Ultrasound Guided Blocks for Pain Management

Chronic Pain Management

- Billions of dollars spent on pain every year
- Definition of chronic pain – pain that lasts longer than 6 months
- Procedures primarily done on an outpatient basis
- Perform cervical spine, lumbar spine and MSK injections
- Gold standard – Fluro

Advantages of Ultrasound

- Soft tissue identification (including nerves)
- Blood vessels can be identified
- No exposure to ionizing radiation
- More readily available due to portability (Can be moved to patient exam room)
- Cheaper (compared to CT, fluoroscopy), consider maintenance as well as initial costs
- Real-time injection
- Smaller footprint

Disadvantages of Ultrasound

- Not useful for deeper nerve blocks
- Fluoroscopy guided procedures well established
- Less publications than other image modalities
- More difficult to visualize needle
- Does not penetrate through bone
- Spine is difficult to image compared to other modalities
- Will insurance companies reimburse?
- Smaller field of view for procedure and image capture

Ultrasound Reimbursement

CPT Codes for Nerve Blocks

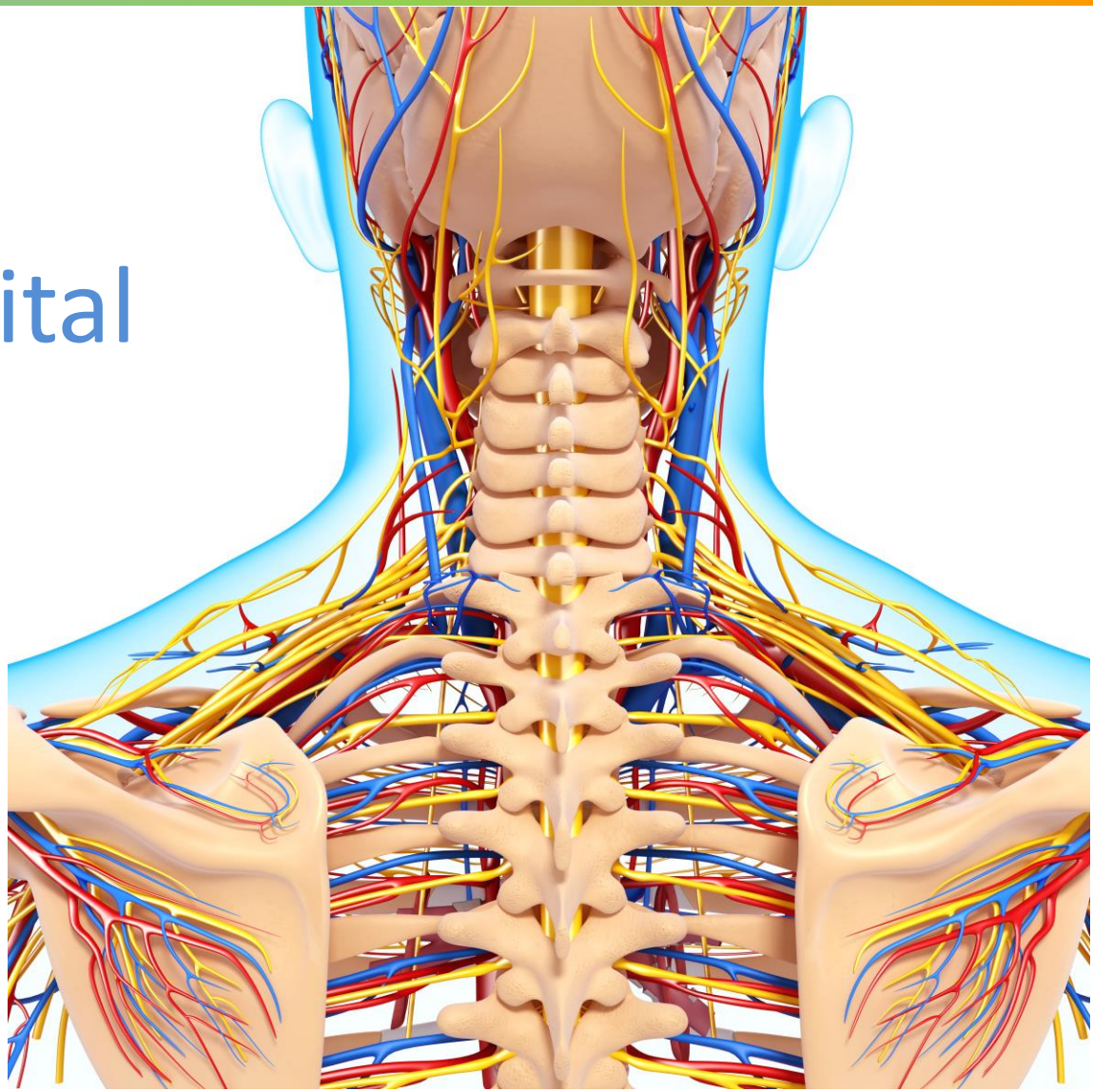
- Occipital nerve
- Stellate ganglion
- Suprascapular nerve
- Intercostal nerve
- Ilioinguinal, iliohypogastric nerves, TAP

+ Ultrasound guidance – CPT 76942

Diagnostic vs. Theraputic

- **Diagnostic**
  - Attempt to find the source of pain
  - Example: Does a dose of local anesthetic at a specific site relieve pain?
    - If Yes, then consider therapeutic intervention
    - If No, consider other sources of pain (or failed block)
  - Examples of diagnostic agents:
    - Local anesthetics

Greater Occipital Nerve

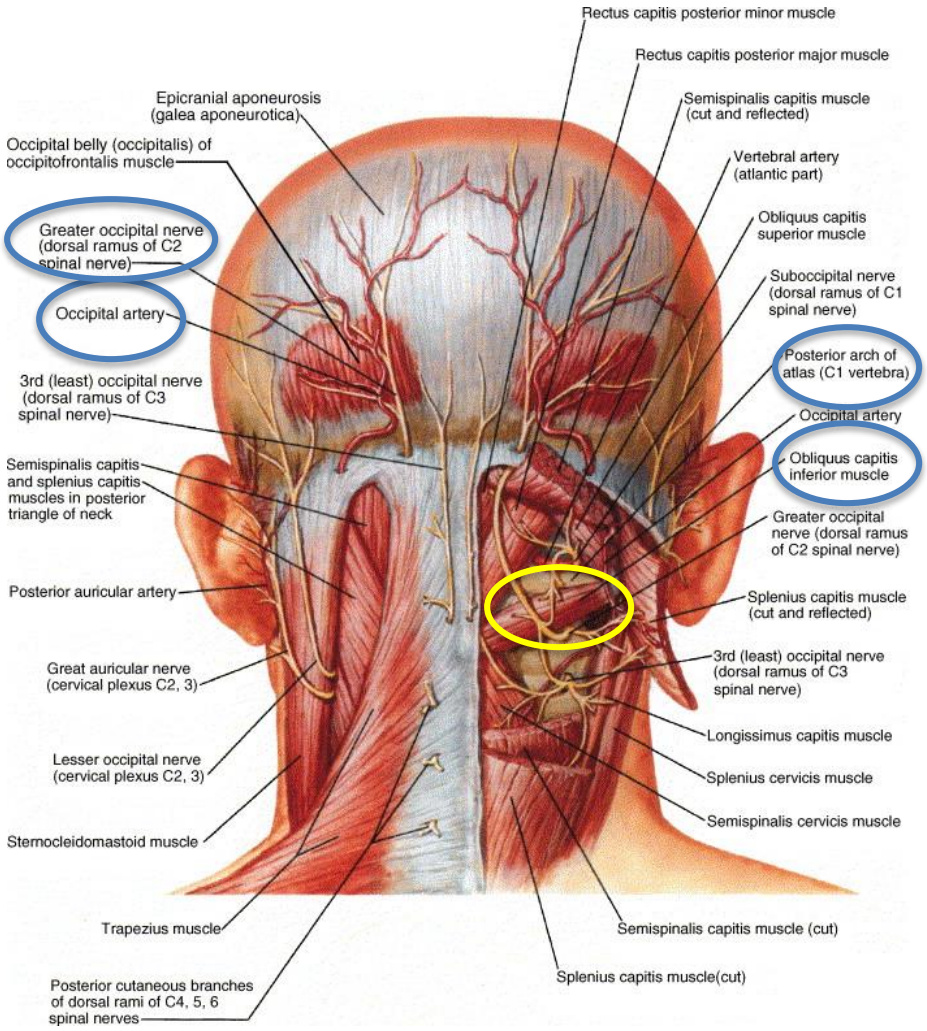


Occipital Nerve Block

- Indications: nerve pain and headaches, may be unilateral or bilateral
- Goal: injection in muscle where greater occipital nerve exits and anesthesia of paraspinal muscles
- Technique:
  - Out of plane or in-plane
- Patient Position: Sitting or prone
- Note: Occipital artery runs beside occipital nerve

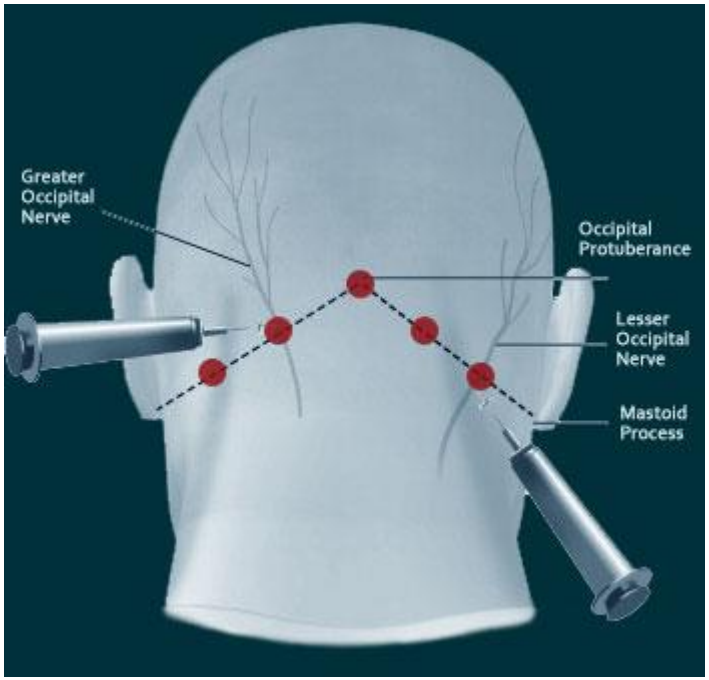
Occipital Nerve Anatomy

- Occipital nerve runs beside occipital artery
- Found on inferior edge of obliquus capitas inferior muscles (rotates the head)



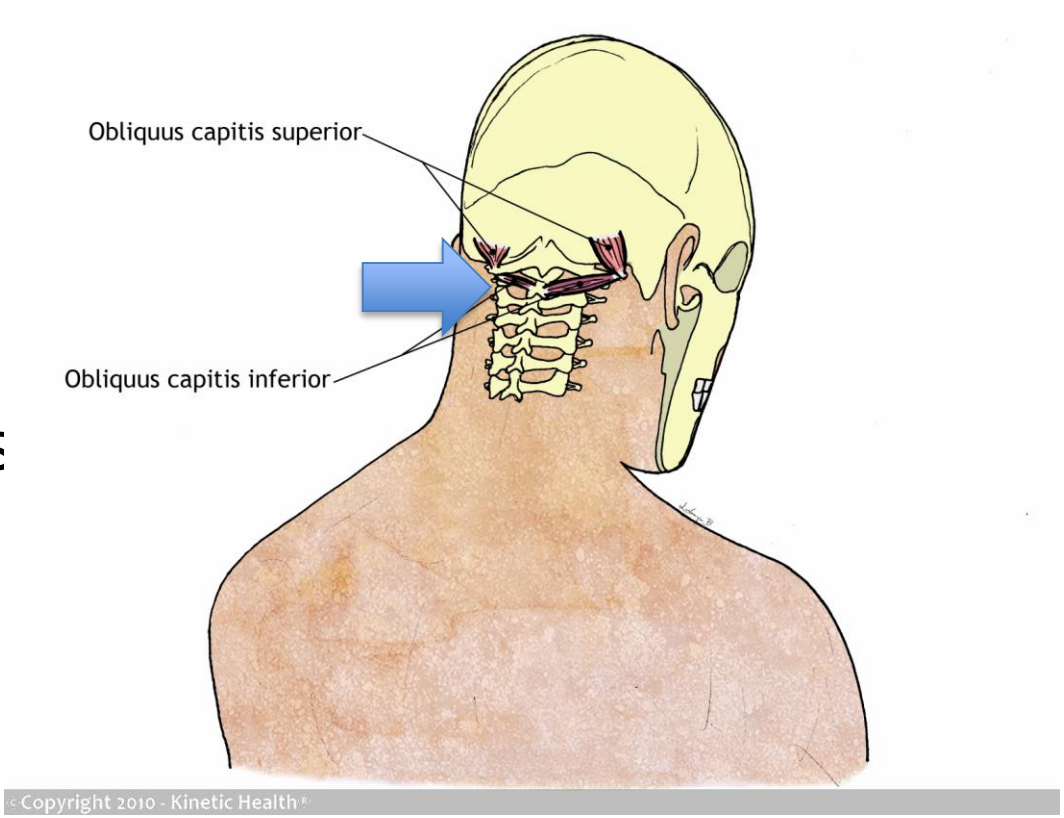
GON Blind Approach

- Palpate artery and inject medially and laterally
- Branching of the occipital nerve varies so may not include entire nerve with this approach

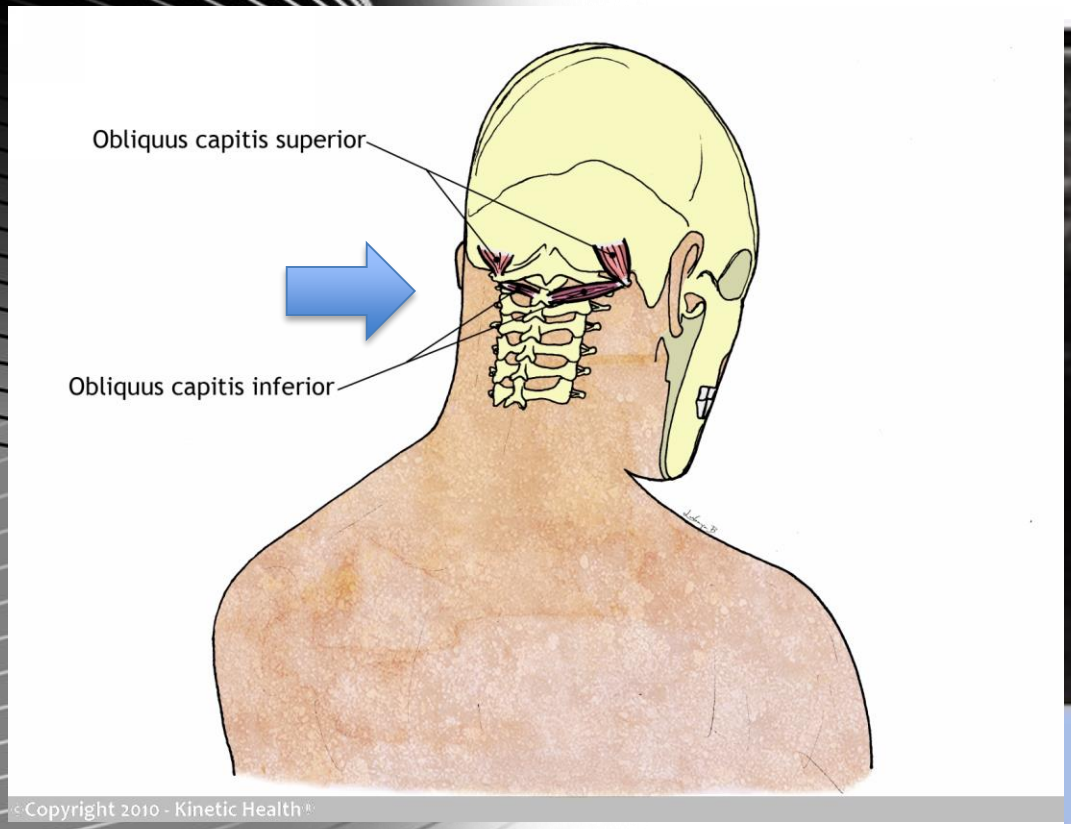


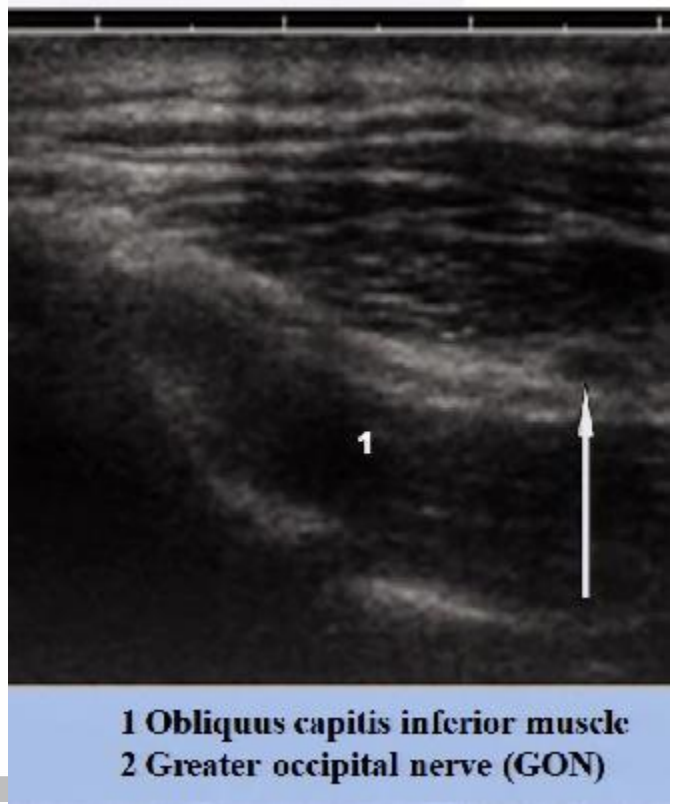
Ultrasound Landmarks

- Ultrasound approach is lower before branching
- Level of obliqus capitus inferior muscle
- Find spinous proces of C2 to locate muscle
- Oblique transducer to see muscle



Ultrasound Landmarks





GON is 2-3mm diameter

Stellate Ganglion

Cervical Sympathetic Trunk Block

Indications

- Common treatment for shingles, complex regional syndromes – head neck face and arms
- Cancer pain head and neck, upper extremities
- Hyperhydrosis (sweating0
- Vasospasm
- Vascular insufficiency
- Raynaud's Syndrome
- Scleroderma

Procedure Technique

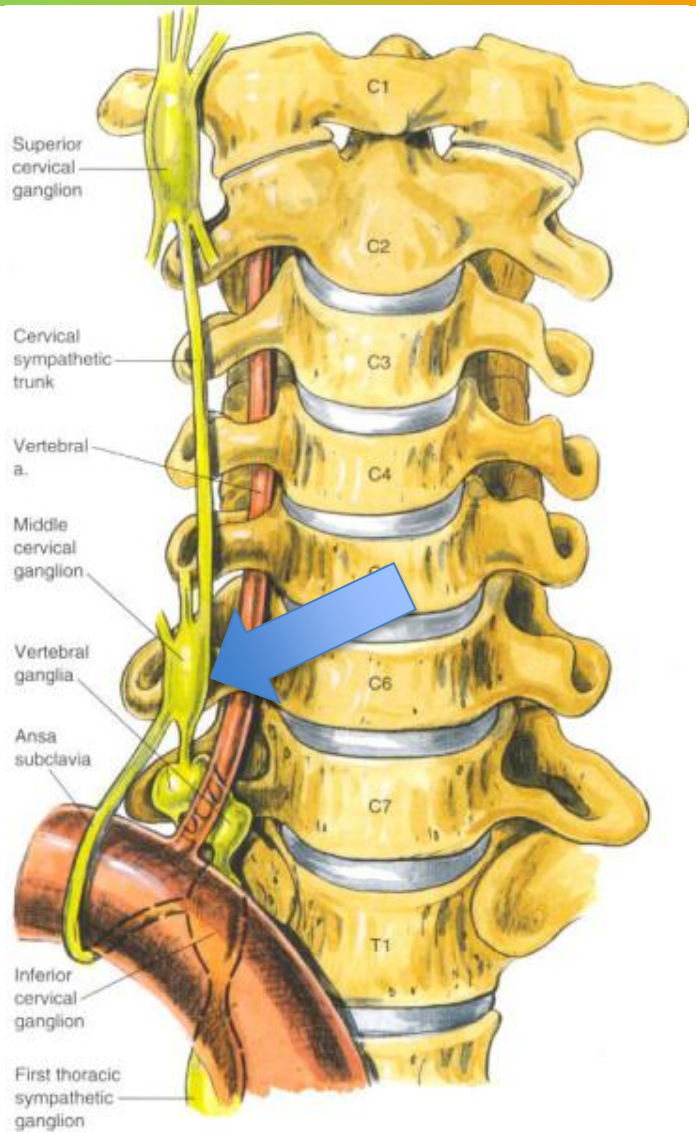
- Goal:
  - Analgesia of sympathetic chain
  - Diagnostic and therapeutic – if diagnostic block produces good analgesic result followed by radiofrequency neurolysis of ganglion
- Technique: In-plane or out of plane
- Patient Position: Supine with pillows under shoulders, neck slightly overextended

Sympathetic Nerves

- Responsible for conducting sensation signals to the spinal cord from the body
- Regulate blood vessels and sweat glands
- Sympathetic ganglia are collections of these nerves near the spinal cord

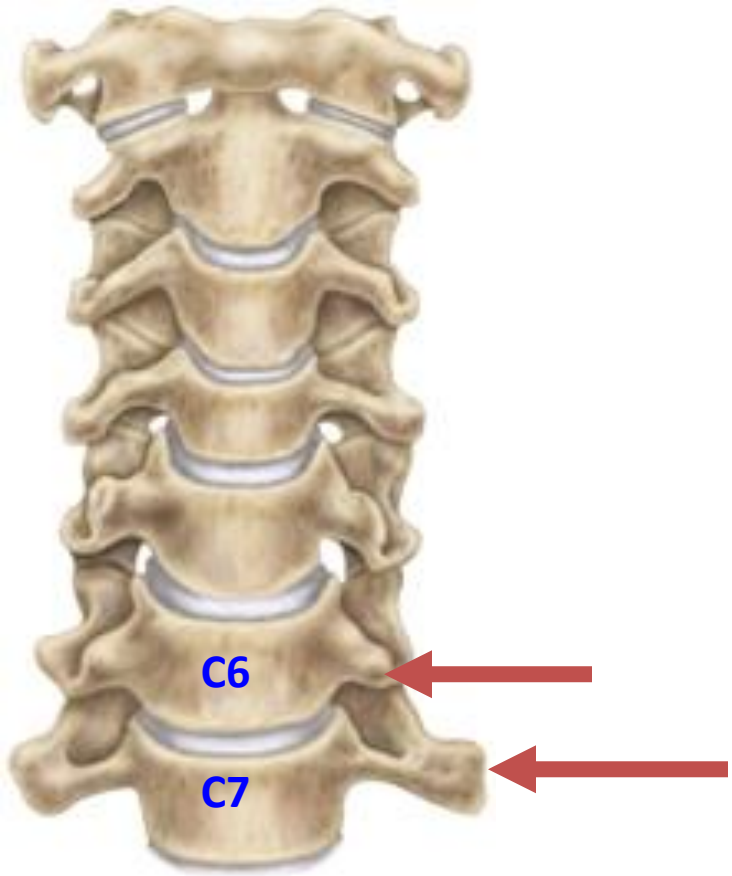
Stellate Ganglion

- Stellate ganglion chain – block at level of middle cervical ganglion
- Located at the level of C6
  - Anterior to the transverse process
  - Close proximity to vertebral artery and carotid artery



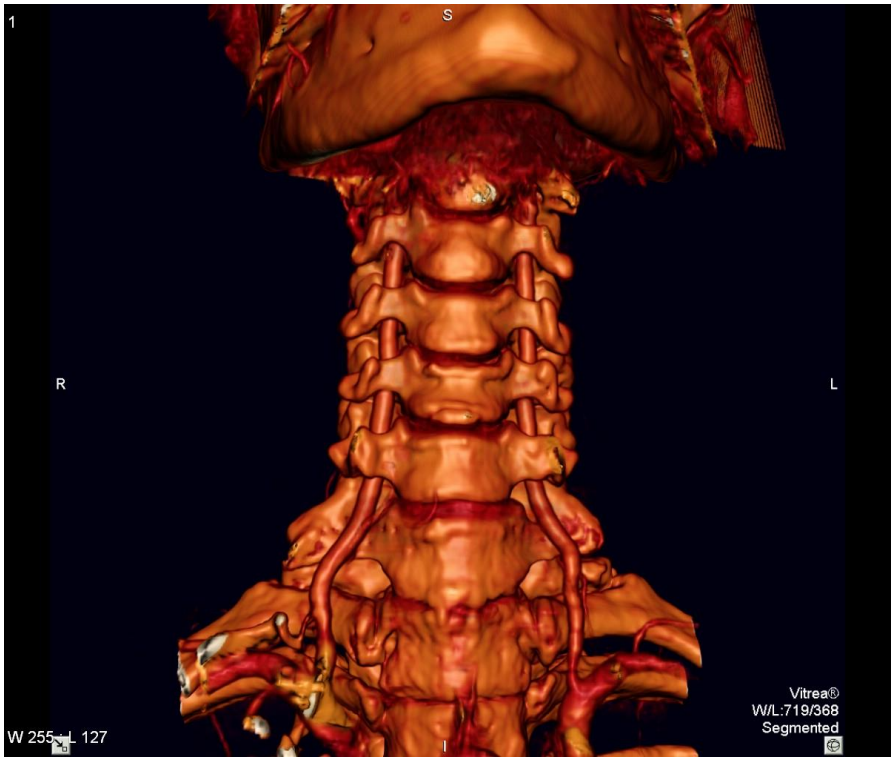
Bony Landmarks

- Note size of transverse process at C6 and C7 levels
- 2 tubercles (anterior and posterior) on transverse process of C6
- There is no anterior tubercle on C7 transverse process



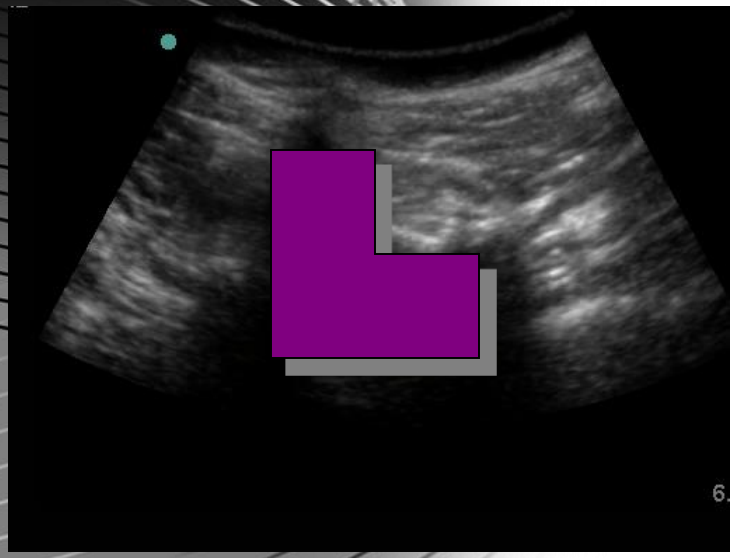
Bony and Vascular Landmarks

- Vertebral artery exposed at C7 (anatomical variant 10% vertebral artery exposed at C6)
- Enters transverse process at C6



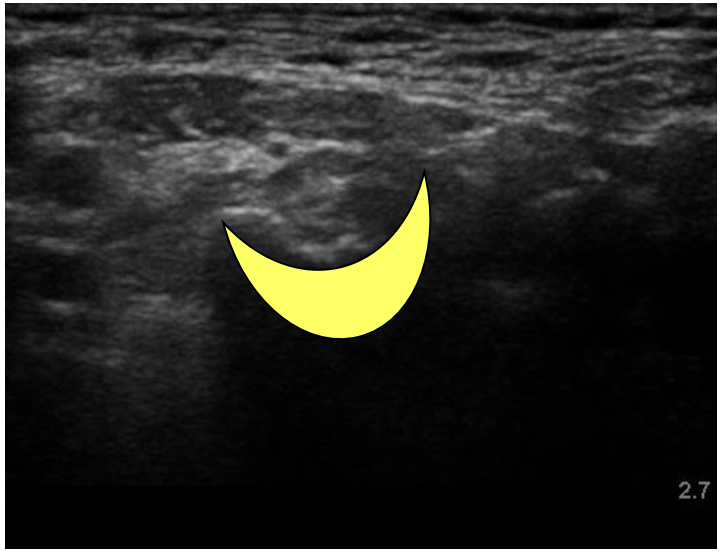
3D Rendered Image Vertebral Artery

Bony Landmarks



C7 – Landmark

Transverse Process



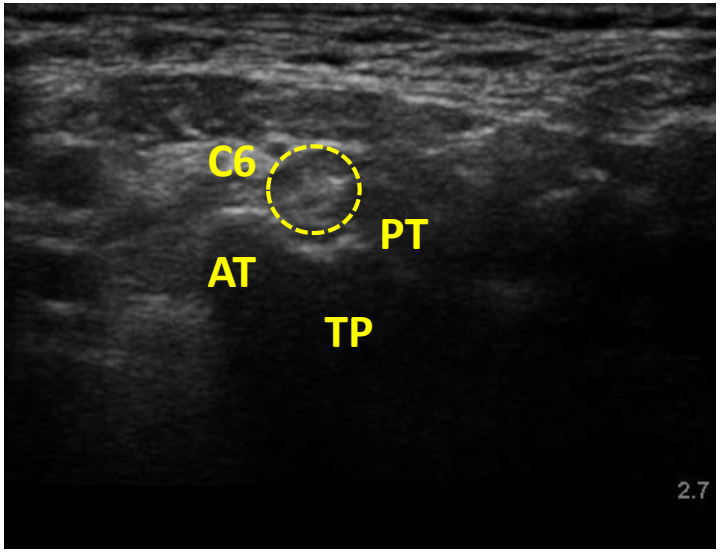
C6 – Landmark

Transverse Process

Bony Landmarks

C7 – Landmark

Transverse Process

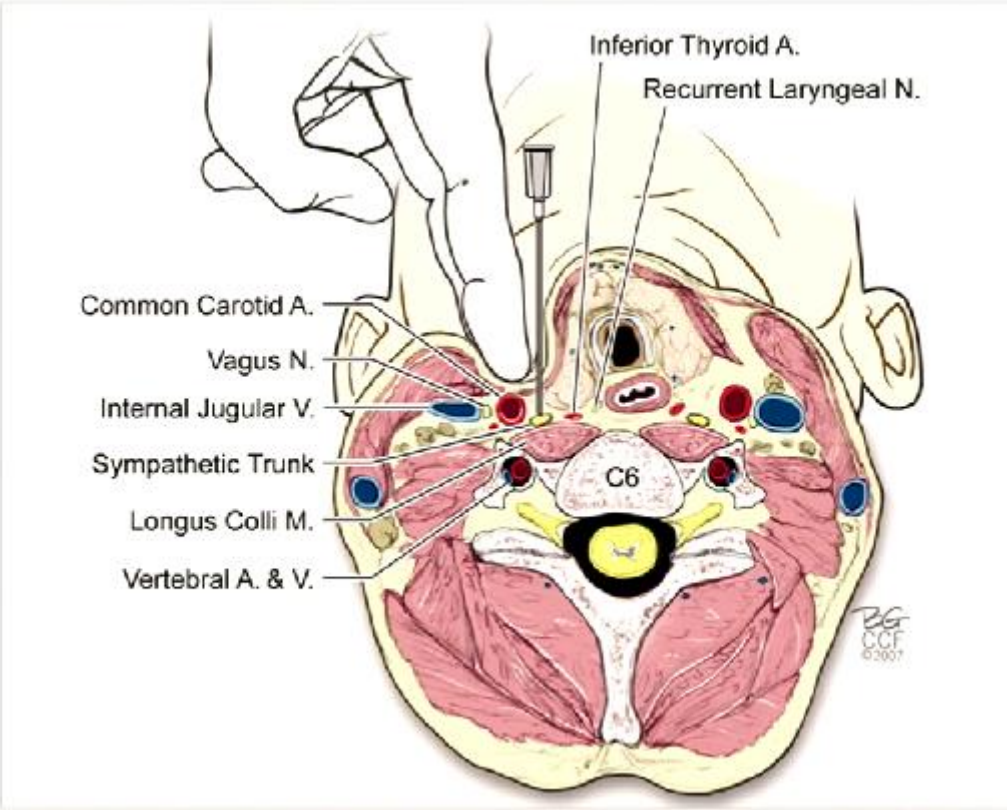


C6 – Landmark
PT = Posterior Tubercle
AT = Anterior Tubercle
TP = Transverse Process

Note: Moving cephalad to C5,C4,C3 the anterior and posterior tubercle become similar in size

Blind Technique

- Palpate for carotid artery, push thyroid medially
- Can easily puncture carotid artery or vertebral artery

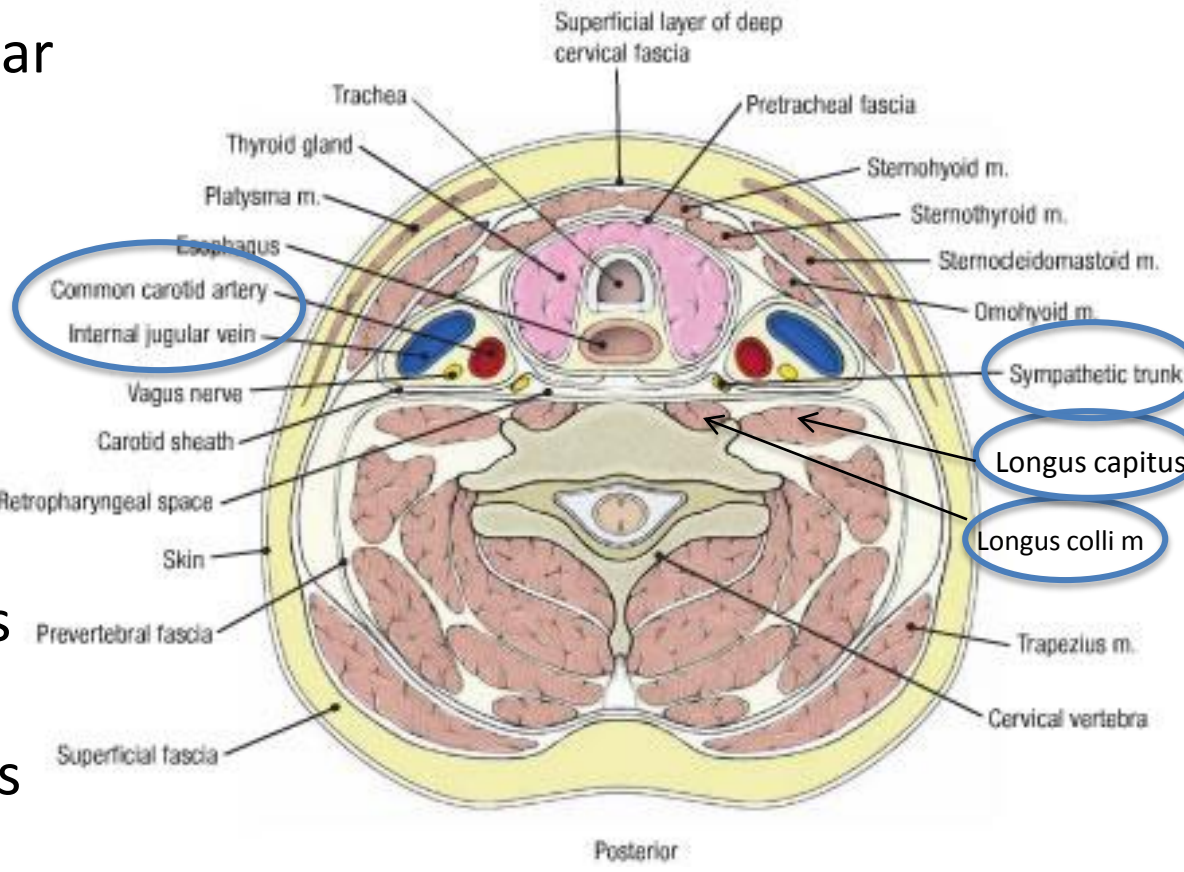


Advantages of US in SGB

- Avoid injury to vascular structures: carotid, vertebral, thyroid and branches of subclavian artery
- Avoid injury to esophagus on left (particularly if diverticulum of esophagus
- Avoid injury to nerve roots
- Allows for precise block
- Prevents pneumothorax

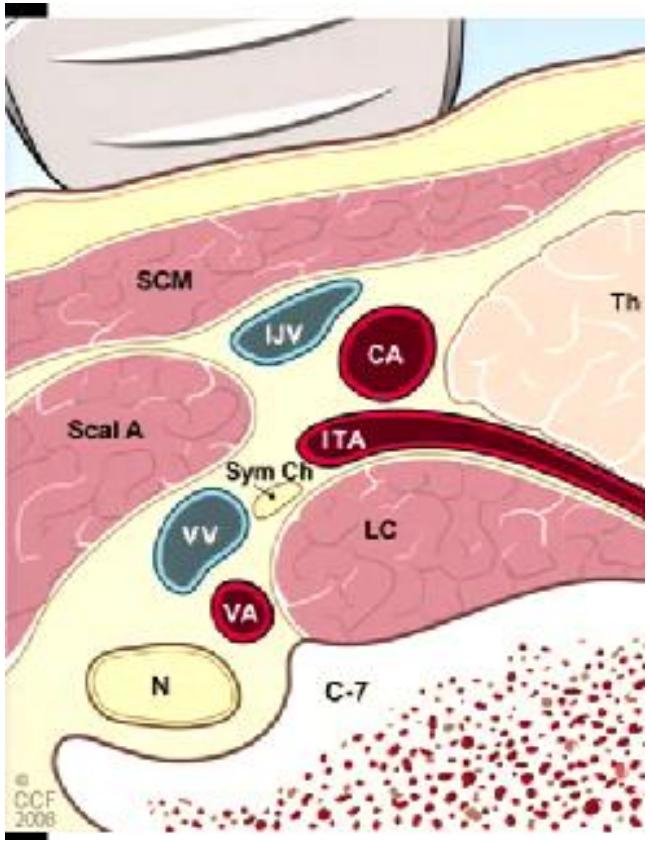
Ultrasound Technique

- Identify level of C6 using bony and vascular landmarks
- Move transducer medial to locate carotid artery and longus colli muscles deep to vessels
- Sympathetic trunk sits in groove between longus colli and longus capitus muscles

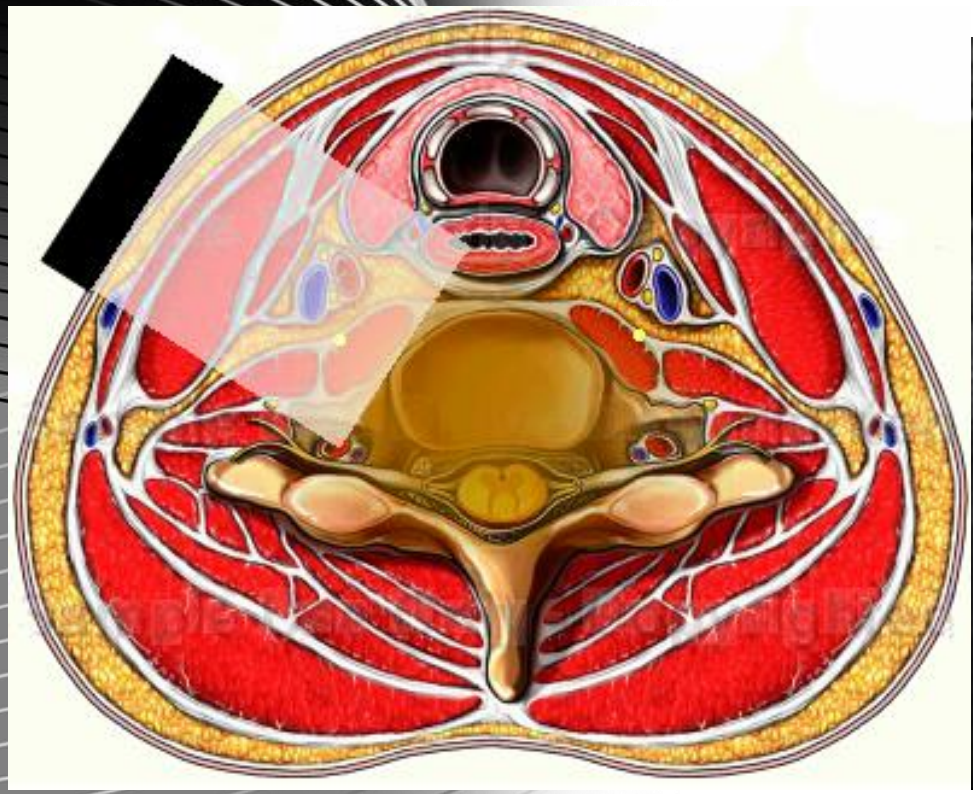


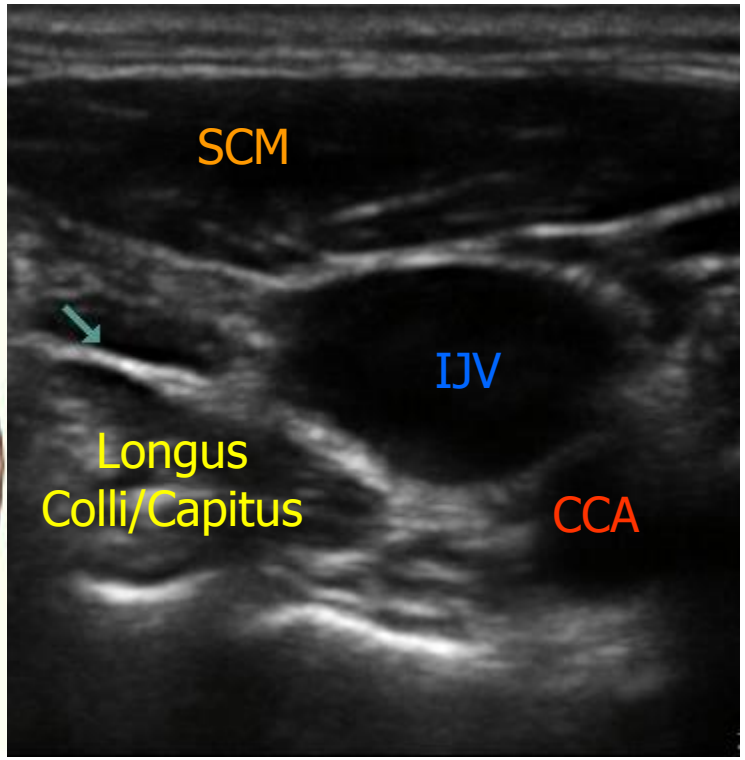
Ultrasound Technique

- Important to identify small vessels with Color Doppler this there are multiple large vessels and many small arterial and venous branches in this region



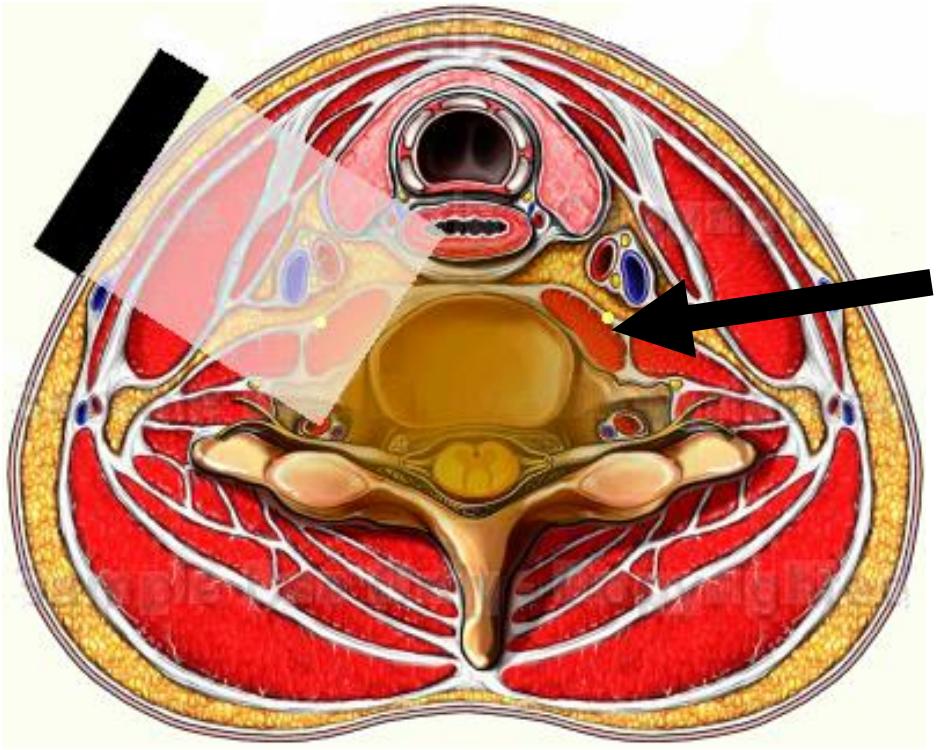
Stellate Ganglion View





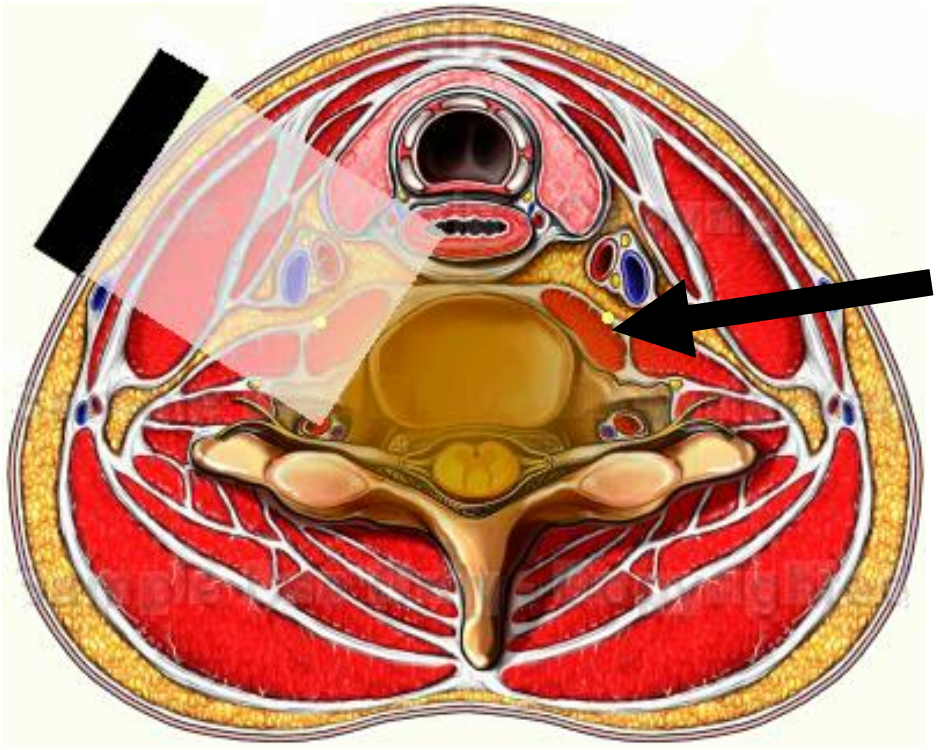
Stellate Ganglion

- Injection Technique
  - Effectiveness of block depends upon being in the correct fascial plane
  - 1-2mm distance between sympathetic chain and vagus nerve
  - Want to inject so push carotid sheath up
  - Inject under fascia covering longus colli muscle

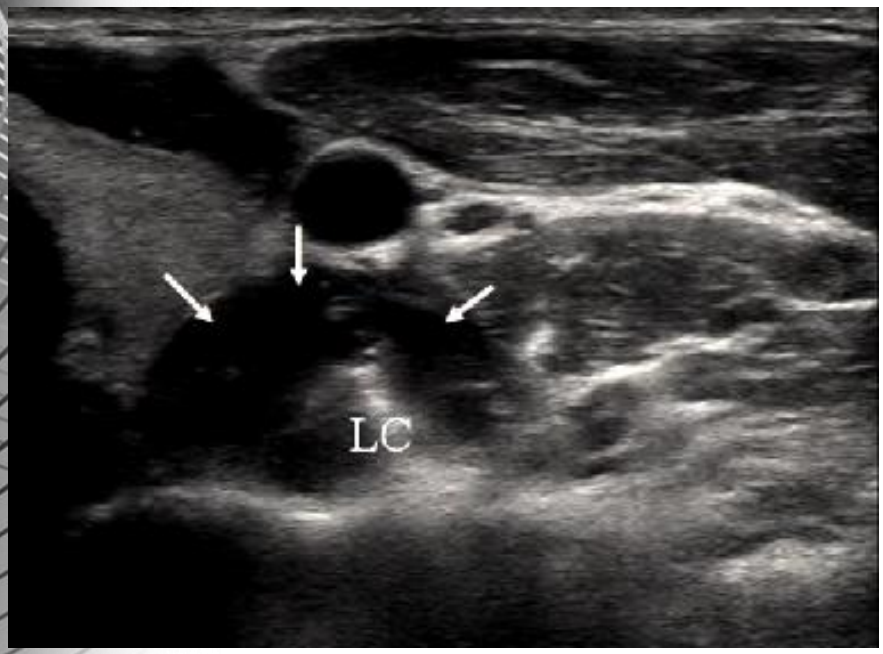


Stellate Ganglion

- Injection Technique
  - In-plane technique approach with needle lateral to medial
  - Out of plane between anterior tubercle and logus colli muscle

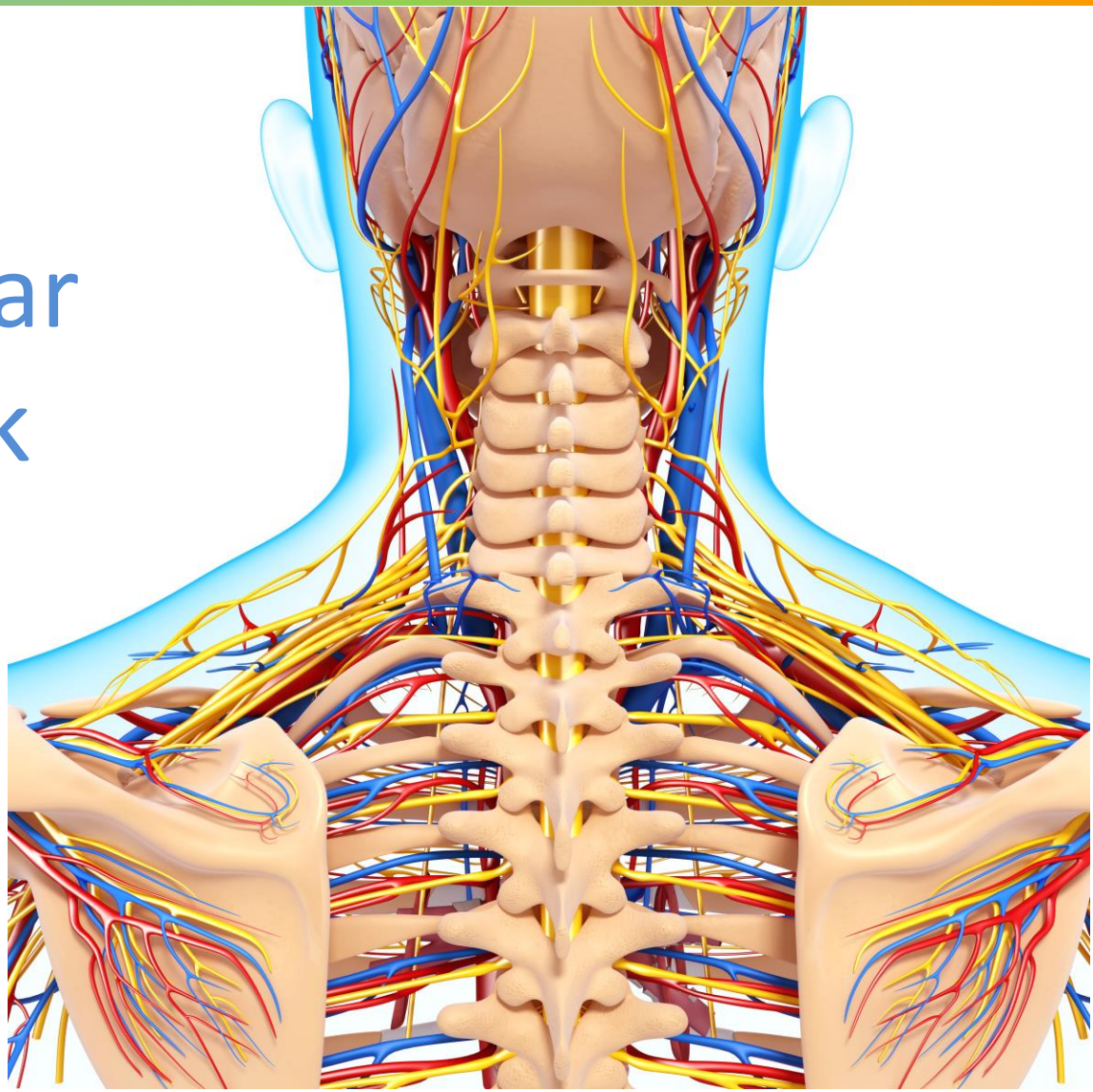


Stellate Ganglion Block



Spread of local anesthesia pushes carotid sheath up and travels under fascia of longus colli muscle but not in muscle

Suprascapular Nerve Block

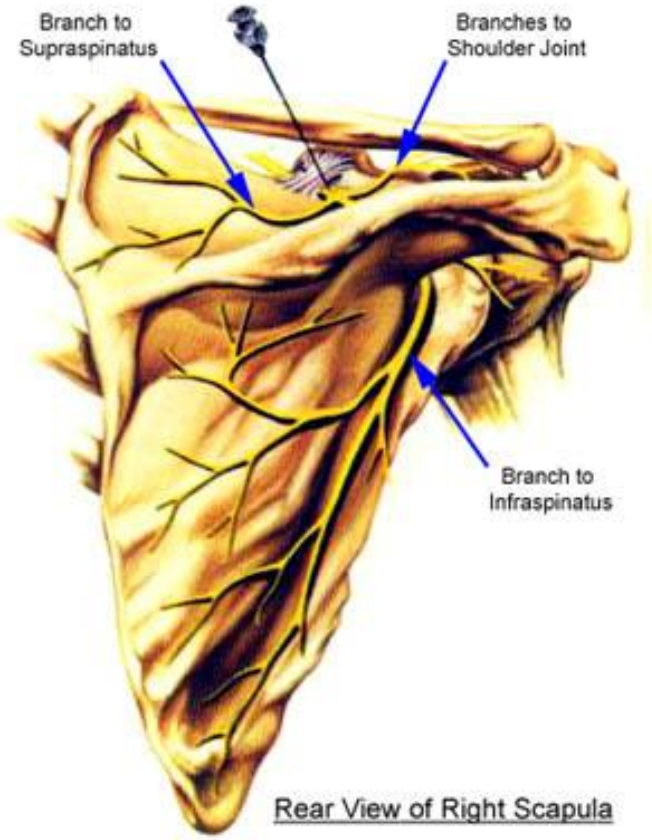


Indications

- Diagnostic
  - Confirm suprascapular nerve irritation or entrapment
- Therapeutic
  - Safe and effective treatment for shoulder pain in degenerative disease, arthritis or bursitis, postoperative pain shoulder surgery
  - It improves pain, disability, and range of movement

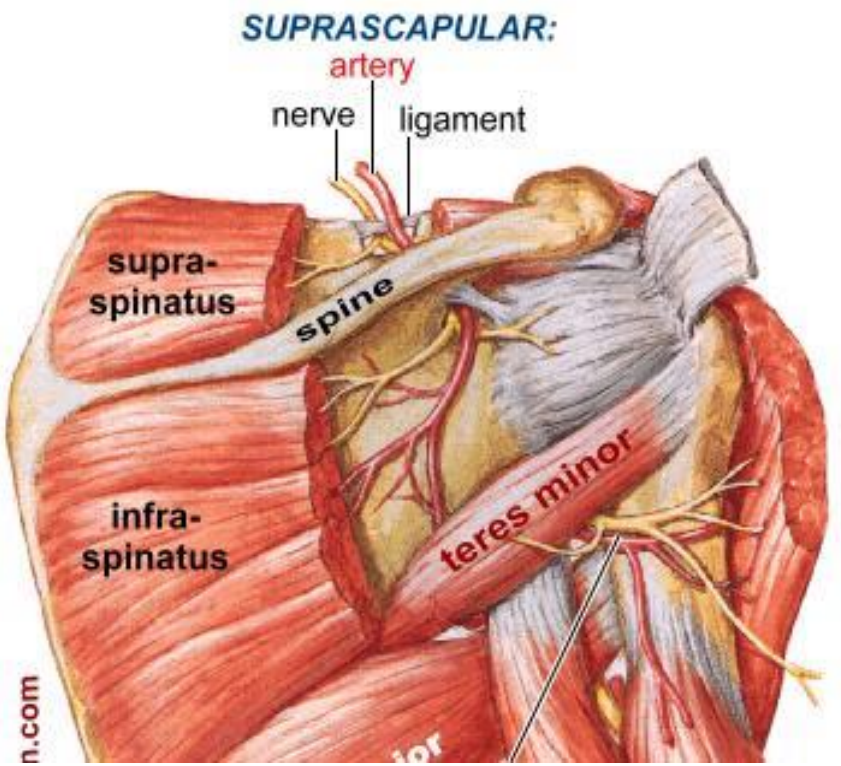
Suprascapular Nerve

- Major sensory supply to the shoulder joint and motor supply to the supraspinatus and infraspinatus muscles



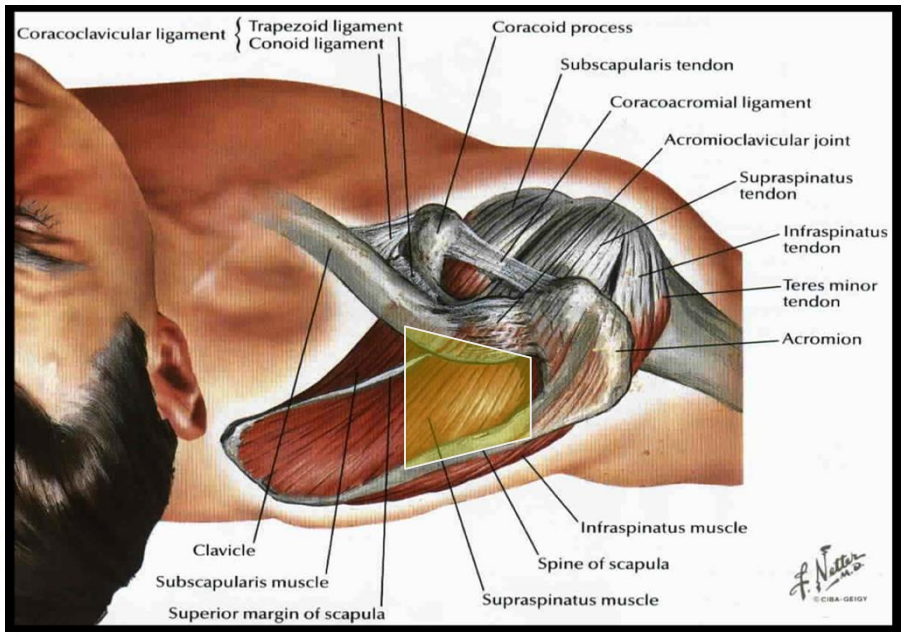
Suprascapular Nerve

- Runs through the scapular notch
- Scapular notch lies on the superior aspect of the suprascapular fossa where the coracoid process fuses to the scapula



Suprascapular Anatomy

- Use the Nevasier Portal as a scanning window
- Located between posterior margin of clavicle, spine of scapula and medial margin of acromion



Ultrasound Scanning Technique

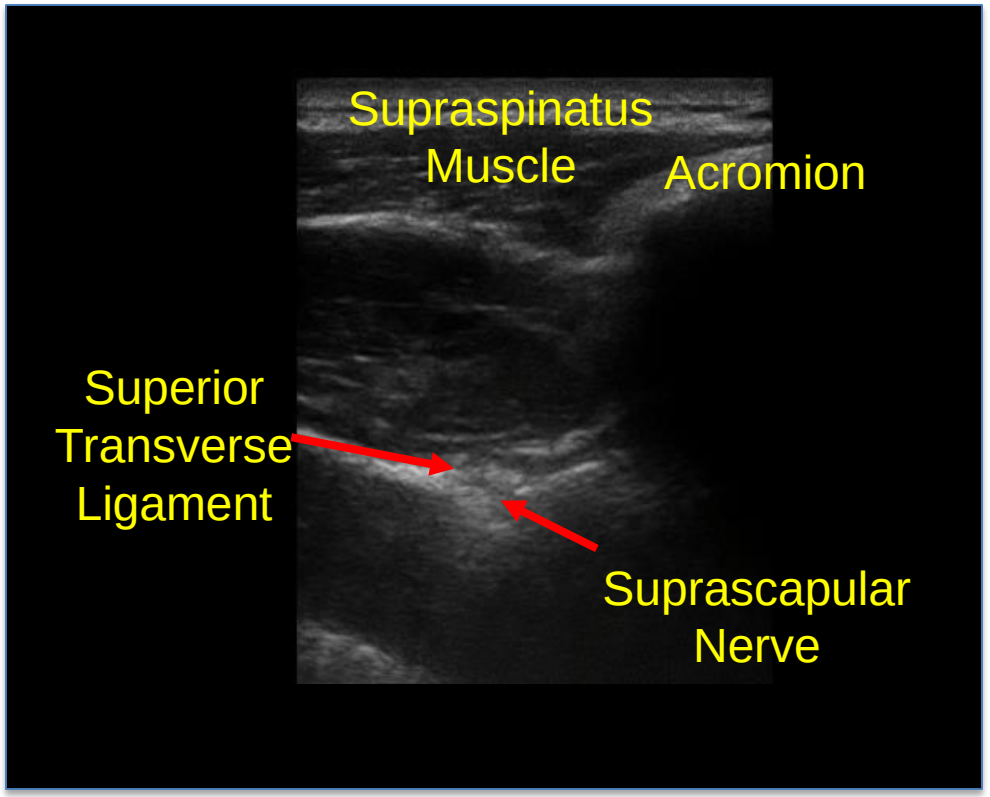
- Patient is sitting with hand on contralateral shoulder
- Shoulder position pulls scapula out of the lung field
- Operator positioned behind the patient
- Ultrasound system on the right side in front of the patient

Ultrasound Scanning Technique

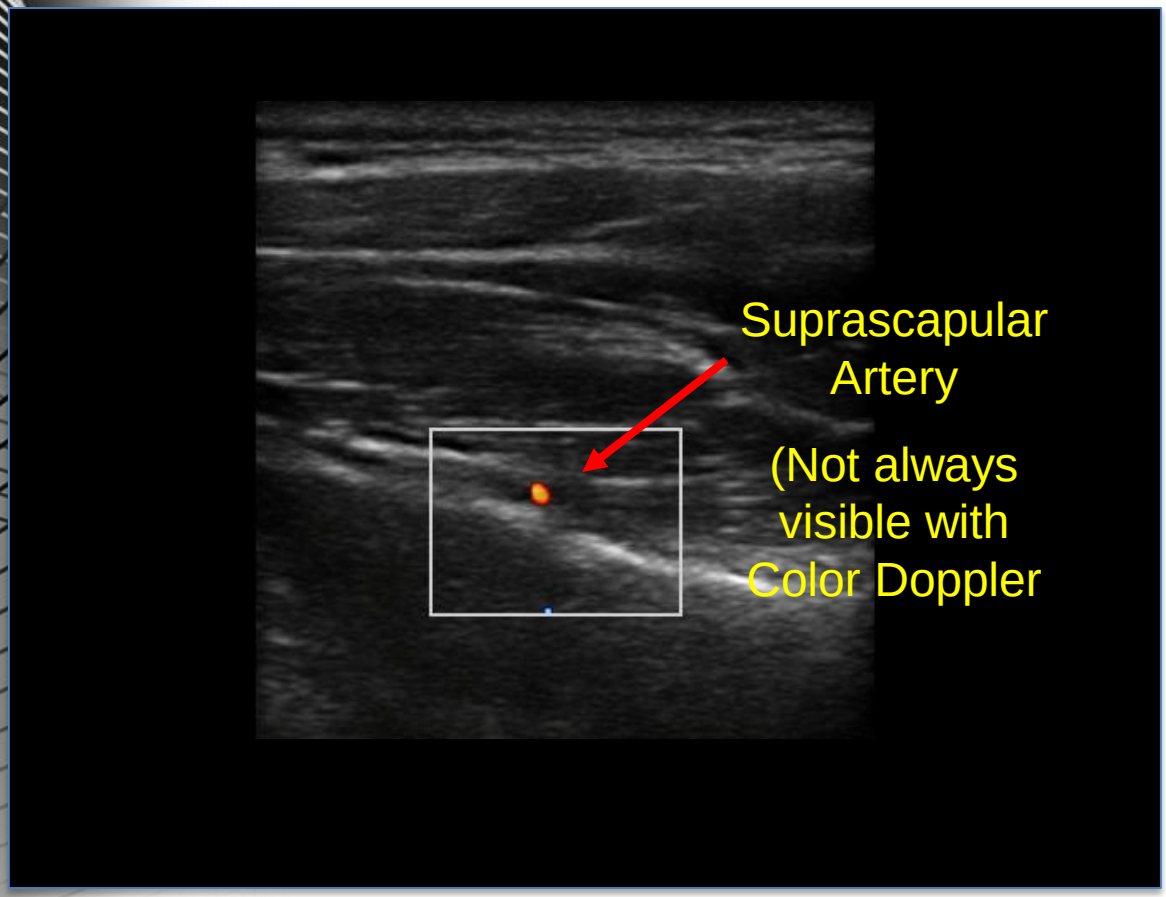
- Identify spine of scapula by palpation
- Position transducer superior and parallel to the spine of scapular
- Identify pleura (medial), scapula and suprascapular notch (deep), supraspinatus (superficial), acromion (lateral)
- Supracapular artery runs with nerve
- Nerve lies in suprascapular notch
- Use notch as the main target because nerve is not always visible (Note: 15% population do not have a suprascapular notch)
- **Suprascapular nerve passes UNDER the superior transverse scapular ligament**
- **Suprascapular artery passes OVER the superior transverse scapular ligament**

Ultrasound Image

- Suprascapular nerve seen as a round hyperechoic structure at 4 cm depth
- Beneath the Superior Transverse Ligament in the Suprascapular Notch
- Diameter of 20 mm

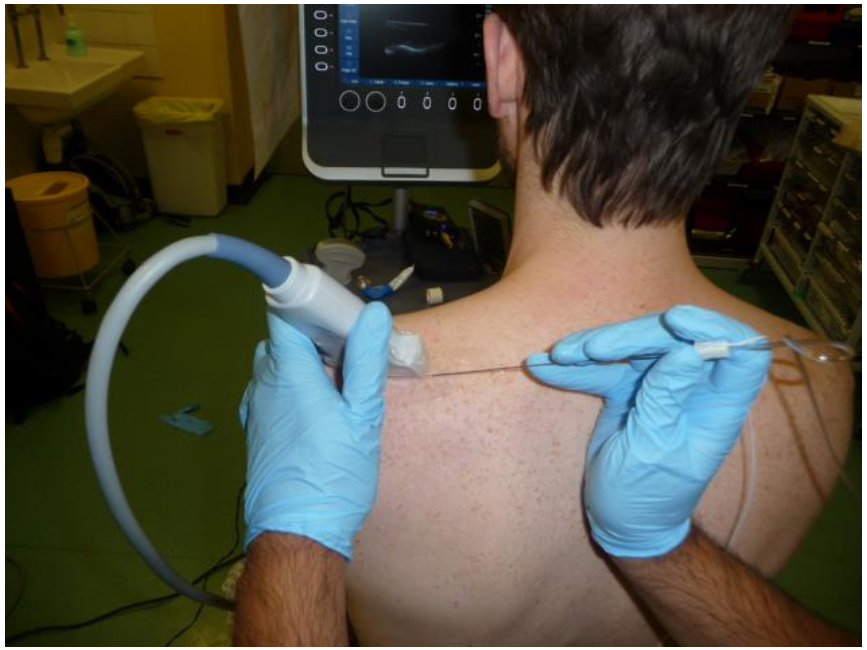


Suprascapular Artery



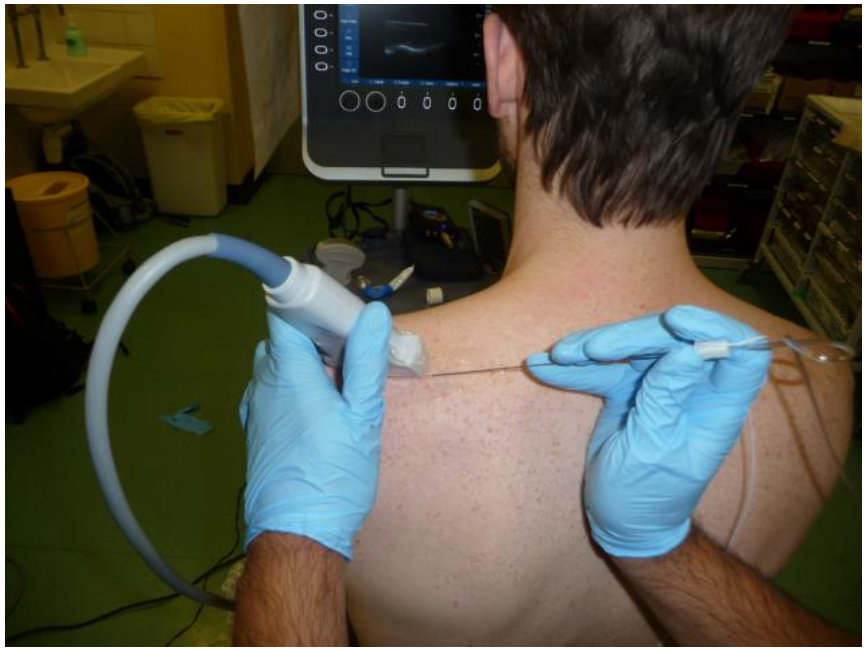
Block Technique

- Suprascapular nerve is blocked before it branches by placing anesthetic in the suprascapular notch
- Common technique
  - 2.5 cm superior and lateral to the mid point of the scapular spine

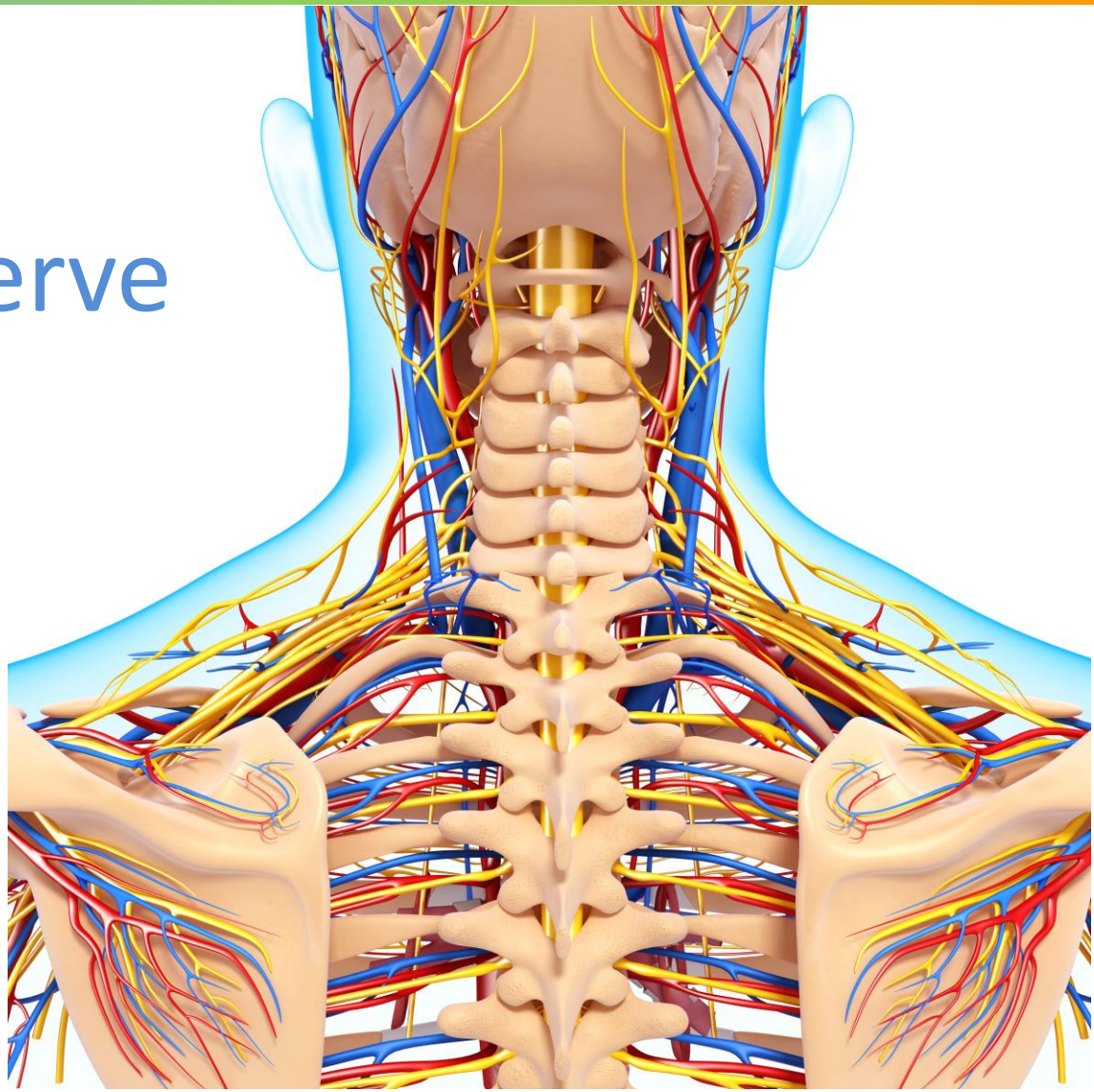


Injection Technique

- In plane or out of plane
- Medial or lateral
- Endpoint for injection
  - needle tip in proximity to the **suprascapular nerve** under the superior transverse scapular ligament
- Injection will lift up supraspinatus muscle



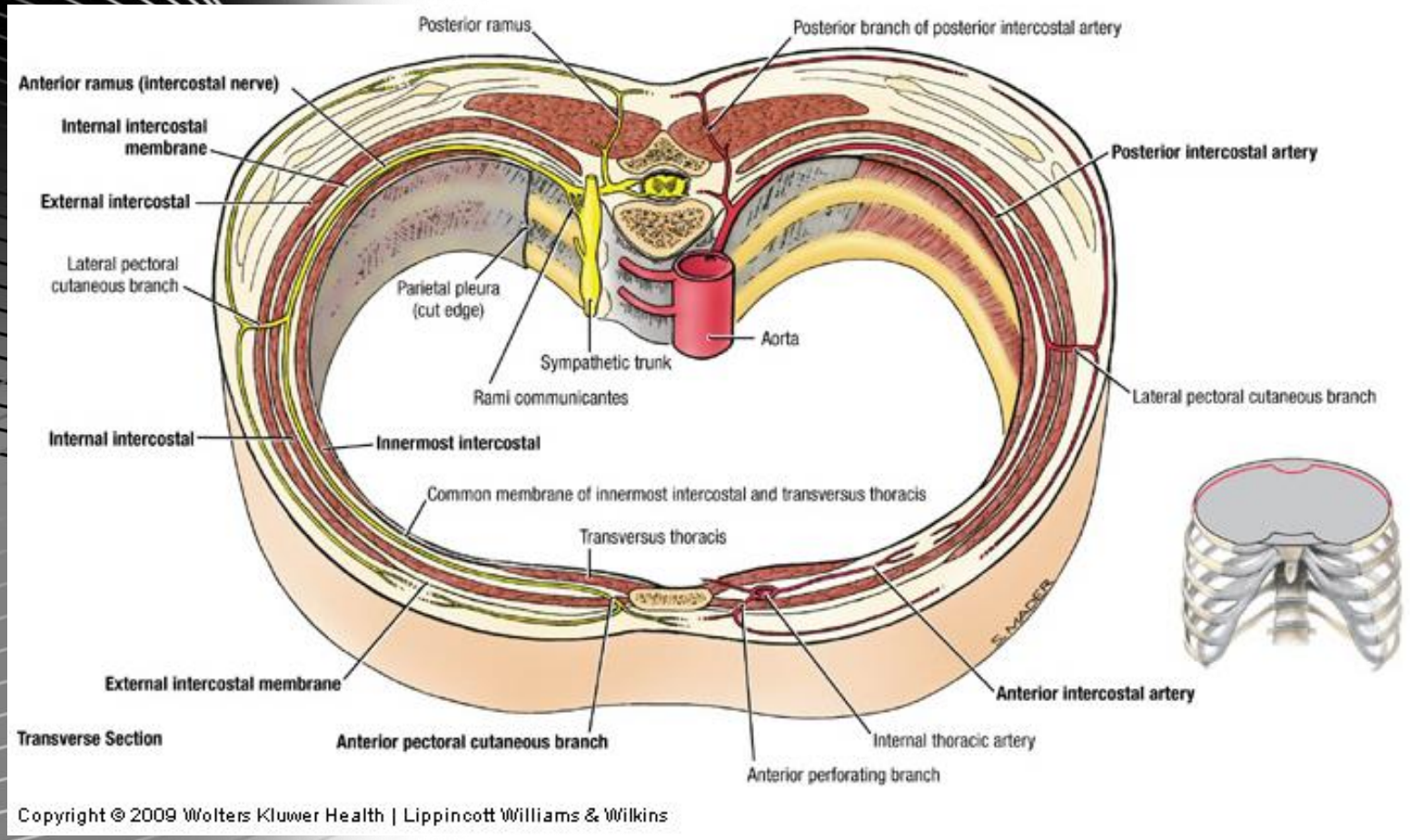
Intercostal Nerve Block



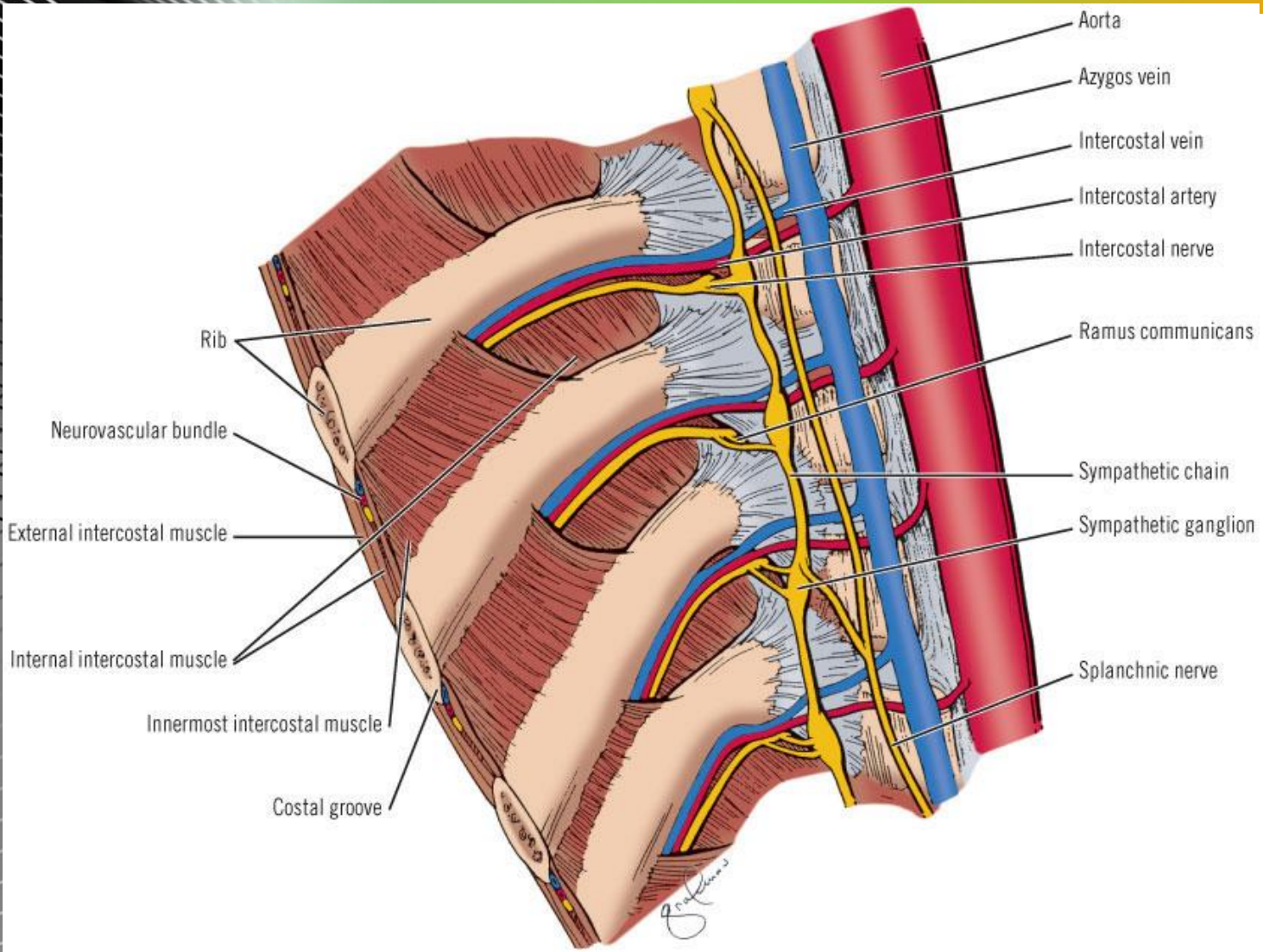
Intercostal Nerve Block

- Indications: Thoracic or upper abdominal surgery, rib fractures, breast surgery
- Goal: Anesthetic at neurovascular bundle at inferior border of rib
- Complications: Pneumothorax, the intercostal nerve sits adjacent to pleura
- Patient Position: sitting, lateral decubitus, prone
- Technique: In-plane or out of plane
- Advanced Block

Anatomy



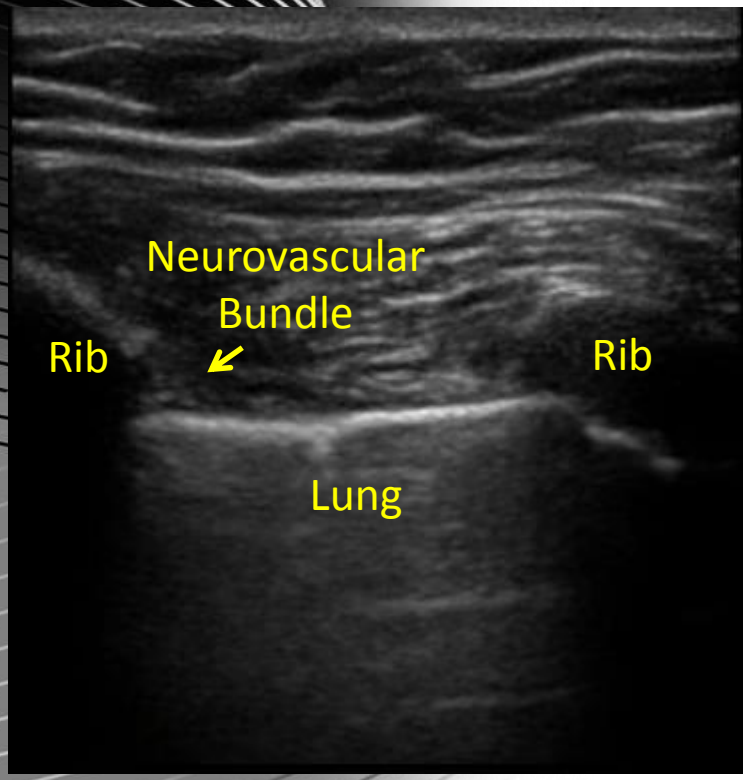
Anatomy

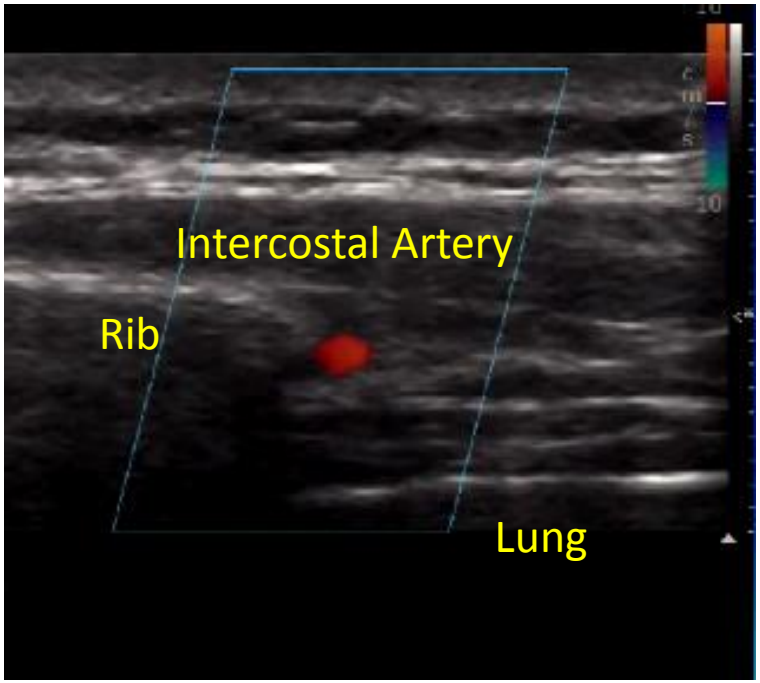


Block Technique

- Can't often see intercostal nerve
- Look for intercostal artery and inject caudad to artery
- Injection 5-7 cm lateral from midline (spinous process of vertebrae)
- Closer to vertebrae intercostal nerve is very close to edge of rib as the nerve travels laterally the nerve position becomes more subcostal

Ultrasound Image



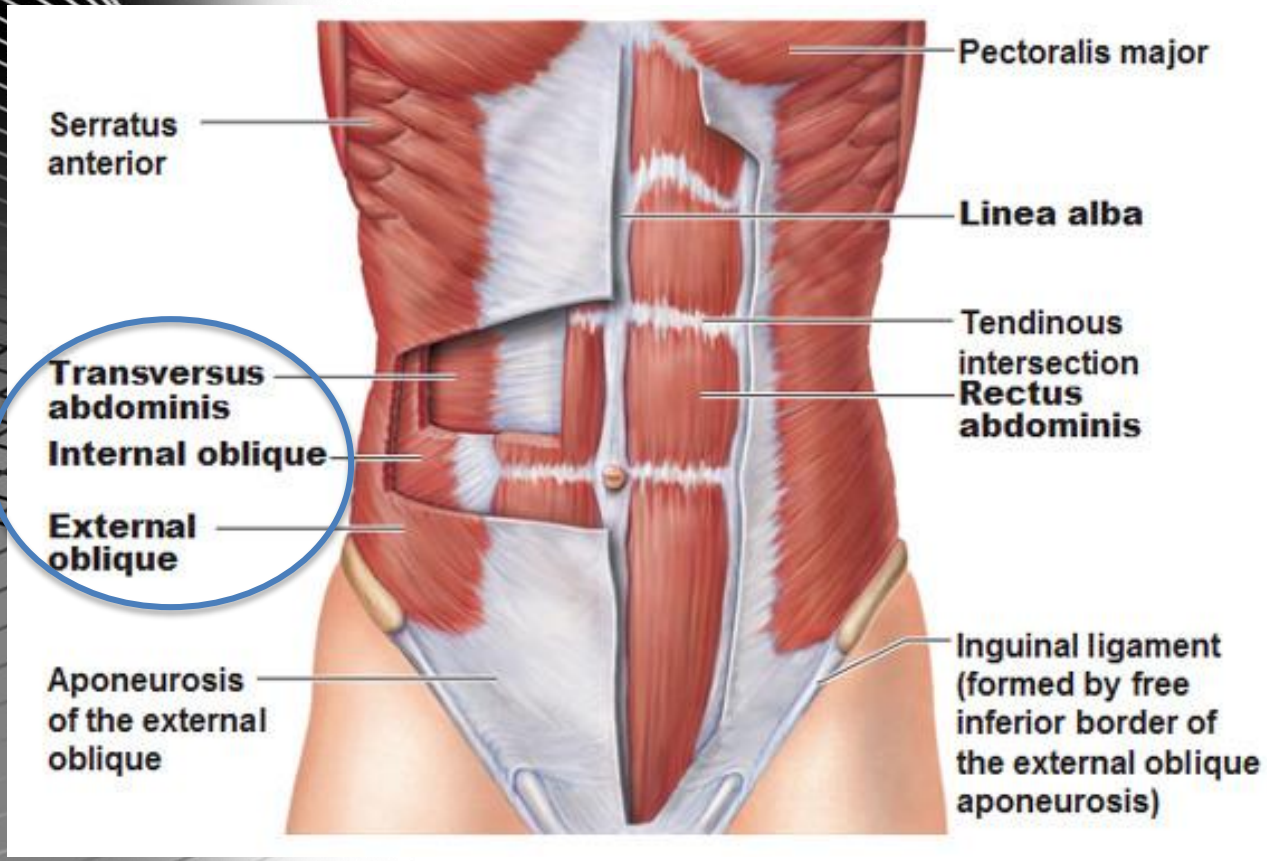


Transversus Abdominum Plane (TAP)

Transversus Abdominus

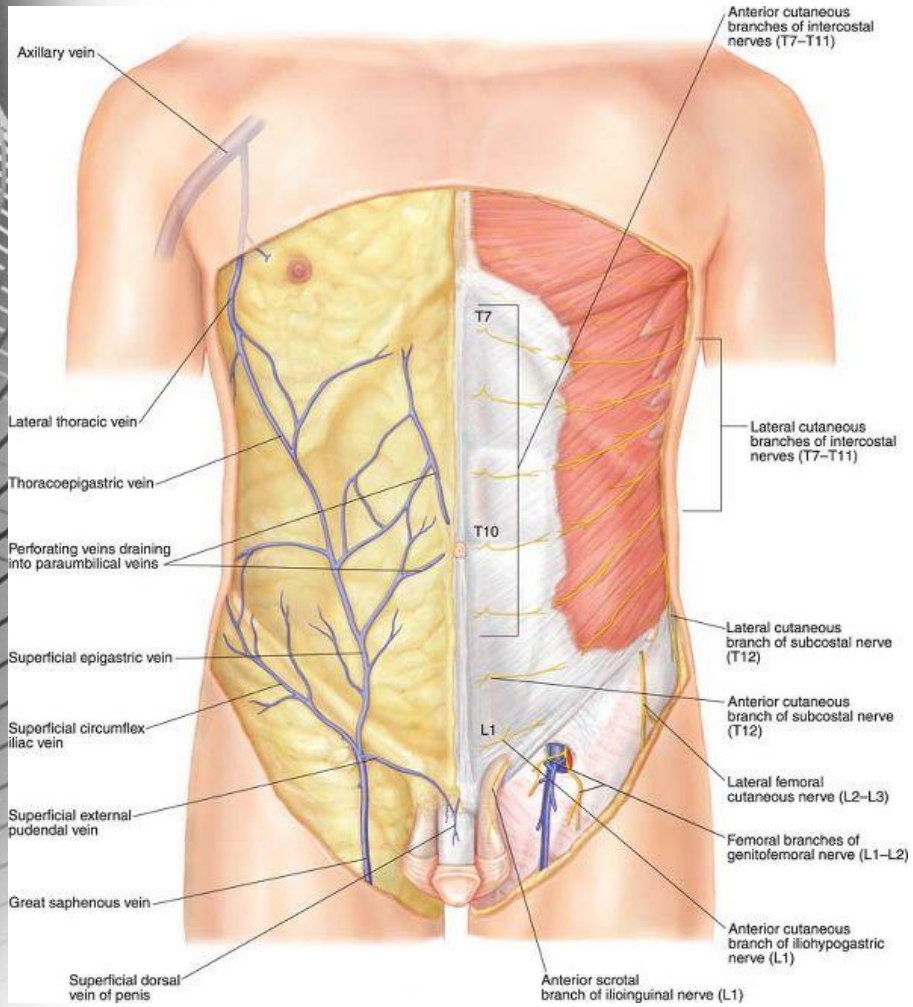
- Indications: Surgeries below umbilicus, post-op laparotomy, appendectomy, laparscopic surgery, hernia surgery, hysterectomy, abdominoplasty, cesarean delivery, alternative to epidural for operations on abdominal wall, diagnosis for chronic pain procedures
- Goal:
  - Anesthetic spread in fascial plane between transversus abdominus and internal oblique muscles
  - Block T7-T12 and L1
- Technique: In-plane
- Patient Position: Supine

Anatomy Abdominal Muscles



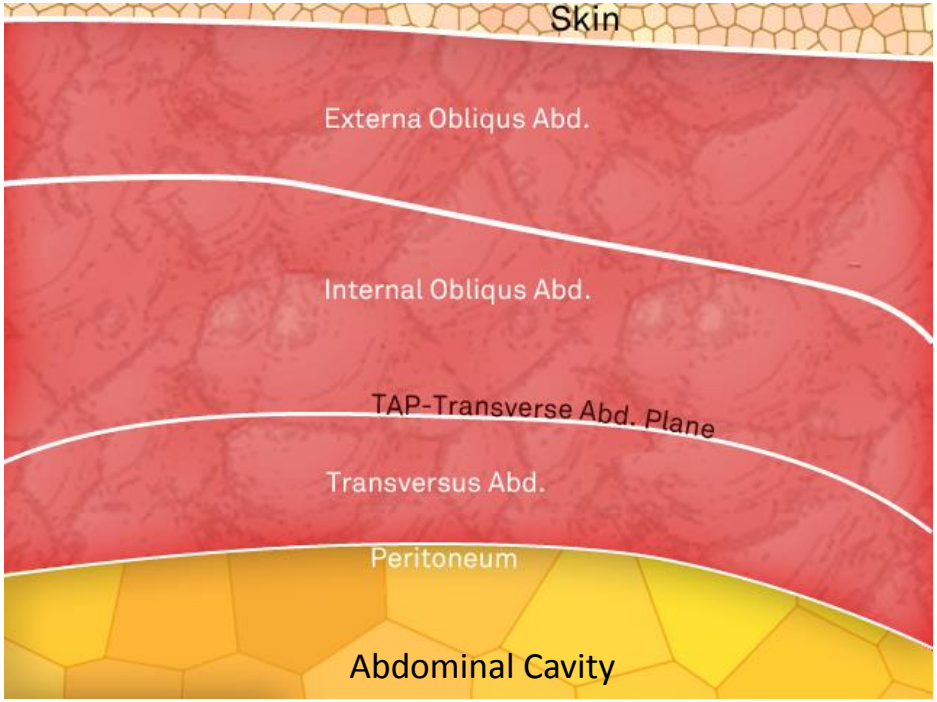
Anatomy Nerves Anterior Abdomen

Anterior Rami of Thoracic T7-T12 and L1



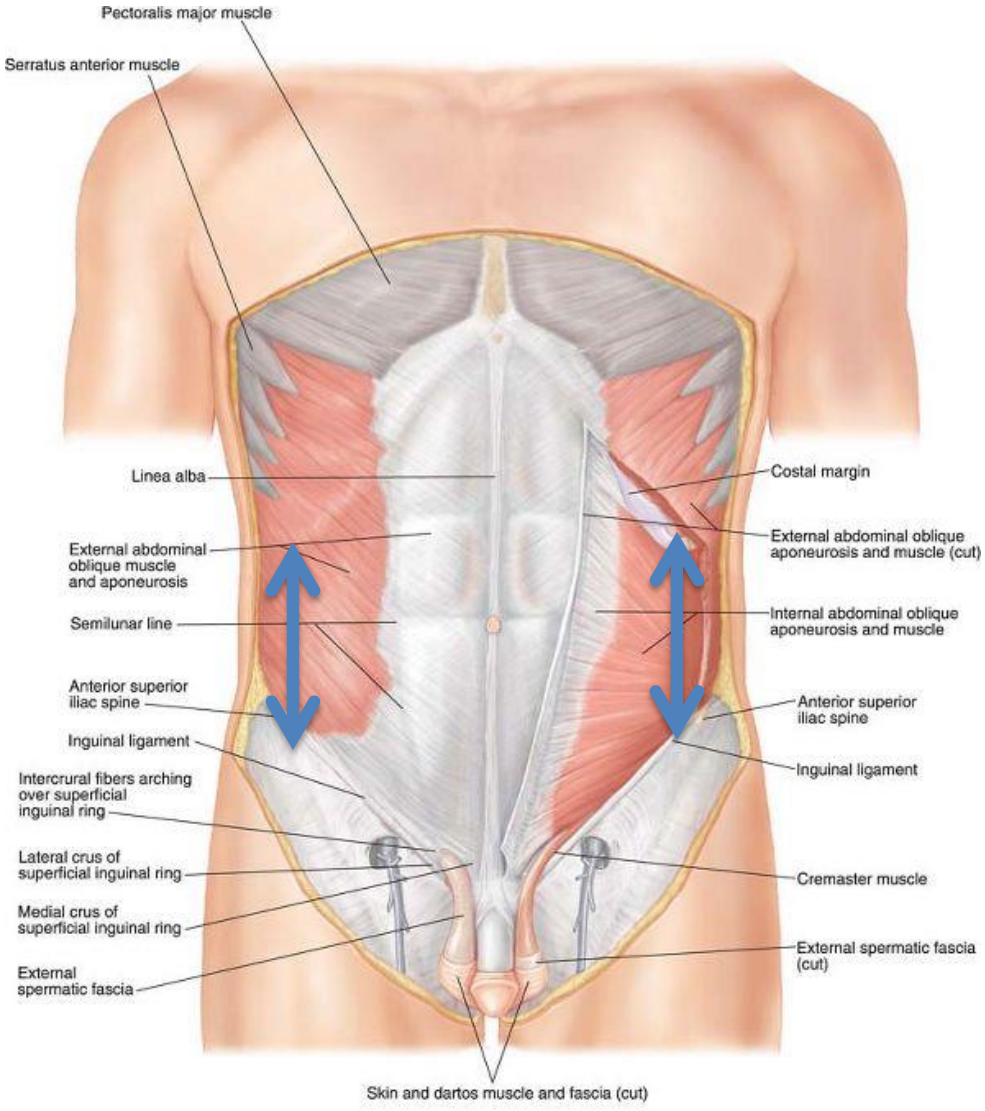
Anatomy Abdominal Muscle

- Subcutaneous layer is large in obese patient
- Internal oblique is the thickest layer
- Nerves are not well visualized with ultrasound
- Peritoneum divides muscles from abdominal cavity
- Intestines will be seen below peritoneum as moving structures due to peristalsis



Transducer Position

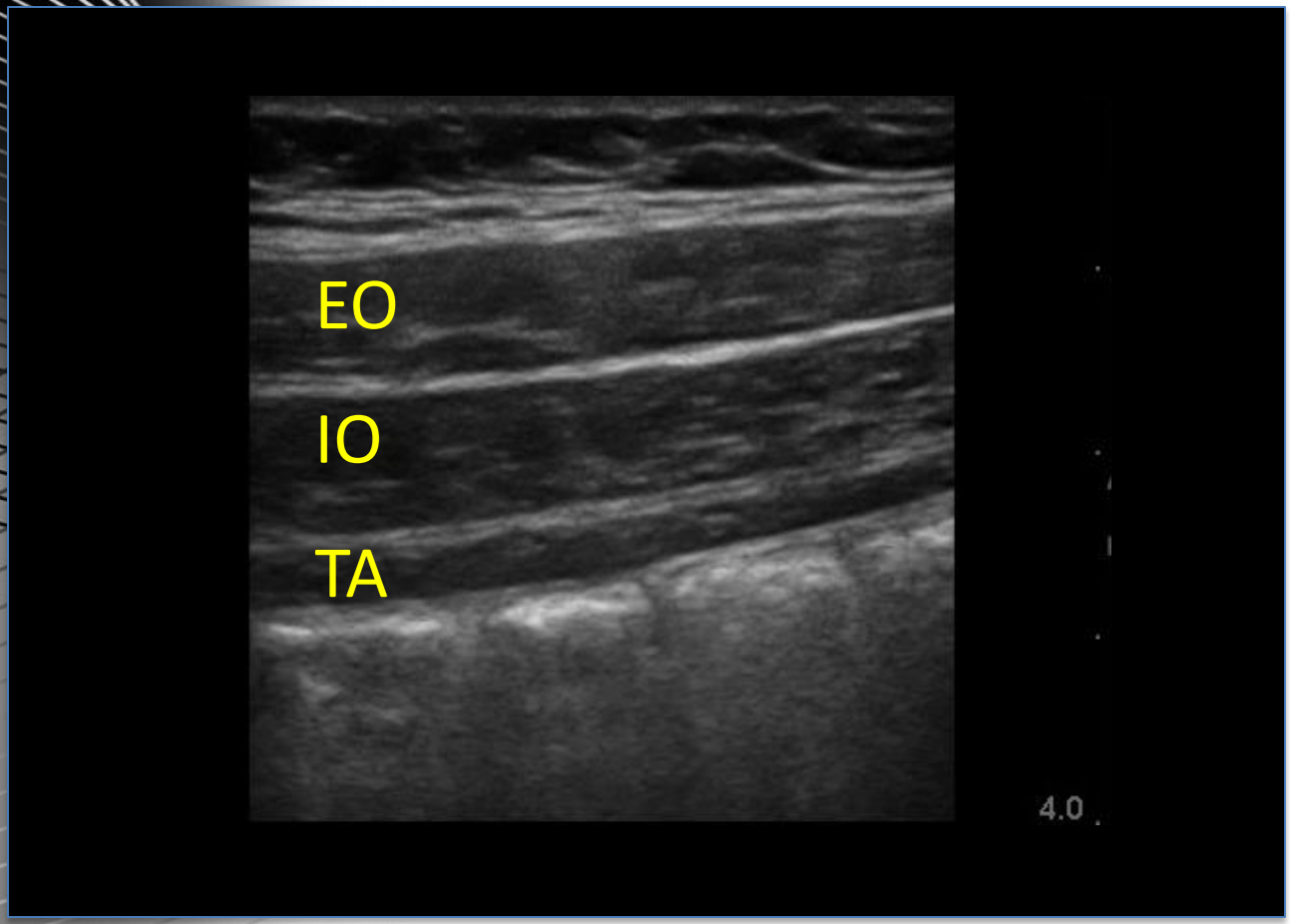
- Find the costal margin and iliac crest
- Scan this region along the Anterior midaxillary line (blue arrows)
- Identify fascial plane between IOM and TAM
- Transducer placed transverse on abdomen



Transducer Position

- Midpoint between costal margin and iliac crest along anterior midaxillary line
- Transverse position on abdomen

Ultrasound Image Muscle Layers TAP



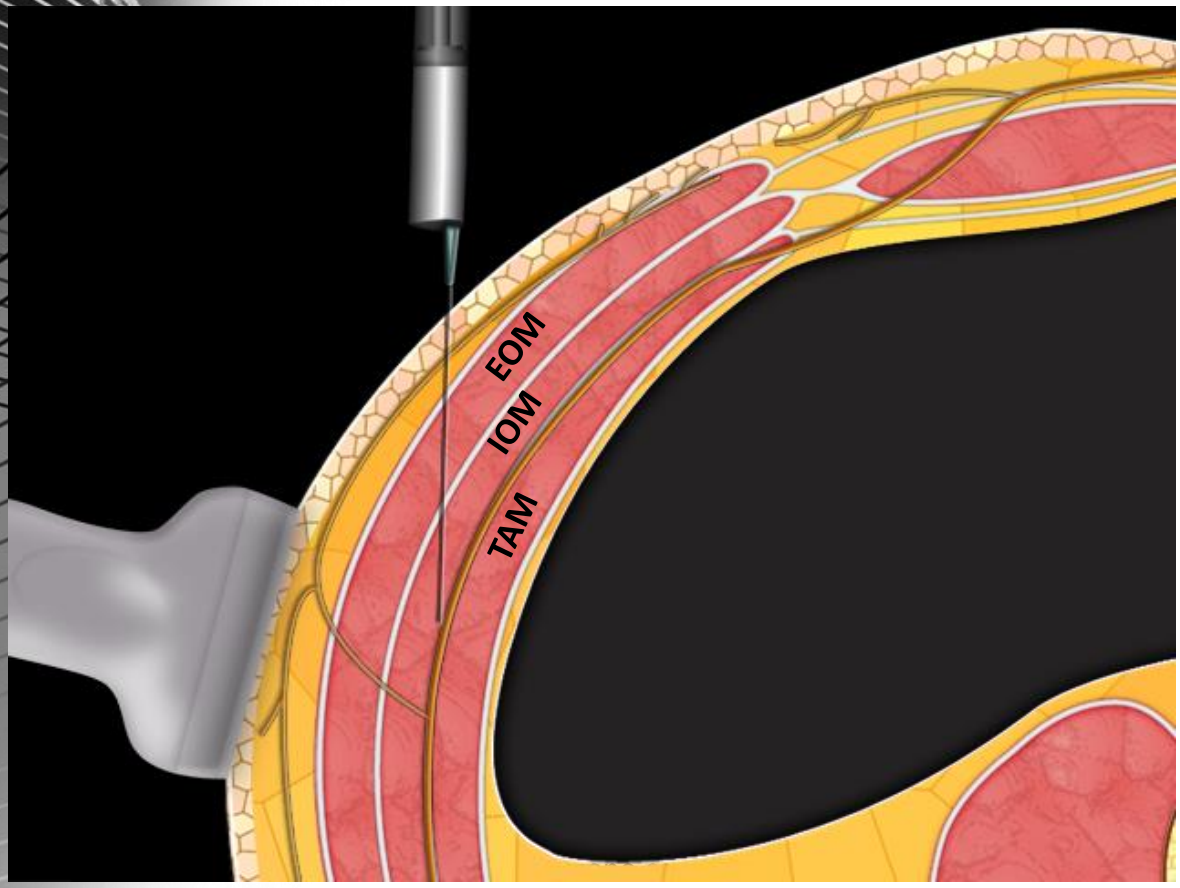
EO- External Oblique IO –Internal Oblique, TA – Transversus Abdominus

Injection Technique

In-plane injection, needle 2-3 cm medial to transducer

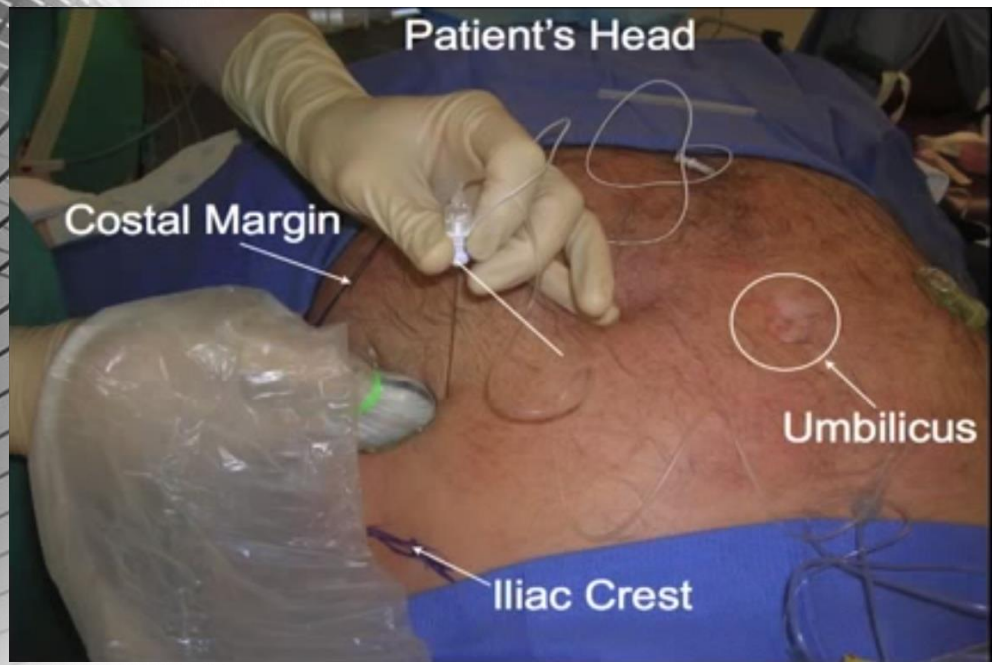
Advance needle medial to lateral

Target between internal oblique and transvers abdominus layers

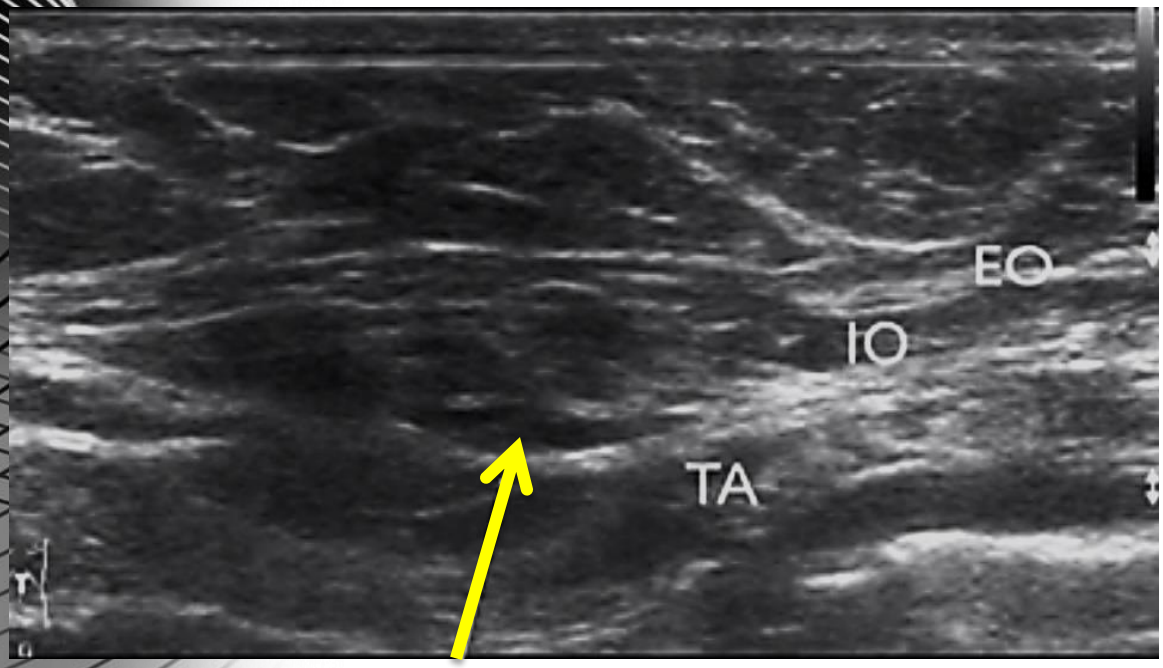


Injection Technique

- Transducer position between iliac crest and costal margin
- Avoid too far medial will only see 2 muscle layers
- Needle inserted medial to lateral

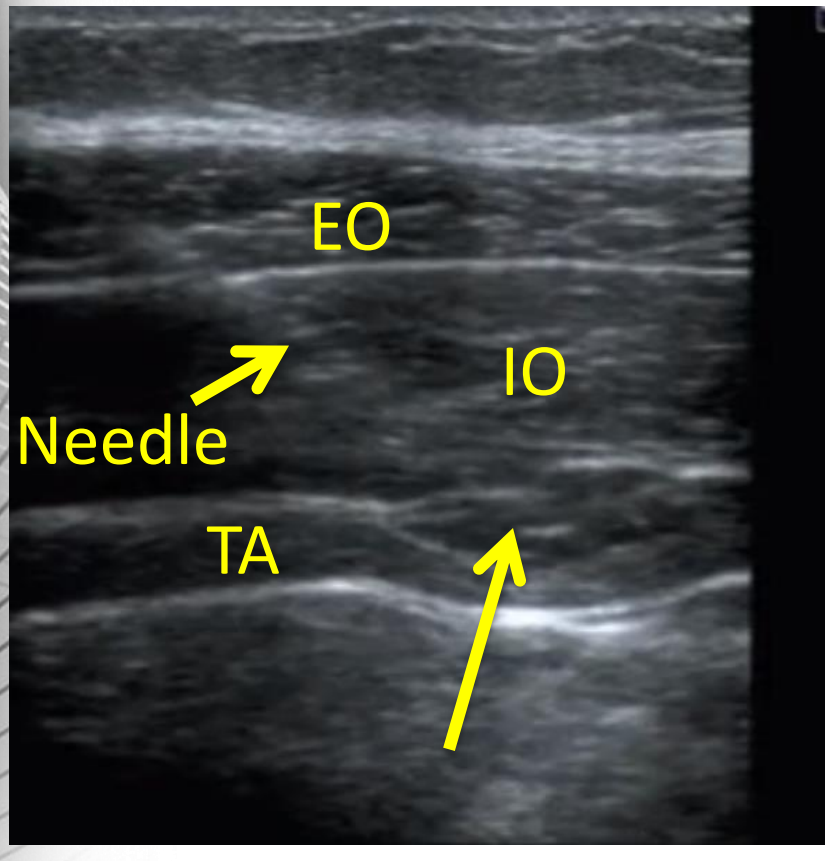


Ultrasound Technique



Local anesthetic between IOM and TAM

Ultrasound Technique



Local anesthetic fascia between IOM and TAM

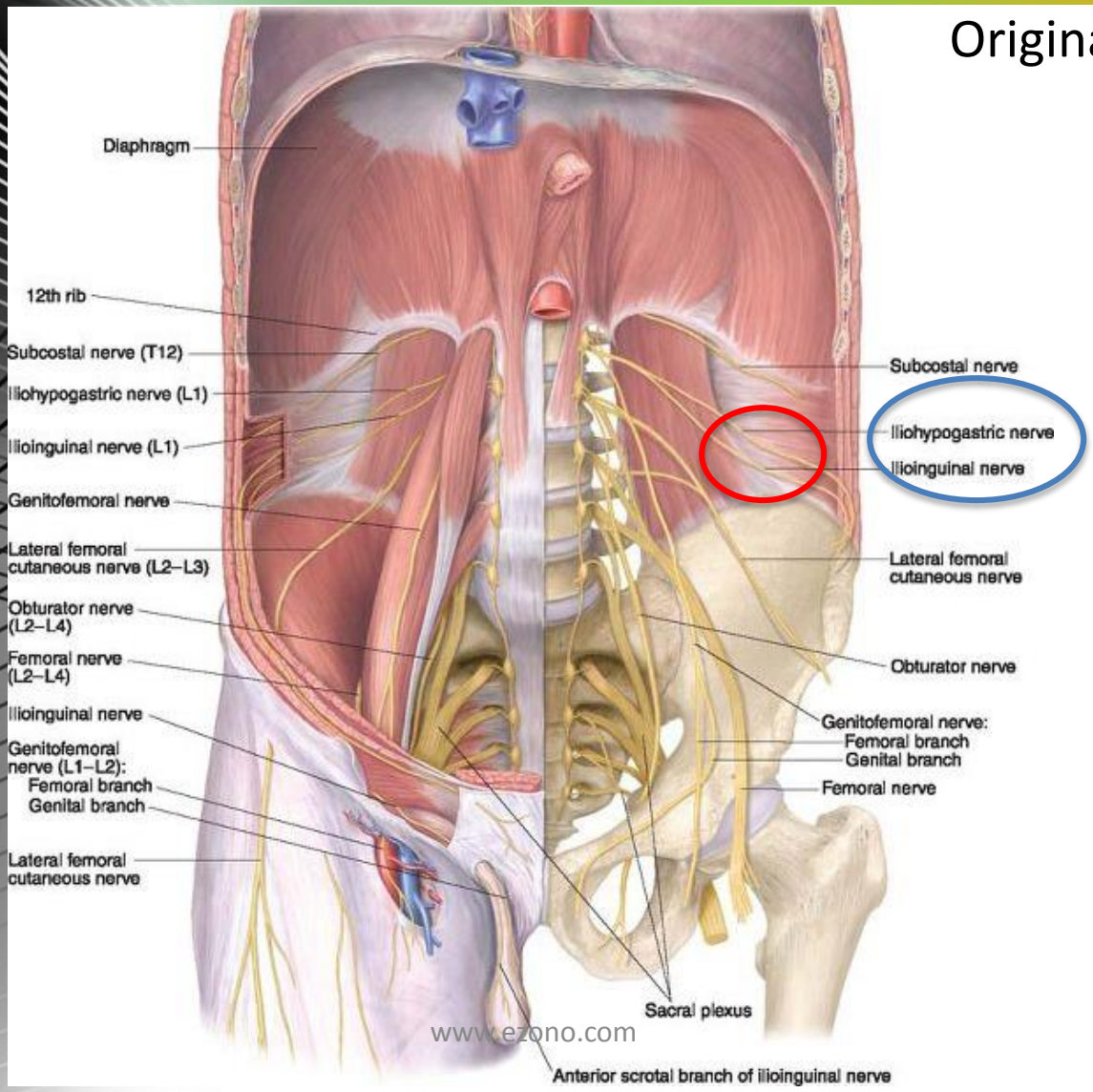
Iliohypogastric and Ilioinguinal Nerve Block

Iliohypogastric and Ilioinguinal Nerves

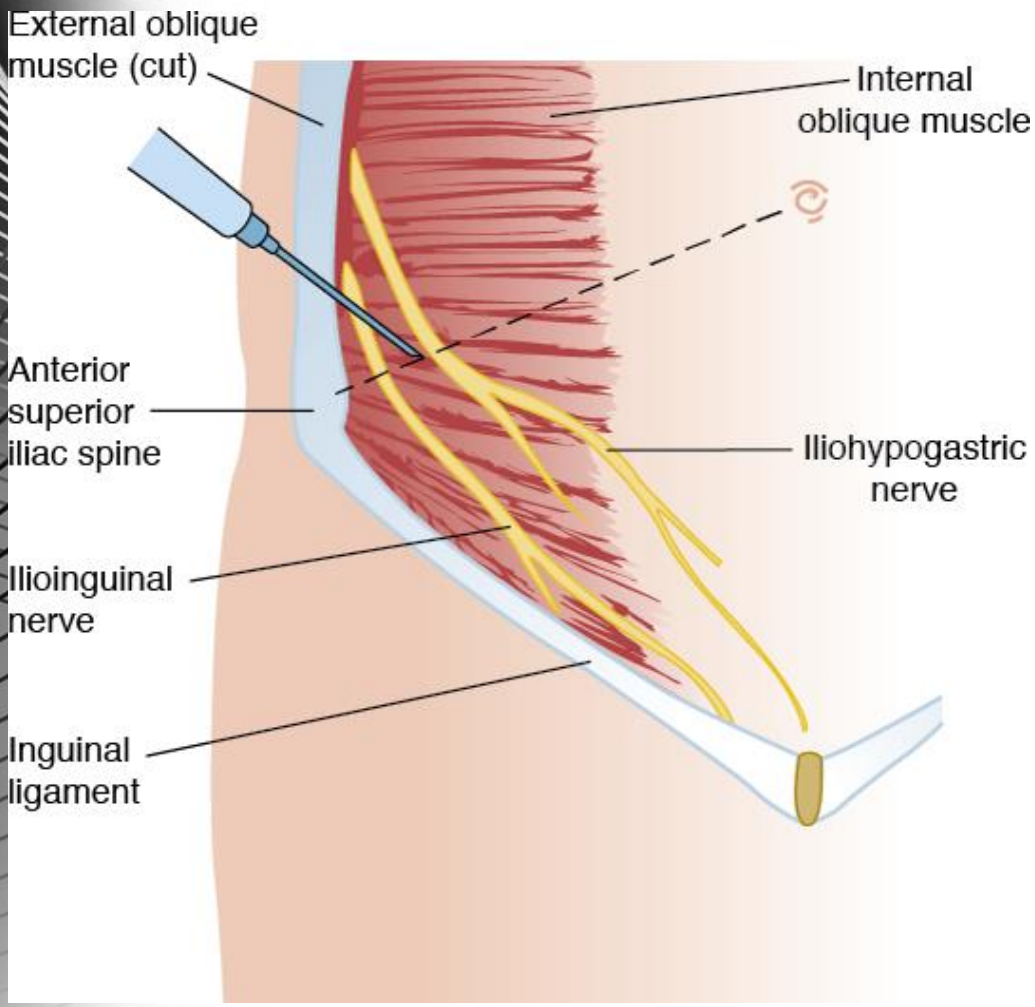
- Indications: Anesthesia and post op for inguinal hernia repair, analgesia following suprapubic incision
- Goal:
  - Anesthetic spread in fascial plane between transversus abdominus and internal oblique muscles at level of iliohypogastric and ilioinguinal nerves
- Technique: In-plane or out of plane (obese patients)
- Patient Position: Supine

Ilioinguinal/Iliohypogastrci Nerve

Originate L1/2 level

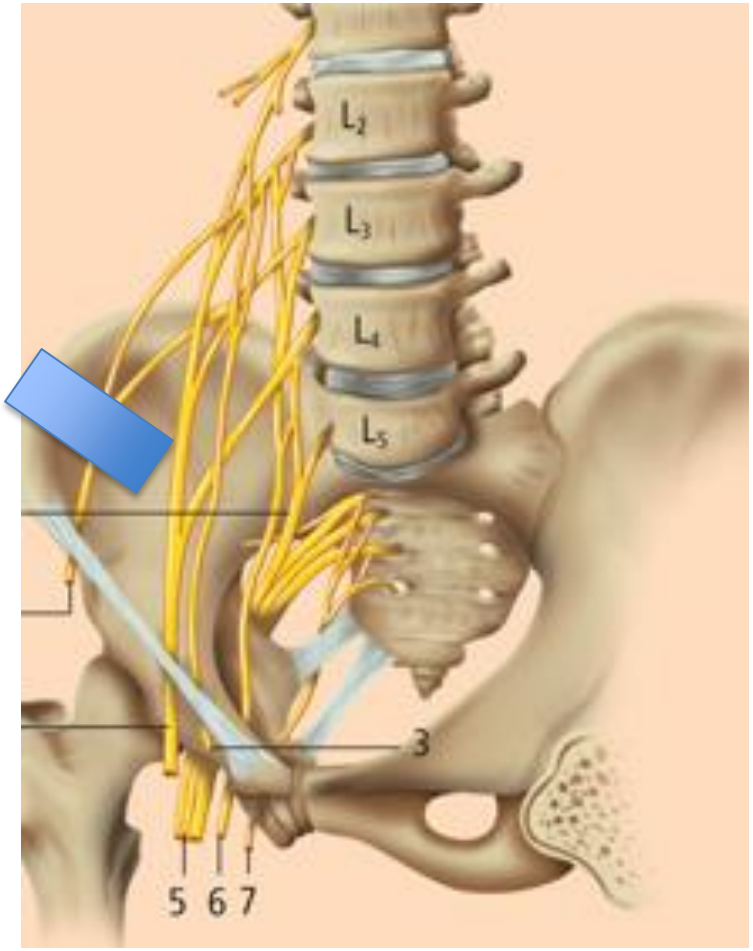


Anatomy


External oblique muscle (cut)
Internal oblique muscle
Anterior superior iliac spine
Iliohypogastric nerve
Ilioinguinal nerve
Inguinal ligament

Scanning Technique

- Start with transducer in long axis and identify iliac crest
- Rotate the transducer to oblique position so perpendicular to course of nerves
- Nerves appear as hypoechoic with hyperechoic sheath

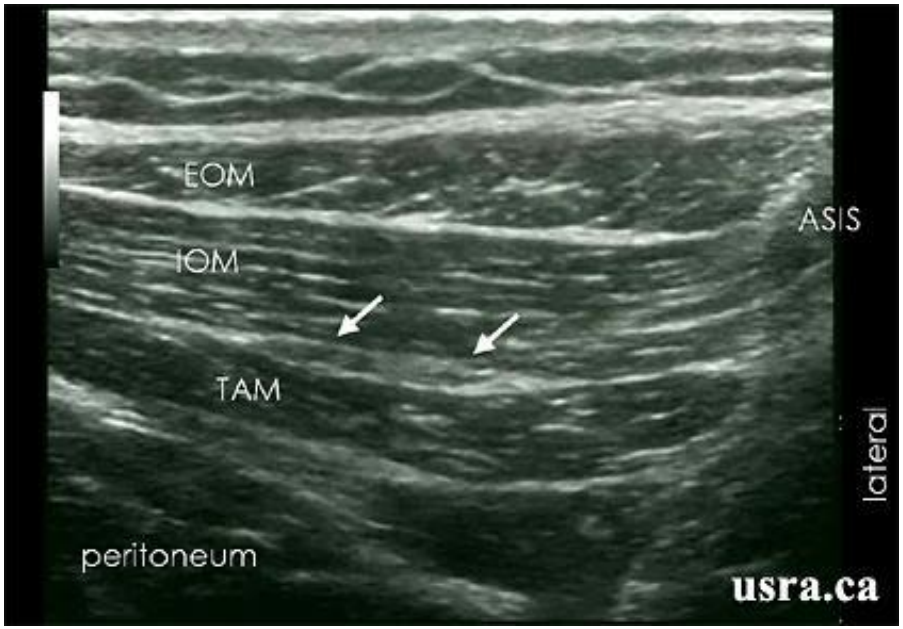


Scanning Technique

- Place transducer oblique on abdomen oriented on a line joining the ASIA with umbilicus
- ASIS seen as bony landmark on ultrasound image
- Ilioinguinal nerve is found close to iliac crest and iliohypogastric is medial to it

Ultrasound Image

- Identify 3 muscle layers of abdomen
- Nerves between IOM and TAM muscles

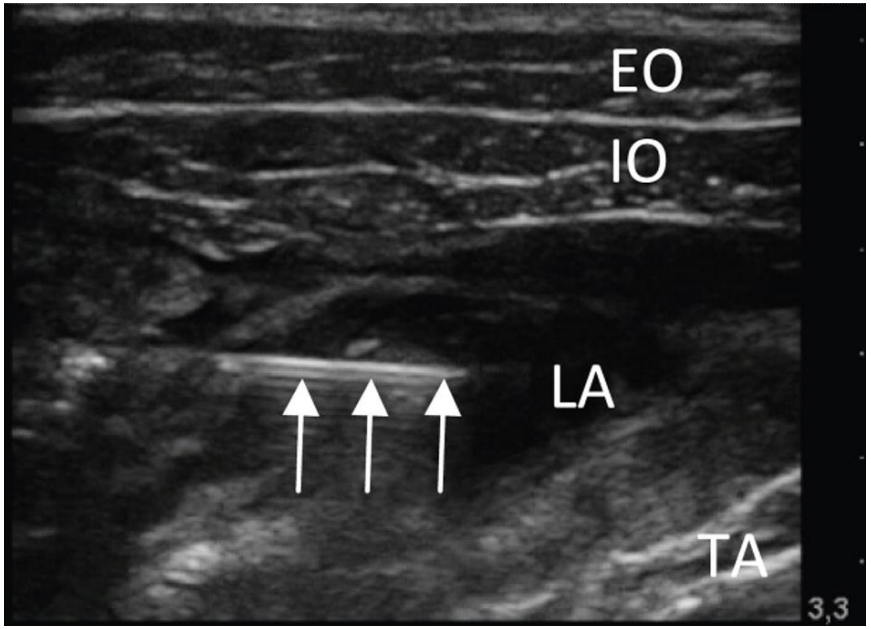


Scanning Technique

- Color Doppler useful to identify deep circumflex iliac artery can be mistaken for nerve because of size and position
- 90% of cases nerve between TAM and IOM
- Median diameter of nerves is 2-3 mm

Injection Technique

- In-plane technique
- Needle inserted 2-3 cm from transducer from medial or lateral sides
- Inject in fascial plane between IO and TA



Summary

- Benefits of Ultrasound Guidance
  - Visualization of soft tissue, vessel and nerves to identify best approach for block
  - Real-time visualization of injection for accurate placement of local anesthesia versus blind technique
  - Replaces uses of non-ionizing radiation for current techniques