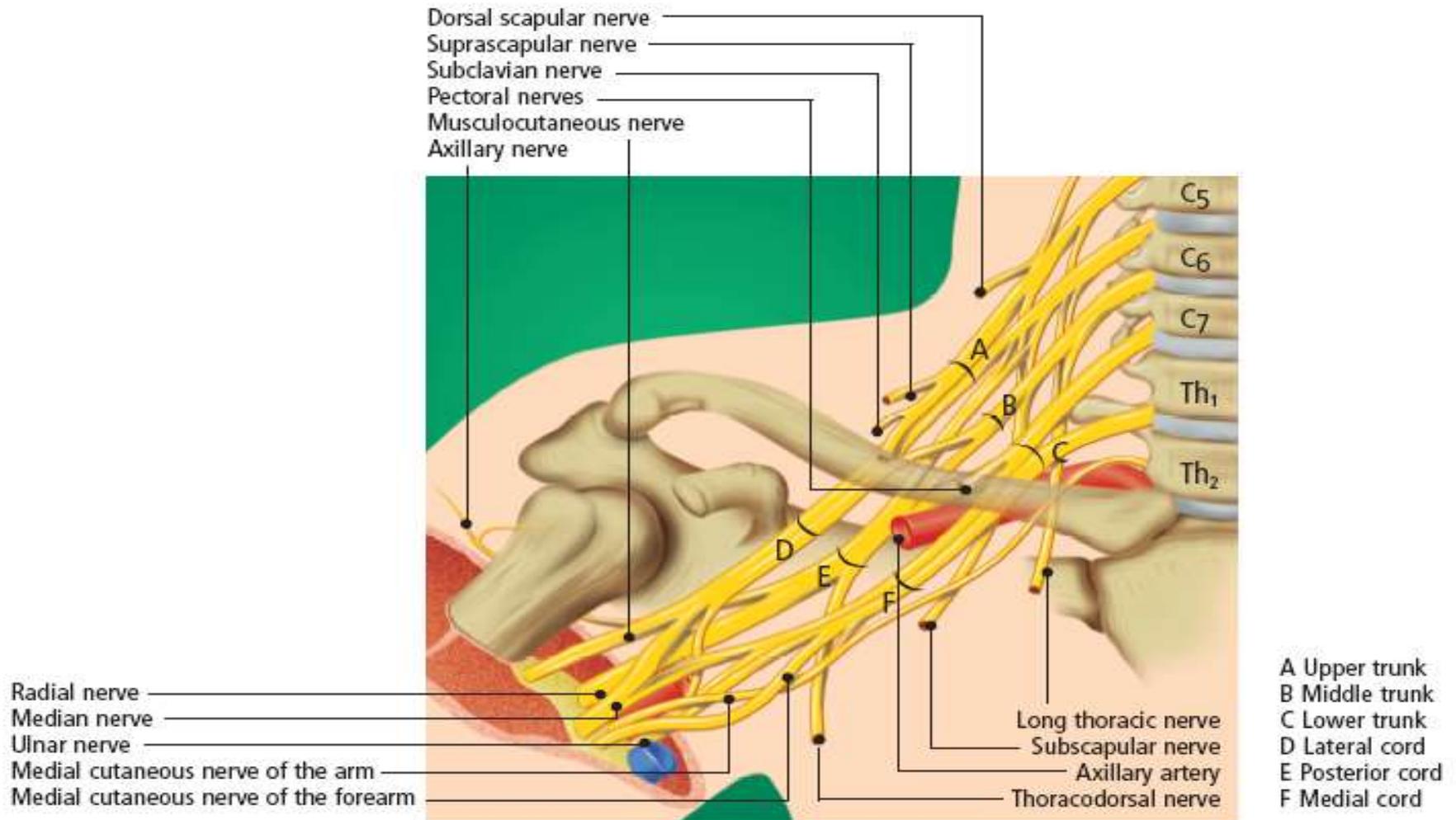


Regional anesthesia

Dr Walid Zuabi

FCA RCSI

ANATOMY of BRACHIAL PLEXUS:



ROOTS

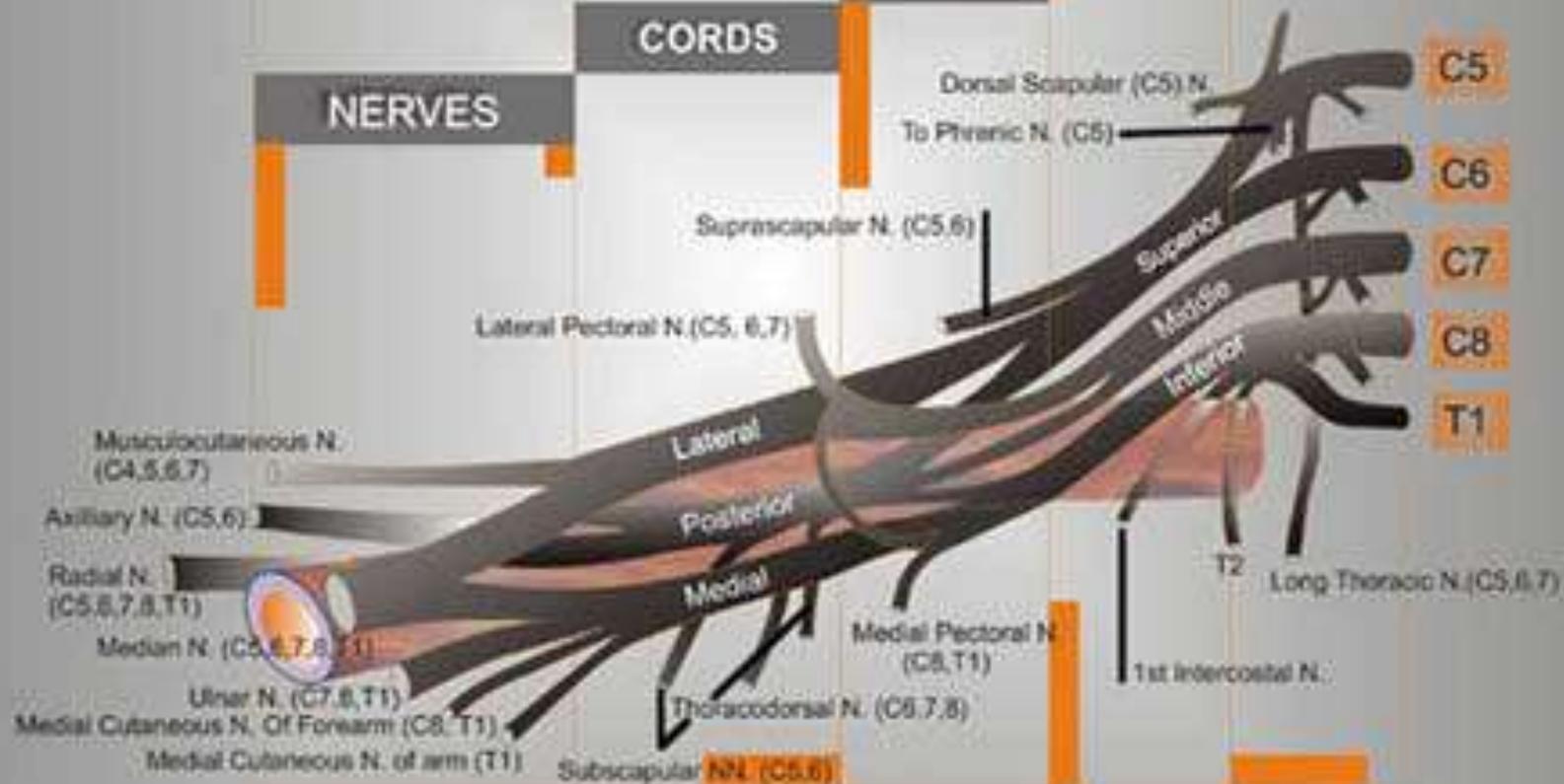
TRUNKS

DIVISIONS

CORDS

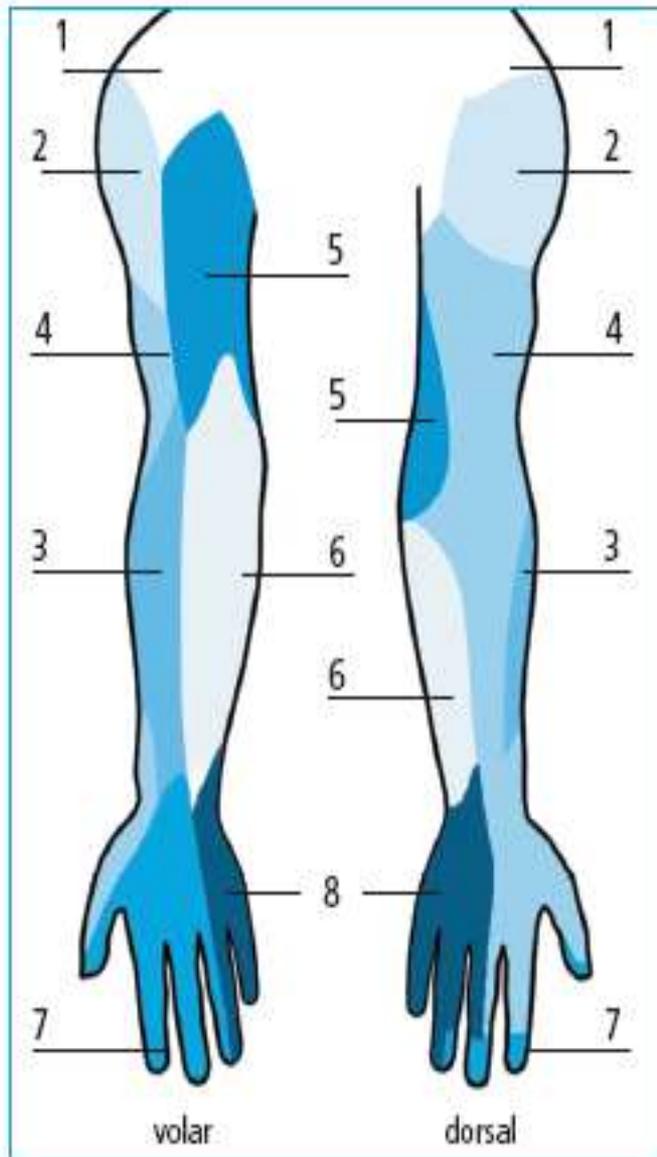
NERVES

from C4

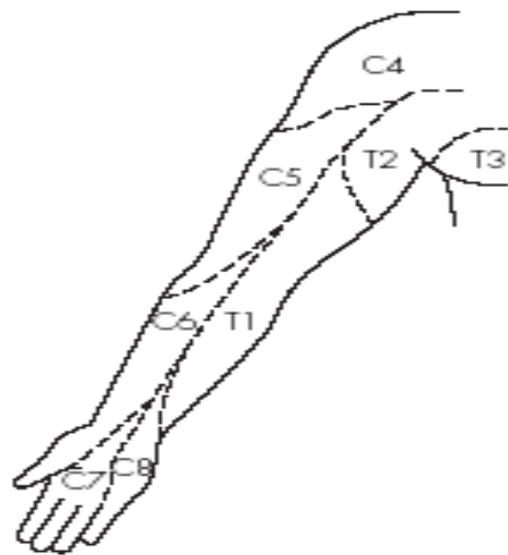


Motor supply areas

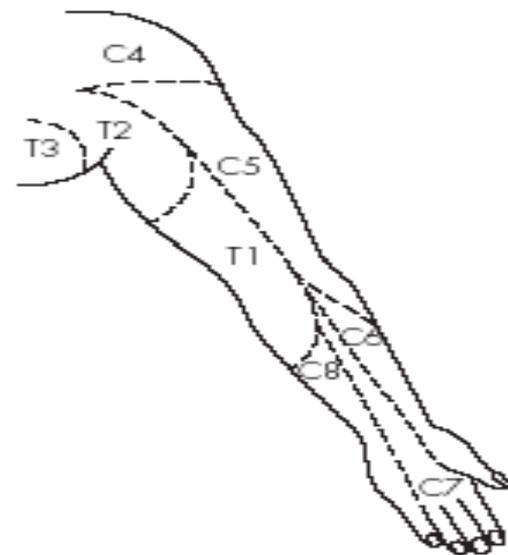
Peripheral nerve	Muscle	Function
Suprascapular nerve	Supraspinatus/ infraspinatus muscles	Forms parts of the rotator muscles
Axillary nerve	Deltoid muscle	Abduction of the arm in the shoulder joint
Musculocutaneous nerve	Biceps brachii muscle Brachial muscle Flexor pollicis brevis muscle	Bends the elbow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



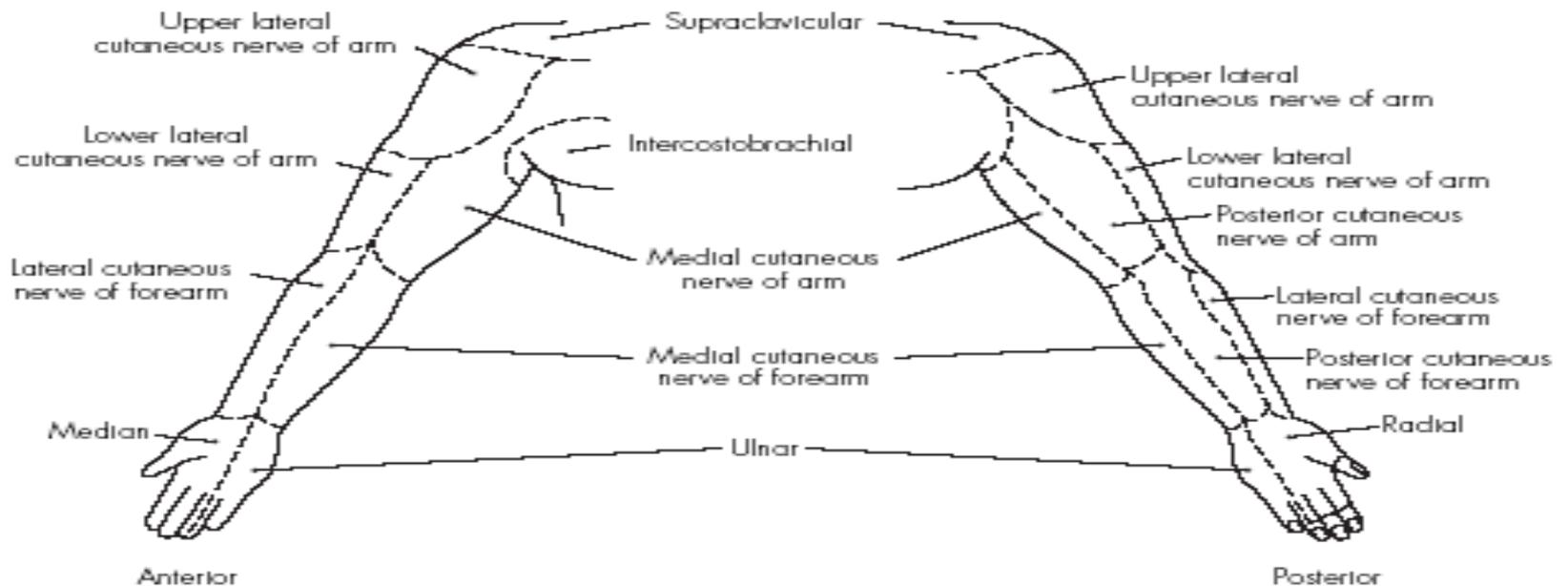
- 1 Supraclavicular nerves (from the superficial cervical plexus)
- 2 Axillary nerve
- 3 Musculocutaneous nerve
- 4 Radial nerve
- 5 Medial cutaneous nerve of the arm
- 6 Medial cutaneous nerve of the forearm
- 7 Median nerve
- 8 Ulnar nerve



Anterior



Posterior



Anterior

Posterior

App 1
 Dermatomes and cutaneous nerves of arm

ELECTRICAL NERVE STIMULATION

- **PERIPHERAL NERVES :THEY CONTAIN EITHER SENSORY OR MOTOR, SOMETIMES BOTH.**
- **ELECTRICAL IMPULSES REACHING A NERVE.**

- **THE ELECTRICAL CURRENT REQUIRED TO TRIGGER MUSCLE CONTRACTIONS CORRELATES WITH THE DISTANCE OF THE TIP OF THE NEEDLE TO THE NERVE.**
- **THE CLOSER THE NEEDLE IS TO THE NERVE, THE LOWER THE ELECTRICAL CURRENT THAT IS REQUIRED TO INDUCE CONTRACTIONS OR SENSORY RESPONSES.**
- **IN ROUTINE CLINICAL PRACTICE, AN INITIAL ELECTRICAL CURRENT, CALLED THRESHOLD CURRENT, OF 1 mA IS USED TO ELICIT A RESPONSE.**
- **THE STIMULATION NEEDLE HAS REACHED THE DESIRED POSITION AT THE NERVE WHEN CONTRACTIONS OF THE EFFECTOR MUSCLE ARE INDUCED AT A THRESHOLD CURRENT OF 0.2 - 0.3 mA (PULSE DURATION OF 0.1 ms).**
- **LOWER PULSE AMPLITUDES MAY CAUSE INJURY TO THE NERVE.**
- **PAIN FIBERS ARE NOT AFFECTED AT THIS PULSE DURATION.**

STIMULATION NEEDLES:

- COMPLETELY INSULATED, EXCEPT FOR THE TIP.
- HAVE NO SHARP EDGES.
- THE ELECTRICAL CURRENT HAS A VERY SMALL EXIT OPENING.
- HIGHER CURRENT DENSITY AT THE TIP OF THE NEEDLE.
- EXACT LOCALIZATION, 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)*

BLOCKS OF UPPER EXTREMITY:

- **INTERSCALENE BRACHIAL PLEXUS BLOCK**
- **INFRACLAVICULAR BRACHIAL PLEXUS BLOCK**
- **AXILLARY BRACHIAL PLEXUS BLOCK**
- **WRIST BLOCK**

INTERSCALENE BRACHIAL PLEXUS

BLOCK:

- MOST CRANIAL
- TWO APPROACHES, ANT. & POST.
- SAME INDICATIONS & CONTRAINDICATIONS
- ANT., LESS TIME
- POST. USEFUL IN ANATOMICAL DIFFICULTY (NO NECK)
- INDICATIONS:
 - SINGLE-SHOT TECHNIQUE
 - SURGICAL INTERVENTIONS ON THE SHOULDER INCLUDING SHOULDER TOTAL ARTHROPLASTY, PROXIMAL HUMERUS, LATERAL CLAVICLE.
 - CATHETER TECHNIQUE
 - POSTOPERATIVE ANALGESIA REQUIREMENTS, E.G., ARTHROPLASTY OF THE SHOULDER JOINT
 - SUPPORTIVE PHYSIOTHERAPY OF THE SHOULDER JOINT.

- **CONTRAINDICATIONS**

- CONTRALATERAL RECURRENT PARESIS

- CONTRALATERAL PHRENIC PARESIS

- **SIDE EFFECTS/COMPLICATIONS**

- PHRENIC PARESIS

- HORNER SYNDROME

- RECURRENT PARESIS

- VESSEL PUNCTURE (EXTERNAL JUGULAR VEIN, INTERNAL JUGULAR VEIN, COMMON CAROTID ARTERY)

- PNEUMOTHORAX (RARE)

- **LIMITATIONS:**

- USEFUL ONLY IN SHOULDER SURGERY

PUNCTURE SITE, TECHNIQUE: VIDEO 1

• ANT. APPROACH

Anatomical landmarks

Superior thyroid notch, sternocleidomastoid muscle (posterior scalene gap)

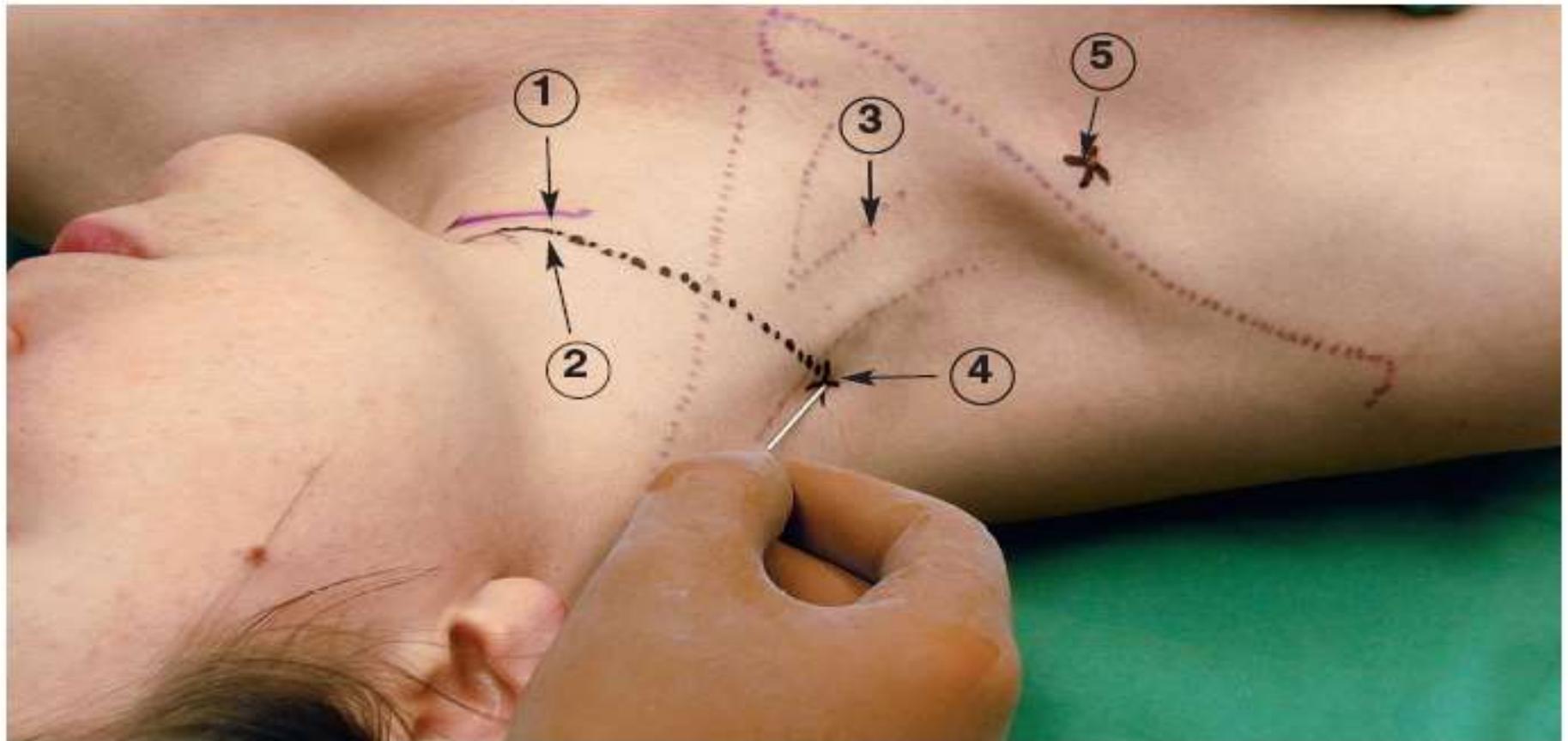


Fig. 11: Interscalene nerve block: Modification according to G. Meier

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

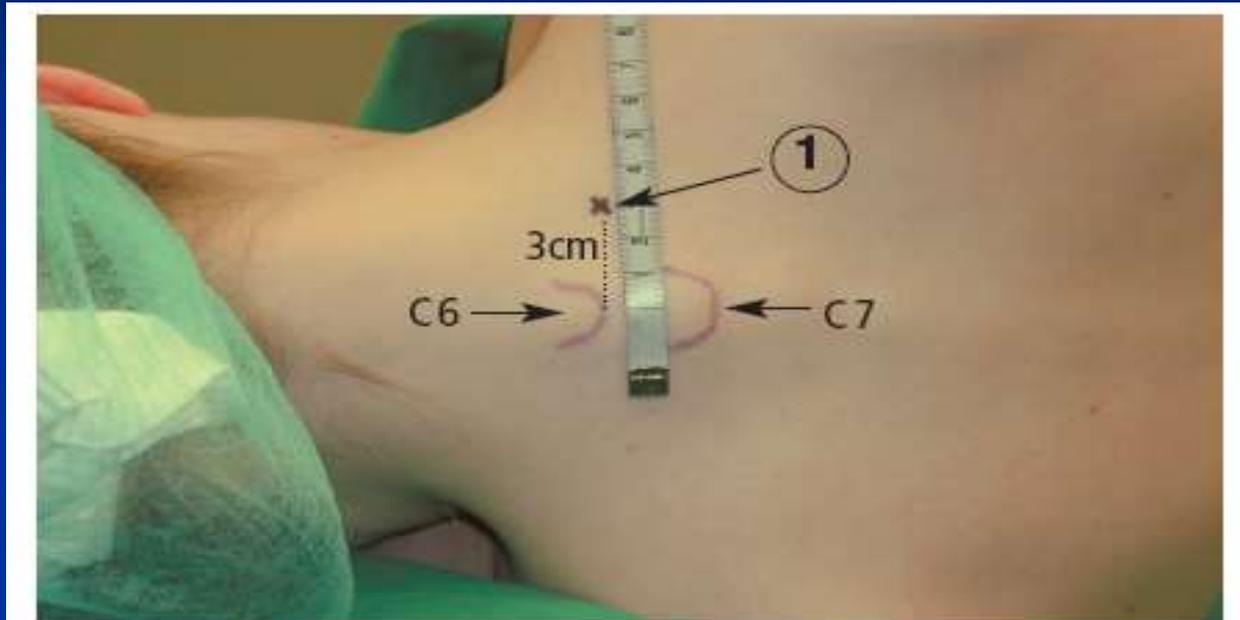
NOTE:

- **PT SUPINE (NO PILLOW)**
- **HEAD TILTED TO OTHER SIDE**
- **EXTERNAL JUGULAR VEIN**
- **DIRECTION OF PUNCTURE IS CAUDAL & DORSAL TO BODY AXIS**
- **CONTRACTIONS OF BICEPS INDICATES PROXIMITY TO UPPER TRUNK**
- **USUALLY AT 3-4 CM DEPTH**
- **LA INJECTED AT THRESHOLD CURRENT 0.2-0.3 MA**
- **ALLOW 15 MINUTES FOR ADEQUATE BLOCK**

POST APPROACH: VIDEO 2

Anatomical landmarks

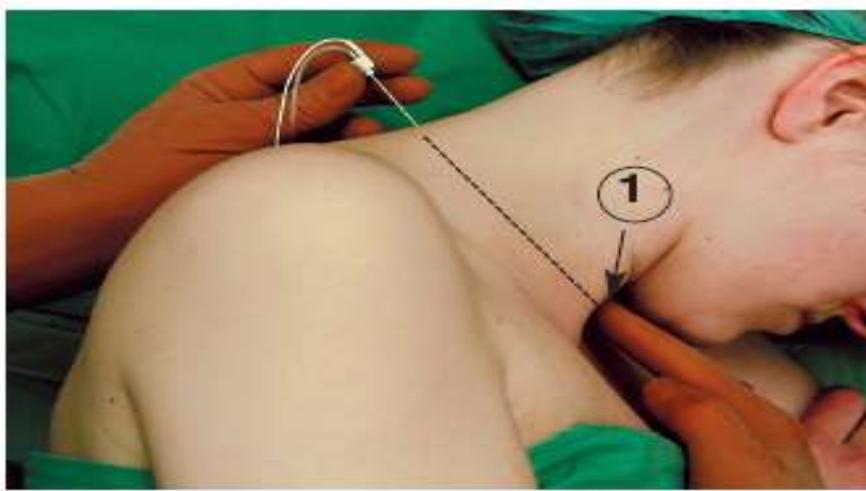
Processus spinosus C7 (vertebra prominens), Hinterrand M. sternocleidomastoideus, Cricoid



*Fig. 13: Posterior access
- Positioning*

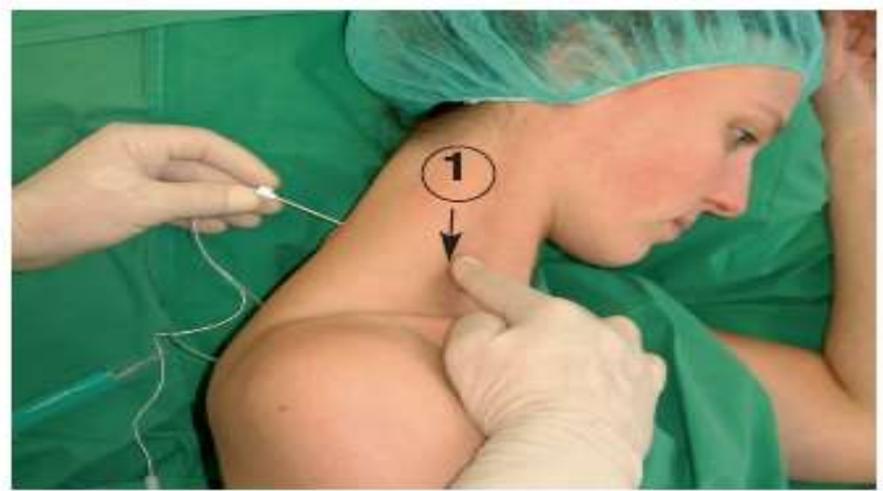
1. Puncture site

- HEAD PLACED ON PILLOW
- CERVICAL SPINE FLEXED



**Fig. 14: Posterior access
- Puncture technique**

1. Cricoid



**Fig. 15: Posterior access
- Puncture technique**

1. Posterior edge of the sternocleidomastoid muscle

- **PUNCTURE (10-15)° LATERALLY TOWARDS POST EDGE OF SCM AT LEVEL OF CRICOID**
- **UPON REACHING TRANSVERSE PROCESS OF C7, ADJUST CRANIALLY**
- **CONTRACTION OF BICEPS INDICATES PROXIMITY TO UPPER TRUNK**

INFRA CLAVICULAR BRACHIAL PLEXUS BLOCK:

- EASY, SAFE, SIMPLE, LOW RISK

- INDICATIONS

- PROCEDURES IN THE REGION OF THE DISTAL UPPER ARM, ON THE FOREARM AND THE HAND.

- CONTRAINDICATIONS

- CHEST DEFORMITIES

- DISLOCATED FRACTURE OF THE CLAVICLE

- UNCERTAINTY IN PUNCTURE SITE IDENTIFICATION

SIDE EFFECTS/COMPLICATIONS

- HORNER SYNDROME

- VESSEL PUNCTURE (CEPHALIC VEIN, SUBCLAVIAN ARTERY AND VEIN AND THEIR BRANCHES)

- PNEUMOTHORAX

- PHRENIC NERVE PARESIS (VERY RARE)

PUNCTURE SITE & TECHNIQUE:

Anatomical landmarks

Jugular fossa, ventral apophysis of the acromion, infraclavicular fossa

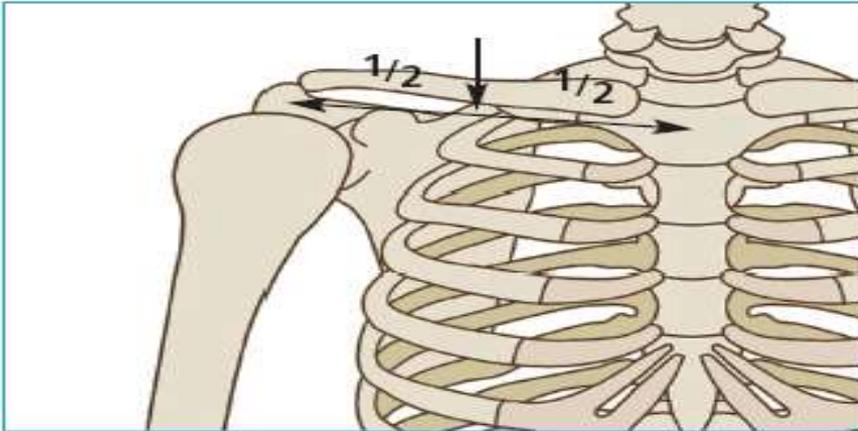


Fig. 16:
IVBP- Principal structures for orientation

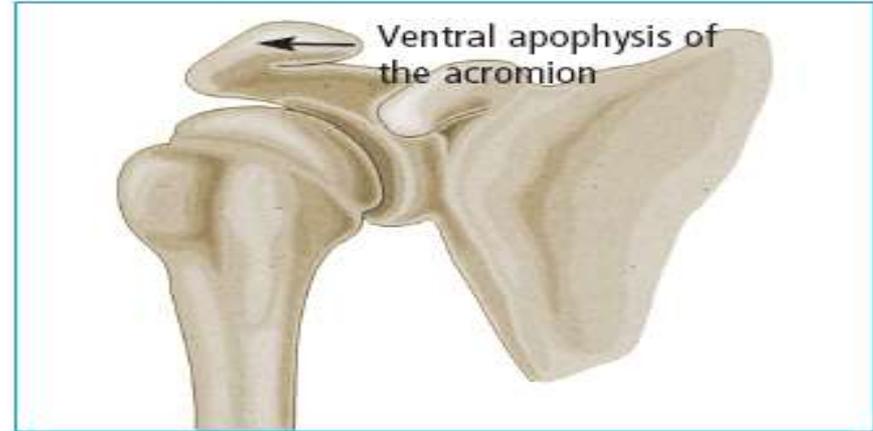


Fig. 17:
IVBP - Lateral limit

- MIDWAY BETWEEN STERNAL NOTCH & ACROMION PROCESS NOT CORACOID PROCESS
- 4 CM IS THE MAXIMUM DEPTH OF PLEXUS
- PUNCTURE SHOULD BE VERTICAL & IMMEDIATELY UNDER CLAVICLE
- MEDIAL DIRECTION RESULTS IN INJURY TO AXILLARY VESSELS

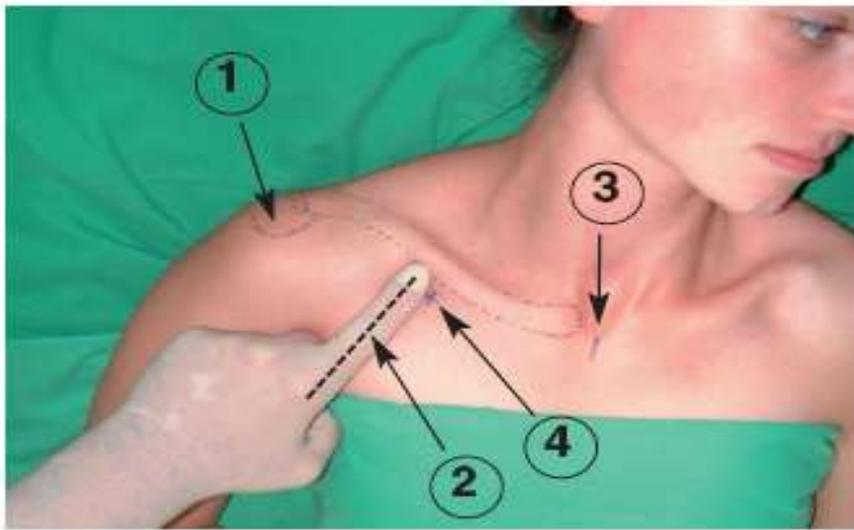


Fig. 20: VIP - Puncture site

1. Ventral apophysis of the acromion
2. Infraclavicular fossa
3. Jugular fossa
4. Puncture site

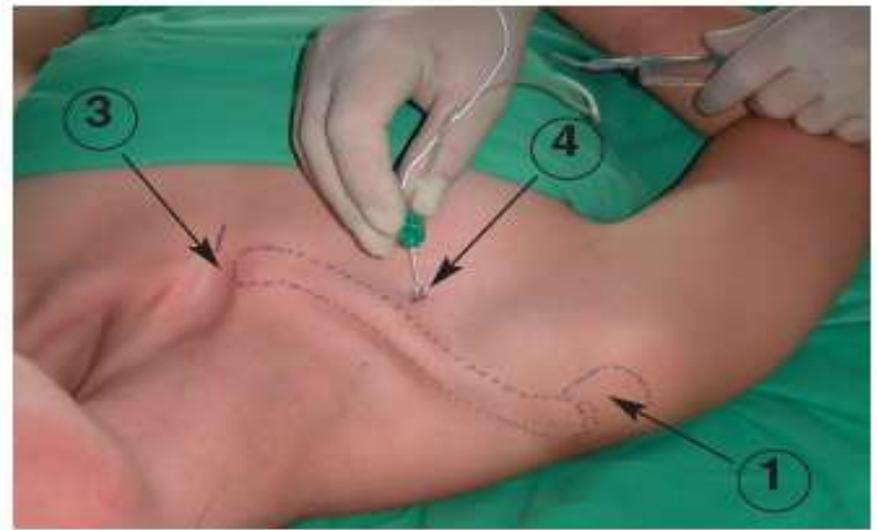


Fig. 21: VIP - Puncture technique

- **PT SUPINE**
- **IPSI LATERAL HAND RELAXED, PREFERABLY ON ABDOMEN**
- **THIN PTS ARE MORE AT RISK OF PNEUMOTHORAX**
- **LOCAL INJECTED WHEN DESIRED MUSCLE GROUP ARE STIMULATED (FLEXORS OR EXTENSORS OF THE FINGERS)**

• **VIDEO 3**

SOURCES OF ERROR:

- **PRECISE & EXACT LOCALISATION OF LAND MARKS IS EXTREMELY IMPORTANT TO AVOID COMPLICATIONS**
- **PUNCTURE SHOULD BE VERTICAL TO SUPPORTING SURFACE (BED) NOT TO THE PT.**
- **STAY CLOSE TO CLAVICLE**
- **IF IN DOUBT, RE-LOCALIZE UR LANDMARKS**



Cardinal mistakes:

Puncture site too medial

Puncture depth > 6 cm

Medial puncture direction

**BEWARE: Astheniker
Very slim persons**

Fig. 22: Sources of error and risks

ADVANTAGES OF THE INFRACLAVICULAR VERTICAL BRACHIAL PLEXUS BLOCK

- **CLEARLY DEFINED GUIDE POINTS - CLEARLY DEFINED PUNCTURE DIRECTION**
- **SIMPLE TO LEARN - HIGH SUCCESS RATE**
- **NO ANAESTHETIC GAPS RESULTING FROM THE PROCEDURE**
- **NO PROBLEMS WITH THE ESMARCH TOURNIQUET**
- **COMFORTABLE POSITIONING OF THE PATIENT**

AXILLARY BRACHIAL PLEXUS BLOCK:

- PERFORMED IN AN AREA IN WHICH CORDS HAVE ALREADY FORMED THE PERIPHERAL NERVES OF THE ARM
- AXILLARY NERVE AND MUSCULOCUTANEOUS NERVE EMERGE FROM THE PLEXUS ABOVE THE PUNCTURE SITE.
- WIDESPREAD TECHNIQUE BECAUSE IT IS SIMPLE TO USE AND HAS FEW COMPLICATIONS.

• INDICATIONS

➤ PROCEDURES ON THE ELBOW, FOREARM AND HAND.

• CONTRAINDICATIONS

➤ NO SPECIFIC CONTRAINDICATIONS

SIDE EFFECTS/COMPLICATIONS

➤ NO SPECIFIC SIDE EFFECTS

• ADVANTAGES

➤ SIMPLE AND LOW-RISK AND CAN BE PERFORMED WITH OR WITHOUT THE NERVE STIMULATOR.

• DISADVANTAGES

➤ UPPER ARM TOURNIQUET MAY BE POORLY TOLERATED BECAUSE THE MEDIAL UPPER ARM IS SUPPLIED BY THE INTERCOSTOBRACHIALIS NERVES (Th2) AND THE LATERAL UPPER ARM BY THE AXILLARY NERVE (WHICH IS USUALLY NOT BLOCKED).

➤ FREQUENT GAPS IN THE AREA OF THE MUSCULOCUTANEOUS NERVE AND THE RADIAL NERVE ARE ANOTHER DISADVANTAGE.

➤ **THESE TECHNIQUE-RELATED WEAKNESSES CAN BE COMPENSATED BY CARRYING OUT SECONDARY PERIPHERAL BLOCKS OF ISOLATED NERVES.**

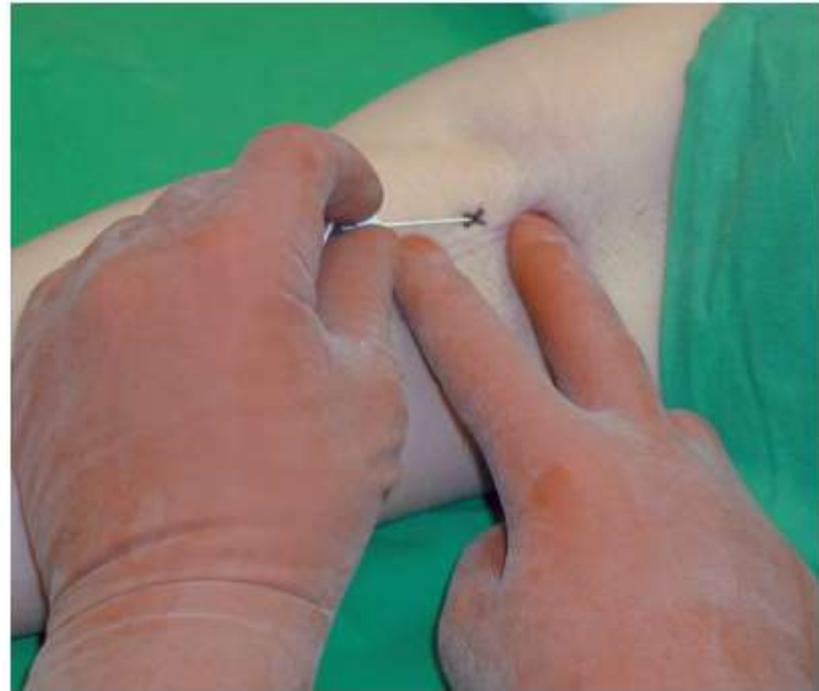
LANDMARKS & TECHNIQUE:

Anatomical landmarks

Axilla, axillary artery, medial bicipital groove, pectoralis major muscle, coracobrachialis muscle



*Fig. 23:
Axillary nerve block - Puncture site*

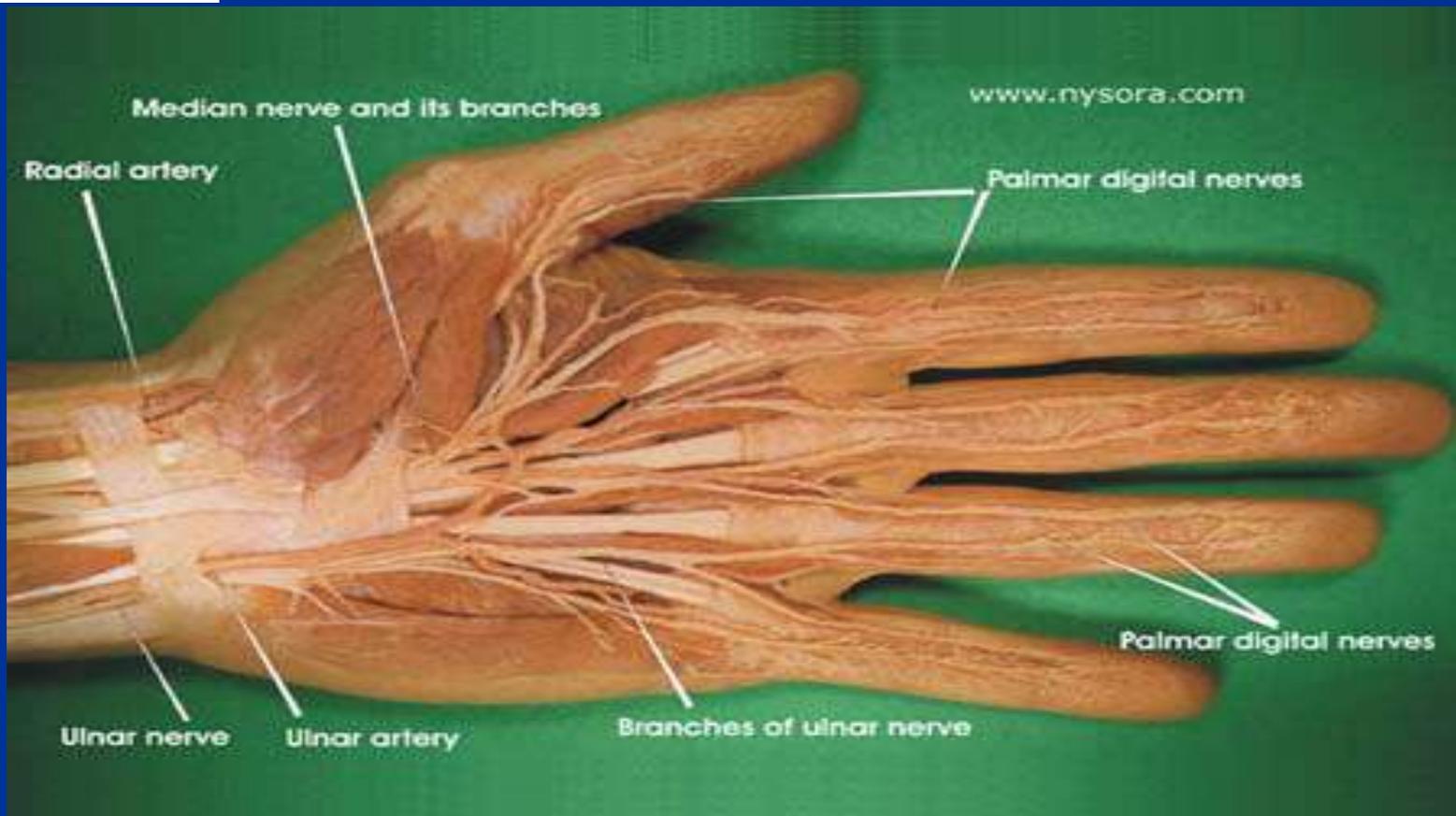


*Fig. 24:
Axillary nerve block -Puncture technique*

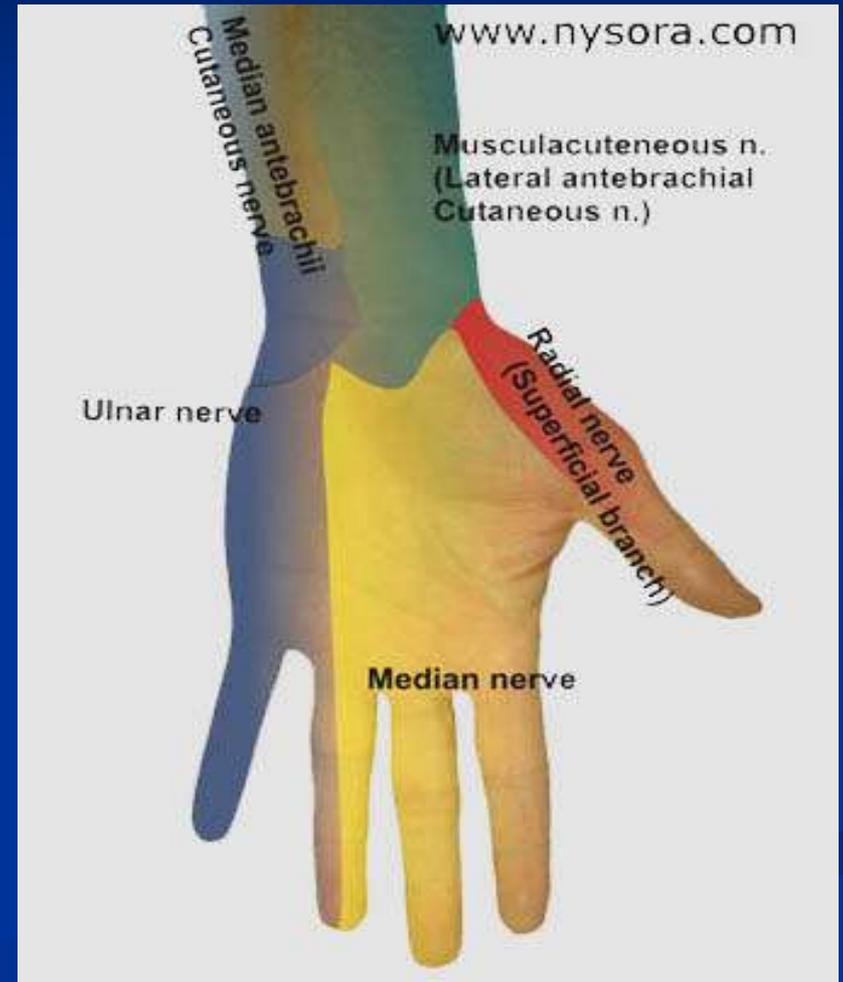
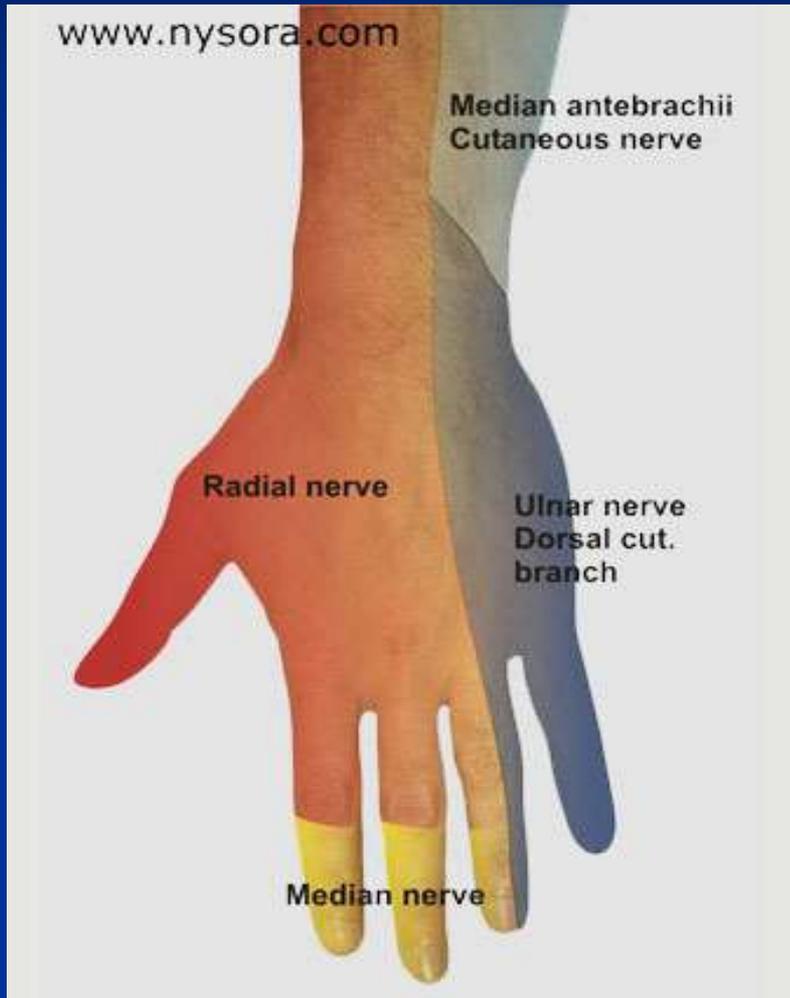
- **SUPINE PT**
- **ARM ABDUCTED 90 DEGREES, RELAXED.**
- **AXILLARY ARTERY IS FELT DORSAL TO BICIPITAL GROOVE**
- **PUNCTURE IS SLIGHTLY ABOVE AXILLAR ARTERY, HIGH IN THE AXILLA, BENEATH PECTORALIS MUSCLE**
- **NEEDLE IS INSERTED PARALLEL TO THE AXILLARY ARTERY AT A 30°-ANGLE TO THE SKIN.**
- **DESIRED RESPONSE IS AREA OF RADIAL OR ULNAR NERVE**
- **VIDEO**

WRIST BLOCK:

- INDICATIONS: SURGERY ON HAND & FINGERS
- NERVES: ULNAR, RADIAL & MEDIAN (TERMINAL BRANCHES)
- ANATOMY:

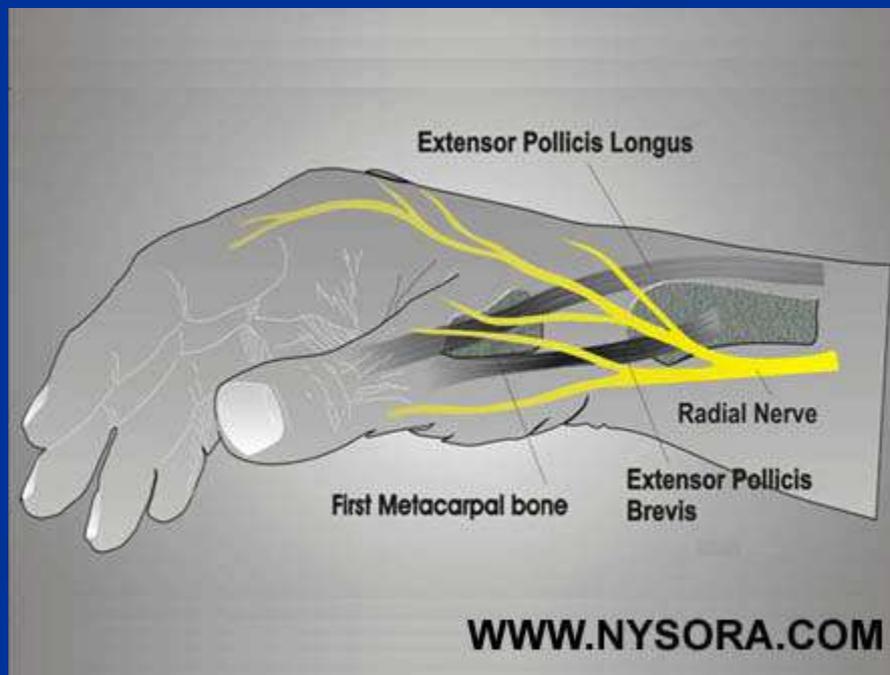


DISTRIBUTION OF ANESTHESIA



• LANDMARKS:

➤ **RADIAL NERVE**



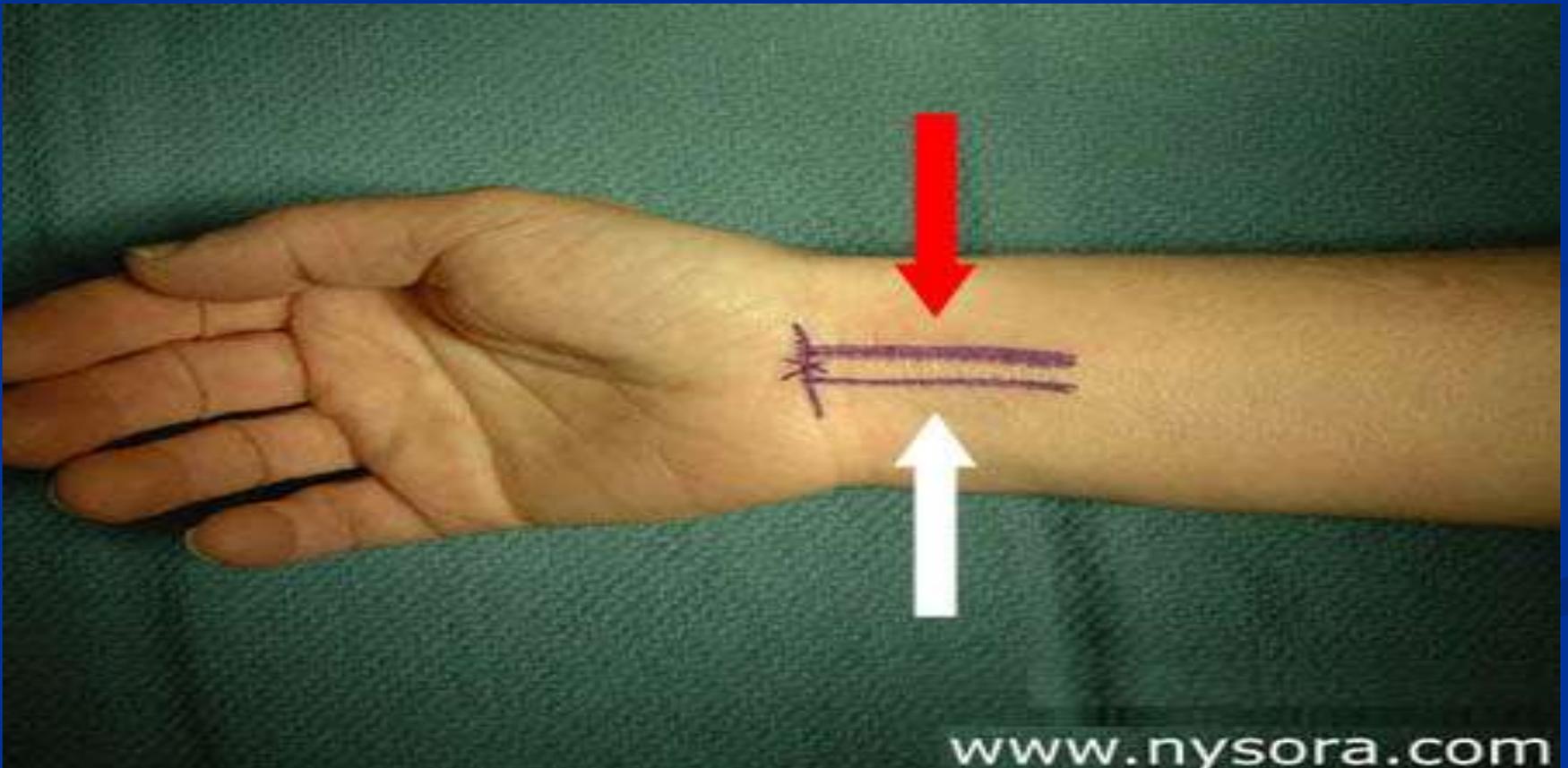
➤ ULNAR NERVE:

BETWEEN THE ULNAR ARTERY AND TENDON OF THE FLEXOR CARPI ULNARIS.



➤ MEDIAN NERVE:

**BETWEEN THE TENDONS OF THE PALMARIS LONGUS
AND THE FLEXOR CARPI RADIALIS**



TECHNIQUE:

- **THE RADIAL NERVE: FIELD BLOCK, EXTENSIVE INFILT.**
- **LESS PREDICTABLE ANATOMIC LOCATION**
- **AND DIVISION INTO MULTIPLE SMALLER BRANCHES.**
- **ABOVE THE RADIAL STYLOID, AIMING MEDIALLY. THE INFILTRATION IS THEN EXTENDED LATERALLY,**



➤ ULNAR NERVE

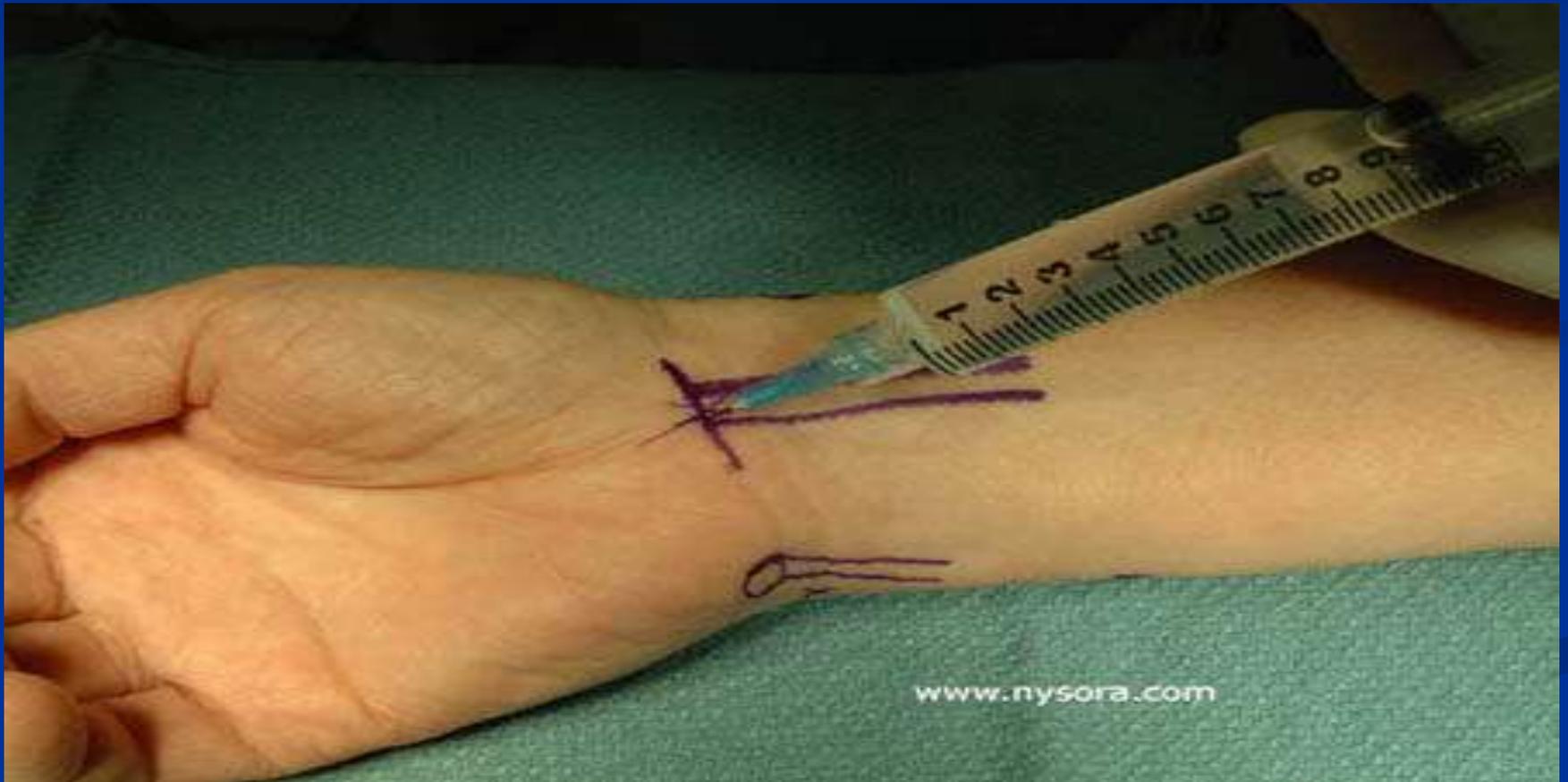
➤ DISTAL ATTACHMENT OF TENDON OF THE FLEXOR CARPI ULNARIS, ABOVE THE STYLOID PROCESS OF THE ULNA.

➤ THE NEEDLE IS ADVANCED 5-10 MM TO JUST PAST THE TENDON OF THE FLEXOR CARPI ULNARIS.

➤ SUBCUTANEOUS INJECTION WHICH OFTEN EXTEND TO THE HYPOTHENAR AREA .



- **MEDIAN NERVE**
- **BETWEEN THE TENDONS OF THE PALMARIS LONGUS AND FLEXOR CARPI RADIALIS. PIERCING DEEP FASCIA. A FASCIAL "CLICK"**



ULTRASOUND-ASSISTED NERVE BLOCKS

- **GROWING INTEREST**
- **IMPROVING BLOCK SUCCESS AND DECREASING COMPLICATIONS.**
- **ALLOWS ONE TO VISUALIZE NEURAL STRUCTURES (PLEXUS AND PERIPHERAL NERVES) AND THE SURROUNDING STRUCTURES (E.G., BLOOD VESSELS AND PLEURA), NAVIGATE THE NEEDLE TOWARD THE TARGET NERVES, AND VISUALIZE THE PATTERN OF LOCAL ANESTHETIC SPREAD.**



ULTRASOUND PRINCIPLES:

- **AN ULTRASOUND PROBE EMITS AND RECEIVES SOUND WAVES**
- **ULTRASOUND WAVES ARE HIGH-FREQUENCY SOUND WAVES (20,000 CYCLES/s, 20 kHz)**
- **NOT AUDIBLE TO THE HUMAN EAR.**
- **FREQUENCIES USEFUL IN CLINICAL MEDICINE ARE IN THE MEGAHERTZ (MHZ) RANGE.(**
- **AS THE ULTRASOUND WAVES MOVE THROUGH BODY TISSUES THEY LOSE AMPLITUDE, REFLECTED, AND/OR SCATTERED.**
- **WAVES REFLECTED TO THE TRANSDUCER ARE THEN TRANSFORMED INTO AN ELECTRICAL SIGNAL THAT IS THEN PROCESSED BY THE ULTRASOUND MACHINE TO GENERATE AN IMAGE ON THE SCREEN .**

- **DEPENDING ON THE AMOUNT OF WAVE RETURNED, ANATOMIC STRUCTURES TAKE ON DIFFERENT DEGREES OF ECHOGENICITY.**
- **HIGH WATER CONTENT STRUCTURES, EG BLOOD VESSELS AND CYSTS, APPEAR HYPOECHOIC (BLACK OR DARK), BECAUSE ULTRASOUND WAVES ARE TRANSMITTED THROUGH THE STRUCTURES EASILY WITH LITTLE REFLECTION.**
- **BONE AND TENDONS BLOCK ULTRASOUND WAVE TRANSMISSION AND THE STRONG SIGNAL RETURNED TO THE TRANSDUCER GIVES THESE STRUCTURES A HYPERECHOIC APPEARANCE (BRIGHT, WHITE) ON THE SCREEN.**
- **STRUCTURES OF INTERMEDIATE DENSITY AND ACOUSTIC IMPEDANCE, SUCH AS THE LIVER PARENCHYMA OR THE THYROID GLAND, APPEAR GRAY ON THE SCREEN.**

- **KNOWING THE SPEED OF SOUND IN TISSUE (1540 M/S ON AVERAGE) AND THE TIME OF ECHO RETURN, THE DISTANCE BETWEEN THE PROBE AND THE TARGET STRUCTURE (DEPTH) IS CALCULATED.**
- **ORIENTATION IS EXTREMELY IMPORTANT**

