injection

RA combined with GA

After induction

- Paediatric population
- Non compliant adult population
- Difficult position, e.g. placement of an epidural for a fractured pelvis
- If the patient refuses to have the technique performed awake

Regional anaesthesia - summary

- RA can be used alone or in combination with general anaesthesia
- RA can improve patient safety and satisfaction or surgical outcome
- RA is a serious and potentially dangerous procedure
- All the appropriate consent, monitoring and safeguards need to be in place before block performance
- The subset of neuraxial blocks are very common and have clear contraindications and complications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DIRECTOR
CAMERA
DATE
SCENE
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Questions ?