LOCAL ANESTHETICS AND REGIONAL ANESTHESIA

Dr Mahmoud Al-mustafa

Associate professor/ Faculty of medicine

Department of anesthesia

Local Anesthetics- History

- 1860 - cocaine isolated from *erythroxylum coca*
- Koller - 1884 uses cocaine for topical anesthesia
- Halsted - 1885 performs peripheral nerve block with local
- Bier - 1899 first spinal anesthetic

Local Anesthetics - Definition

A substance which reversibly inhibits nerve conduction when applied directly to tissues at non-toxic concentrations

- Local anesthetics block generation, propagation, and oscillations of electrical impulses in electrically excitable tissue.
- Mainly by acting on Na channels.

PHARMACOLOGY AND PHARMACODYNAMICS

Clinically used local anesthetics consist of lipid-soluble, substituted benzene ring linked to amine group via alkyl chain containing either an amide or ester linkage.

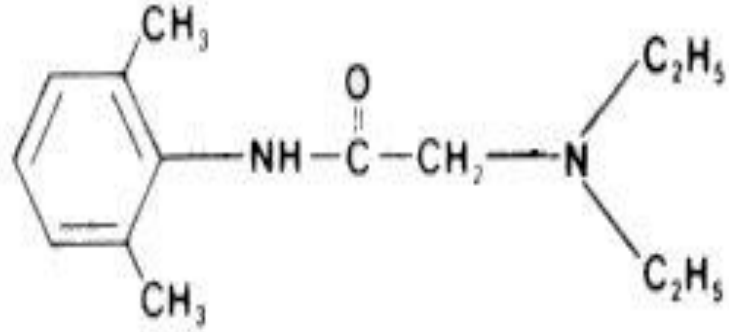
- Type of linkage separates local anesthetics into either aminoamides (metabolized in liver) or aminoesters (metabolized in liver or by plasma cholinesterase).

Local Anesthetics - Classes

Amides

Lidocaine

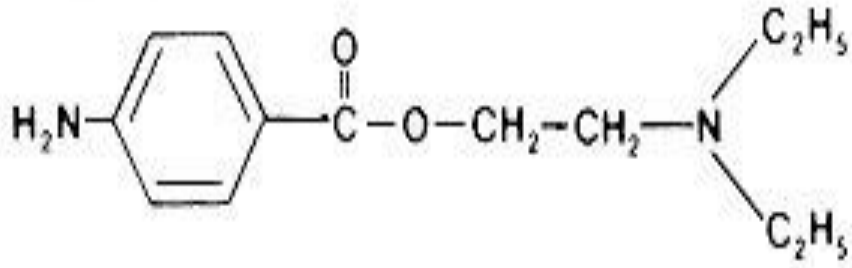
Xylocaine, etc



[redacted]

Procaine

Novocain



Local anesthetics - Classes

Esters	Amides
Cocaine	Bupivacaine
Chloroprocaine	Lidocaine
Procaine	Ropivacaine
Tetracaine	Etidocaine
	Mepivacaine

Local anesthetics - Formulation

Biologically active substances are frequently administered as very dilute solutions which can be expressed as *parts of active drug per 100 parts of solution (grams percent)*

Ex.: 2% solution =

$$\frac{2 \text{ grams}}{100 \text{ cc's}} = \frac{2000 \text{ mg}}{100 \text{ cc's}} = \frac{20 \text{ mg}}{1 \text{ cc}}$$

Local anesthetics - vasoconstrictors

Ratios

Epinephrine is added to local anesthetics in *extremely* dilute concentrations, best expressed as a ratio of grams of drug:total cc's of solution. Expressed numerically, a 1:1000 preparation of epinephrine would be

$$\frac{\text{1 gram epi}}{\text{1000 cc's solution}} = \frac{\text{1000 mg epi}}{\text{1000cc's solution}} = \frac{\text{1 mg epi}}{\text{1 cc}}$$

Local anesthetics - vasoconstrictors

Therefore, a 1 : 200,000 solution of epinephrine would be

$$\frac{\text{1 gram epi}}{\text{200,000 cc's solution}} = \frac{\text{1000 mg epi}}{\text{200,000 cc's solution}}$$

or

$$\frac{\text{5 mcg epi}}{\text{1 cc solution}}$$

Bupivacaine

Amide

- Infiltration: Dose: 2mg/kg
- Concentration : 0.25 % or 0.5 %

Example a 50 kg patient, how much 0.25 % Bupivacaine can I use for infiltration to excise lipoma in the forearm?

Bupivacaine

50 Kg .....max 2mg/Kg

50x 2= 100 mg

0.25% .....2.5 mg/ml

So maximum mls for infiltration is 100/2.5 = 40 ml

Bupivacaine

Epidural anesthesia: Use 0.5-0.75%, moderate onset, 2- to 5-hr duration, max dose 175 mg (225 mg with epinephrine)

- Spinal anesthesia: Use 0.5-0.75%, fast onset, 1- to 4-hr duration, max dose 20 mg
- levo (-) bupivacaine less cardiotoxic than racemic bupivacaine, same

Lidocaine

Amide

- Infiltration: use 1% or 2 %, fast onset, 2- to 8-hr duration, max dose (5 mg/Kg without Epinephrine and 7 mg/Kg with Epinephrine)

- Why Epinephrine increase safety margin ?

Lidocaine

Epidural anesthesia: use 1.5-2%, fast onset, 1- to 2-hr duration, max dose 300 mg (500 mg with epinephrine)

- Spinal anesthesia: use 1.5-2%, fast onset, 0.5- to 1-hr duration, max dose 100 mg
- Topical anesthesia: use 4%, fast onset, 0.5- to 1-hr duration, max dose 300 mg
- IV regional: Use 0.25-0.5%, fast onset, 0.5-1 hr duration, max dose 300 mg

Local Anesthetics - Allergy

- True allergy is very rare
- Most reactions are from ester class - ester hydrolysis (normal metabolism) leads to formation of PABA - like compounds
- Patient reports of “allergy” are frequently due to previous intravascular injections

Local Anesthetics - Toxicity

Tissue toxicity - Rare

- Can occur if administered in high enough concentrations (greater than those used clinically)
- Usually related to preservatives added to solution

Systemic toxicity - Rare

- Related to blood level of drug secondary to absorption from site of injection.
- Range from lightheadedness, tinnitus to seizures and CNS/cardiovascular collapse

Local anesthetics - vasoconstrictors

Vasoconstrictors should not be used in the following locations

- Fingers
- Toes
- Nose
- Ear lobes
- Penis

SPINALS, EPIDURALS AND CAUDALS

DR Mahmoud Al-mustafa

Introduction

- Two main types of anaesthesia – general and regional.
- REGIONAL anaesthesia – Drugs administered directly to the spinal cord or nerves to locally block afferent and efferent nerve input.
- Indications
- Contraindications
- Equipment
- Technique
- Complications

Definitions

Regional anaesthesia – The use of local anaesthetic either alone or to supplement general anaesthesia aiming to prevent or reduce nerve conduction of painful impulses to higher centres.

- **Spinal anaesthesia** – Injection of a local anaesthetic directly into the CSF within the sub-arachnoid space.

- **Epidural anaesthesia** – Injection of a local anaesthetic into the potential space ***outside*** the dura.

- **Caudal anaesthesia –** Injection of local anaesthetic into the caudal canal producing block of the sacral and lumbar nerve roots.

What is the difference between spinal anesthesia and epidural anesthesia

Level of insertion

Site of insertion

Catheter use

Onset of action

Nature of effect (sensory, motor, sympathatic)

Type of surgery

.....

Contraindications to regional techniques

ABSOLUTE

- Patient refusal
- Anticoagulation / coagulopathy
- Local anaesthetic allergy
- Localised infection
- Untreated hypovolaemia

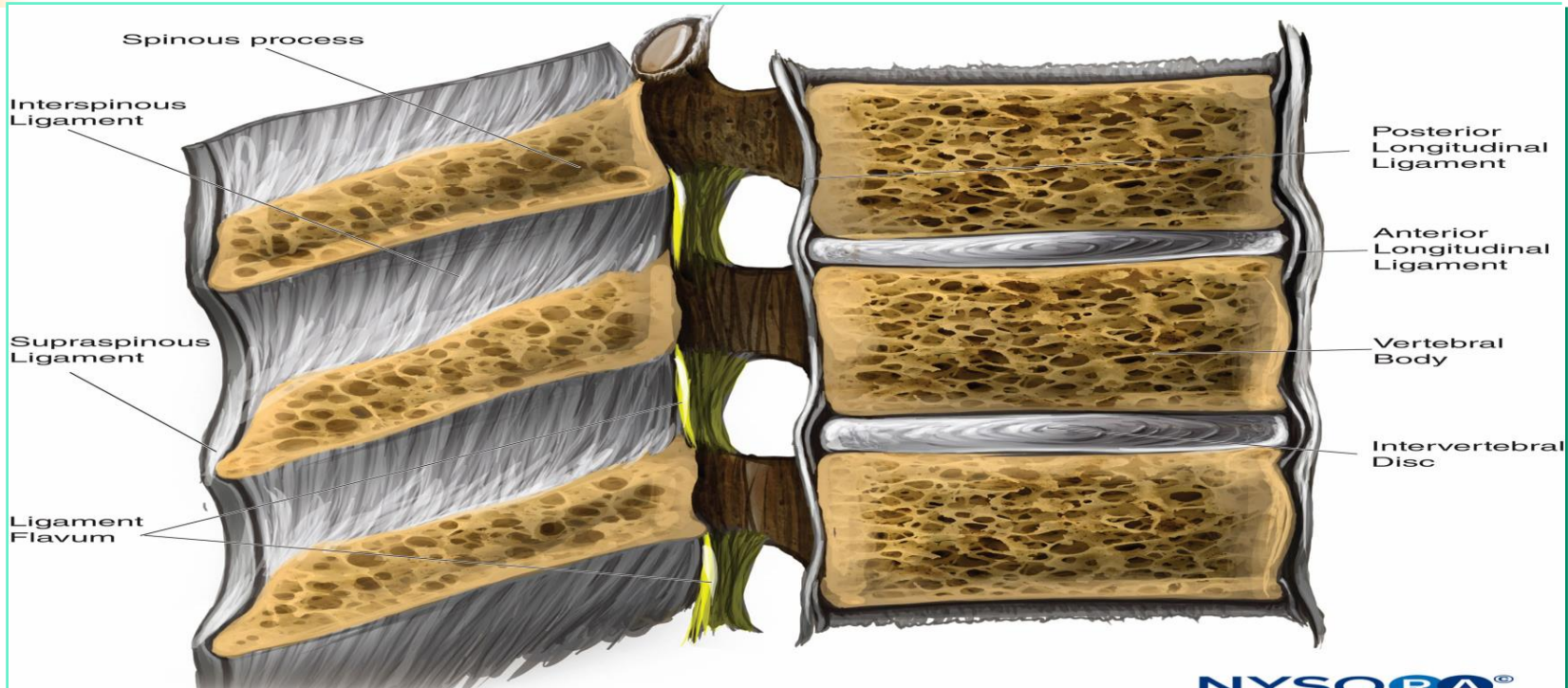
Fixed cardiac output state
eg aortic stenosis

RELATIVE

- Systemic sepsis
- Raised ICP
- Skeletal anomalies
- Neurological disease
- Previous local surgery
- Unco-operative patient

Spinal needle

Layers to reach CSF



Identification of epidural space

Loss of resistance techniqe

Role of U/S

Complications of neuroaxial anesthesia

Needles

Equipment

Complications	**Estimated frequency**	**Comments**
Direct nerve damage	1:10,000 – 1:30,000	No effective treatment
Spinal Haematoma	1:150,000 – 1:220,000	Requires urgent evacuation
Spinal infection	1:100,000 – 1:150,000	Aggressive Abs +/- evacuation
Drug error	Unknown	Avoidable, may be fatal
Systemic toxicity	Unknown	May be fatal without treatment
Respiratory depression	Unknown	Especially using opiods
Hypotension	Common	Early treatment needed
Confusional states	Common in elderly	Especially using opiods
Pruritis / nausea / urinary retention	Up to 16% incidence	Treat effectively
Technical failure	5-25%	Accept failure Consider alternative

CSF

Production

Volume

Complications

Post dural puncture headach

Hypotension

Factors affect the incidence of PDPH

Age

Gender

Length

Type of needle

Size of needle

Experience

.....

Peripheral nerve blocl

Plexuses (Brachial or Lumber)

Nerves (Median, Ulnar, femoral, …)

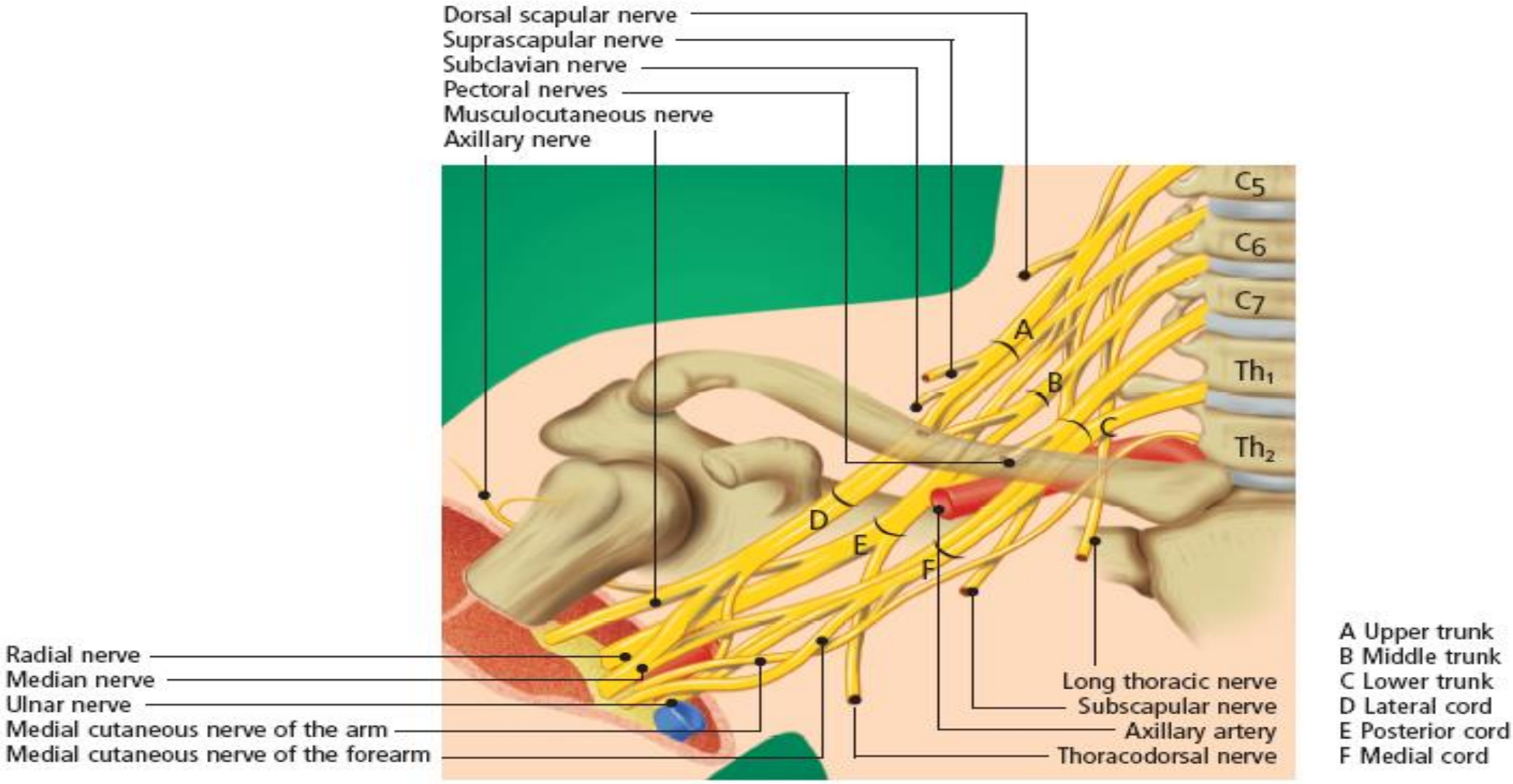
Techniques

Blind

Nerve stimulator

Ultrasound

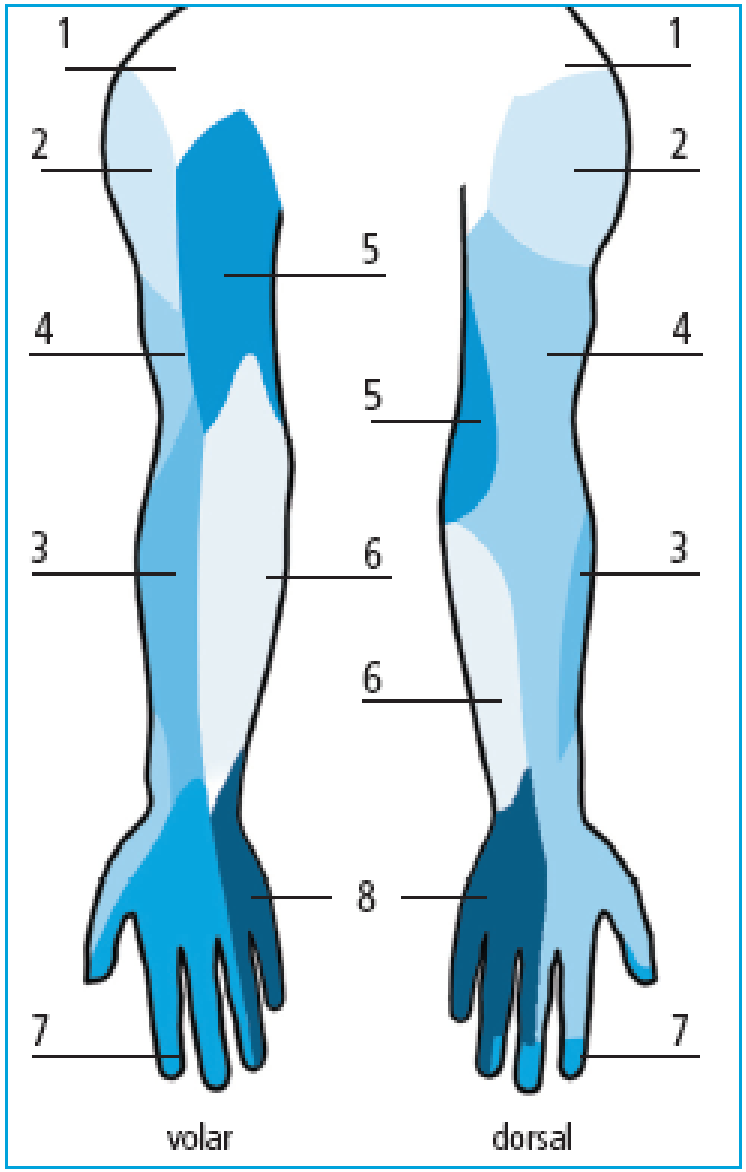
ANATOMY of BRACHIAL PLEXUS:



VIDEO

Motor supply areas

Peripheral nerve	Muscle	Function
Suprascapular nerve	Supraspinatus/ infraspinatus muscles	Forms parts of the rotator muscles
Axillary nerve	Deltoid muscle	Abduction of the arm in the shoulder joint
Musculocutaneous nerve	Biceps brachii muscle Brachial muscle	Bends the elbow in supination
	Flexor pollicis brevis muscle	Pronates the forearm (flexes proximal phalanx of thumb)
Median nerve	Flexor carpi radialis muscle	Flexes and abducts wrist radialward
	Flexor digitorum profundus muscle (I-III)	Flexes and adducts the thumb, flexes fingers I-III
Radial nerve	Triceps brachii muscle	Extends elbow
	Extensor carpi radialis (brevis) muscle	Extends and abducts wrist radialward
	Extensor digitorum muscle	Extends and flexes the hand dorsally Extends and spreads the fingers
Ulnar nerve	Flexor carpi ulnaris muscle	Flexes and abducts wrist ulnarward
	Flexor digitorum profundus muscle (IV-V)	Flexes fingers (IV-V)



1 Supraclavicular nerves (from the superficial cervical plexus)
2 Axillary nerve
3 Musculocutaneous nerve
4 Radial nerve
5 Medial cutaneous nerve of the arm
6 Medial cutaneous nerve of the forearm
7 Median nerve
8 Ulnar nerve

STIMULATION NEEDLES:

- COMPLETELY INSULATED, EXCEPT FOR THE TIP.
- HAVE NO SHARP EDGES.
- MONOPOLAR OR UNIPOLAR.
- THE ELECTRICAL CURRENT HAS A VERY SMALL EXIT OPENING.
- HIGHER CURRENT DENSITY AT THE TIP OF THE NEEDLE.
- EXACT LOCALISATION, RISK OF INJURY AT A MINIMUM.

Fig. 6: Nerve stimulator: Stimuplex® HNS 12 (B. Braun Melsungen AG)

Fig. 7/8: Stimulation needles: Stimuplex® D / Contiplex® D / Contiplex® Tuohy (B. Braun Melsungen AG)

Puncture site,Technique: Video 1

- Ant. Approach

Anatomical landmarks

Superior thyroid notch, sternocleidomastoid muscle (posterior scalene gap)

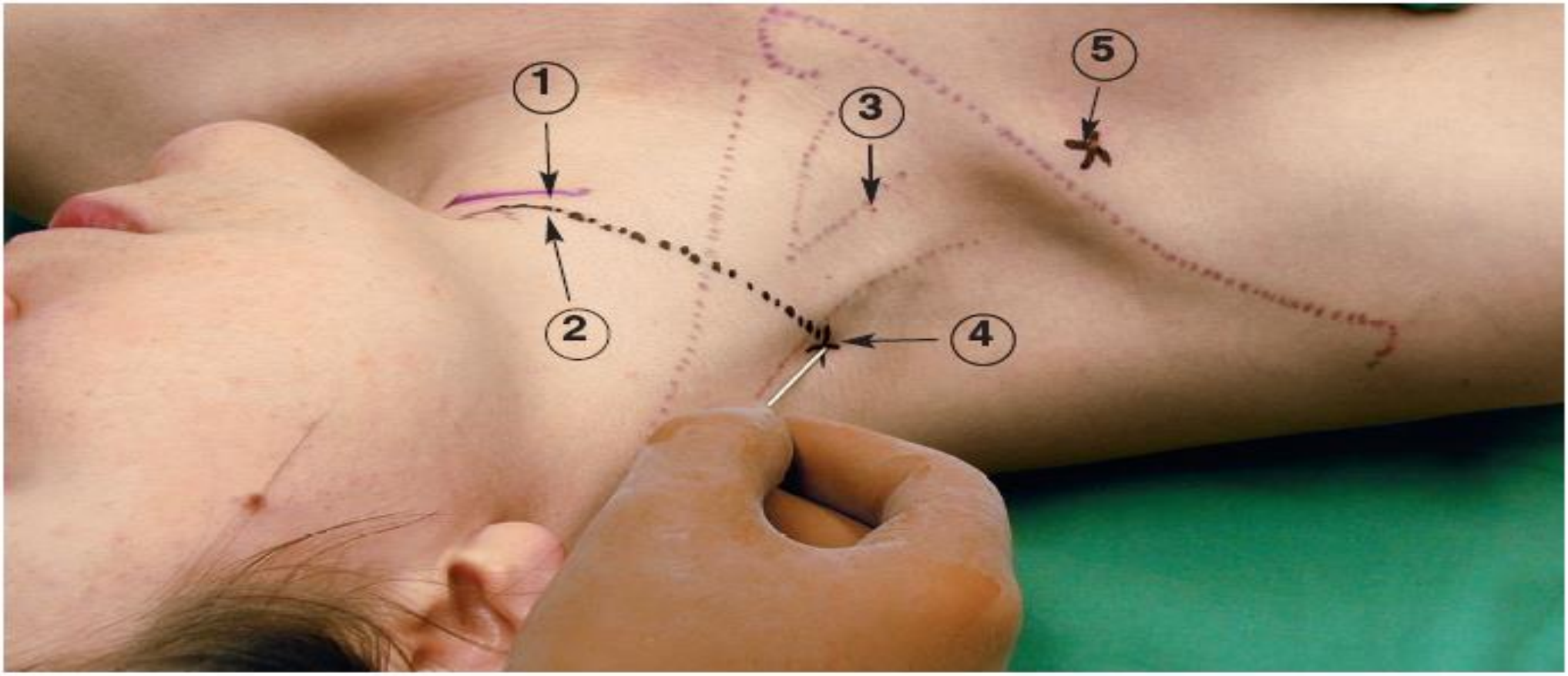


Fig. 11: Interscalene nerve block: Modification according to G. Meier

1. Cricoid
2. Superior thyroid notch
3. Sternocleidomastoid muscle
4. Puncture site for anterior access
5. Vertical, infraclavicular puncture site

Thank you