

[Episode 150: Keywords Part 6: Supraclavicular, Axillary and Benzos](#)

On this episode: Dr. Jed Wolpaw and Dr Gillian Isaac

In this 150th episode I welcome back Dr. Gillian Isaac to do another round of ABA keywords. We discuss 2 additional upper extremity blocks (supraclavicular and axillary) and then benzodiazepines.

Table of Contents

Hyperlinks to section of notes.

INTERSCALENE BLOCK REVIEW	2
SUPRACLAVICULAR BLOCK	2
INFRACLAVICULAR NERVE BLOCK	3
AXILLARY NERVE BLOCK	3
BENZODIAZEPINES	5
INDICATIONS	5
METABOLISM	5
CNS EFFECTS	6
RESPIRATORY EFFECTS	6
FLUMAZENIL	6

Interscalene Block Review

- Interscalene block tested the most → see episode 139
- Ideal for orthopedic and vascular procedures performed on shoulder and upper arm; poor choice for forearm and hand surgery because ulnar nerve commonly spared

Supraclavicular Block

- **Key point #1:** “spinal of the arm” → provide anesthesia to entire upper extremity with single injection
 - Approach at point in plexus where it is reduced to fewest component parts → blocking superior, middle and inferior trunks as pass under clavicle and over 1st rib
 - Question: which section of the brachial plexus is blocked with a supraclavicular block?
 - o A) roots and trunks → interscalene
 - o **B) trunks and divisions** → supraclavicular
 - o C) cords → infraclavicular
 - o D) branches → axillary
 - Question: which portion of the upper extremity is not innervated by the brachial plexus?
 - o **A) posterior medial portion of arm** → intercostal brachial nerve supplies
 - o B) elbow
 - o C) lateral portion of forearm
 - o D) medial portion of forearm
 - **Key point #2:** even though supraclavicular block called spinal of arm, won't block intercostal brachial nerve → may need supplemental block, especially if using tourniquet
 - Question: 40 y.o. man scheduled to undergo repair of tendon laceration of left hand has complete anesthesia in the median, radial, and ulnar nerve distribution after supraclavicular block. Two hours of tourniquet inflation is required for completion of the procedure. The most appropriate next step is an additional block of which of the following?
 - o A) axillary nerve
 - o **B) intercostal brachial nerve**
 - o C) lateral antebrachial cutaneous nerve
 - o D) musculocutaneous nerve
 - o E) stellate ganglion
 - Question: a patient receives 1.5% bupivacaine 40mL and epinephrine 1:200 000 for a supraclavicular brachial plexus block for reduction of forearm fracture. The tourniquet is inflated at 300mmHg. Forty-five minutes later, the patient has pain that radiates to the posterior medial elbow. Which of the following nerves is not adequately blocked?
 - o **A) intercostal brachial**
 - o B) median
 - o C) musculocutaneous
 - o D) ulnar
 - o E) radial
 - **Key point #3:** nerves of brachial plexus lie in cephalo-posterior relationship to subclavian artery; incidence of pneumothorax with traditional technique ranges from 0.5% to as high as 7%
 - o Common ultrasound image will show subclavian artery, 1st rib, and brachial plexus
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- Question: a 69 y.o. man with a history of diabetes and chronic renal failure is to undergo placement of a dialysis fistula. During needle manipulation for supraclavicular brachial plexus block, the patient begins to cough and complain of chest pain and shortness of breath. The most likely explanation is:
 - o A) angina
 - o **B) pneumothorax** → key is question states during needle manipulation + no ultrasound
 - o C) phrenic nerve injury
 - o D) intervascular injection of local anesthetic
 - **Key point #4:** the phrenic nerve is blocked in up to 60% of patients → think twice about blocking patients who will get severe respiratory distress with phrenic nerve block; eg. severe COPD, fibrosis, morbid obesity
 - Question: a 46 y.o. obese man underwent an ultrasound-guided left-sided supraclavicular block in preparation for decompression of Guyon's canal for ulnar mononeuropathy at the wrist. Twenty minutes later, the patient experiences anxiety and acute onset dyspnea. A chest X-ray revealed elevation of the left hemidiaphragm. What is the most likely explanation?
 - o A) angina
 - o B) pneumothorax
 - o **C) iatrogenic phrenic nerve palsy**
 - o D) intervascular injection of local anesthetic
 - Question: the plasma concentration of equal doses of a local anesthetic is highest when the site of administration is:
 - o A) supraclavicular brachial plexus
 - o B) caudal
 - o **C) intercostal** → highest absorbance
 - o D) lumbar epidural
 - o E) subcutaneous
 - Highest to lowest absorbance: intercostal, caudal, epidural, brachial plexus, sciatic femoral, subcutaneous

Infraclavicular Nerve Block

- Infraclavicular blocks: has not been tested in last 10 years

Axillary Nerve Block

- Topics tested: ultrasound anatomy, block limitations and complications
 - Nerves targeted course distally with axillary artery and vein along humerus from apex of axilla
 - Good for surgery distal to elbow; eg. AV fistulas, Colles fracture, Dupuytren's contracture release, wrist fusion, ORIF
 - Key point #1: ulnar, median, and radial nerve are primary targets → targeting branches
 - o Could miss any of them if doesn't spread properly
 - o Musculocutaneous nerve may leave plexus proximal to this point → may need separate blockade of musculocutaneous nerve which provides sensory to lateral aspect of forearm and motor function for flexion of elbow
 - o Ultrasound image shows axillary artery surrounded by ulnar, median, and radial nerves
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- Question: after an axillary brachial plexus block, the patient feels pain when the surgeon clips the skin over the thenar eminence, the most likely cause is inadequate anesthesia in the distribution of the:
 - A) intercostal brachial nerve
 - **B) median nerve**
 - C) musculocutaneous nerve
 - D) radial nerve
 - E) ulnar nerve
 - Question: during axillary block of the brachial plexus, which nerve is most likely to be encountered if the needle is inserted through the posterior wall of the artery?
 - A) intercostal brachial nerve
 - B) median nerve
 - C) musculocutaneous nerve
 - **D) radial nerve**
 - Question: 20 minutes after an axillary block, the patient reports feeling over the back of the hand. Examination shows normal sensation over the lateral aspect of the dorsum of the hand and the dorsal base of the thumb and index finger. Supplemental anesthesia over this area can be provided by blocking which of the following nerves?
 - A) ulnar nerve
 - B) musculocutaneous nerve
 - C) median nerve
 - **D) radial nerve**
 - E) intercostal brachial nerve
 - Question: a patient undergoes axillary block for placement of AV shunt in forearm. Blockade of the musculocutaneous nerve is not achieved. Injection of a local anesthetic at which of the following sites will provide the required sensory block?
 - A) between the tendon of the palmaris longus and flexor carpi radialis
 - **B) body of coracobrachialis muscle**
 - C) medial to the brachial artery at the elbow
 - D) proximal to the medial epicondyle against the medial surface of the humerus
 - E) superficial to the pulse of the axillary artery
 - Question: during surgery of the forearm under axillary block, a patient has pain in the lateral aspect of the forearm and responds by flexing the elbow. The most likely cause is inadequate block of which of the following nerves?
 - A) axillary
 - B) intercostal brachial
 - **C) musculocutaneous**
 - D) radial
 - E) ulnar
 - Question: the muscular action most likely to remain intact following an axillary brachial plexus block is:
 - **A) flexion at the elbow** → most likely to miss musculocutaneous nerve with axillary
 - B) extension at the wrist
 - C) flexion of digits 3, 4, and 5
 - D) extension of digits 1, 2, and 3
 - E) extension at the elbow
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Benzodiazepines

- Topics to know: mechanism of action, pharmacokinetics, pharmacodynamics, metabolism and excretion, effect on circulation, effect on respiration, effect on other organs, side effects and toxicity, indications, contraindications, antagonism
- Previously tested topics: respiratory effects, pediatric oral dosage, flumazenil, metabolism

Indications

- Indications for benzos: anxiolysis, amnesia, sedative, hypnotic, anticonvulsant, to relieve skeletal muscle spasticity and pain in nerve disorder including stroke and spinal cord injury
- Question: three hours prior to induction of anesthesia for elective laparotomy, a 40kg eight y.o. boy is anxious and clings to his parents. Which of the following pre-anesthesia medications is most appropriate?
 - o A) oral ketamine
 - o **B) oral midazolam**
 - o C) rectal methohexital
 - o D) intramuscular droperidol
 - o E) intramuscular promethazine
- Pediatric dosing of midazolam is 0.5mg/kg PO up to maximum amount

Metabolism

- Diazepam undergoes oxidative metabolism in liver and has active metabolites → prolong its sedative effects
 - o Severe liver disease prolongs half-life
 - Lorazepam is directly conjugated to glucuronic acid to form pharmacologic inactive metabolite
 - Midazolam undergoes oxidative metabolism in liver, but different hepatic enzymes than diazepam; primary metabolite is 1-hydroxymethyl midazolam → has mild CNS depressive effects
 - o Hepatic clearance is 5x greater than lorazepam and 10x greater than diazepam
 - Question: compared with midazolam, diazepam has which of the following characteristics:
 - o A) greater solubility in water
 - o B) shorter beta half-life → diazepam has longer half-life than midazolam
 - o C) more potent ventilatory depressant effect
 - o D) lower risk for thrombophlebitis
 - o **E) pharmacological active metabolite**
 - Question: which of the following statements concerning diazepam is true?
 - o A) absorption is more predictable after IM administration than after oral administration
 - o B) it produces a shift to the left of the CO₂ ventilatory response curve
 - o **C) rebound drowsiness is caused by a metabolite**
 - o D) the degree of CNS depressant is independent of serum albumin concentration
 - o E) the extent of amnesia is proportional to the degree of sedation
 - Question: which of the following drugs is NOT directly conjugated to glucuronic acid?
 - o A) temazepam
 - o B) oxazepam
 - o C) lorazepam
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- **D) diazepam**
 - Question: the plasma half-time of which of the following drugs is prolonged in patients with end stage cirrhotic liver disease?
 - A) diazepam
 - B) pancuronium
 - C) alfentanil
 - **D) all are prolonged**
 - Question: 78 y.o. woman with a history of reactive airway disease is taking Cimetidine 400mg at night. An additional dose is given IV 30mins before induction of anesthesia for exploratory laparotomy. Possible side effects associated with this drug include all of the following except:
 - A) bradycardia
 - B) delayed awakening
 - C) confusion
 - **D) increased metabolism of diazepam** → it should decrease metabolism

CNS Effects

- Benzodiazepines decrease CMR O₂ and cerebral blood flow, but unlike propofol and barbiturates, it is unable to produce burst suppression on EEG
- Question: cerebral blood flow is decreased by each of the following except:
 - A) etomidate
 - B) midazolam
 - **C) NO** → increases cerebral blood flow
 - D) increased minute ventilation
 - E) positive end expiratory pressure
- Question: the drug that causes dose dependent EEG evidence of both central nervous excitation and depression is:
 - **A) lidocaine**
 - B) halothane
 - C) thiopental
 - D) NO
 - E) midazolam

Respiratory Effects

- Benzodiazepines do produce dose dependent respiratory depression
 - Insignificant in healthy patients, but enhanced in patients with chronic respiratory disease and synergistic when co-administered with opioids

Flumazenil

- Specific, competitive antagonist for benzodiazepines that is rapidly metabolized in liver
 - Shorter acting than any benzodiazepines → recurrence of central nervous system effects of benzodiazepines may occur after single dose because of slower metabolized benzodiazepines →
 - Question: which of the following statements regarding flumazenil is true?
 - A) hepatic clearance is low
 - B) it binds irreversibly with benzodiazepine receptor → binds reversibly
 - C) it causes hypertension and tachycardia → does not cause
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- **D) it has a shorter duration of action than midazolam**
 - E) it reverse opioid induced respiratory depression
- Question: which of the drugs has the shortest elimination half-life?
 - A) diazepam
 - **B) flumazenil**
 - C) flurazepam
 - D) lorazepam
 - E) midazolam
- Question: 55kg 70 y.o. woman with mild chronic renal failure is unresponsive 20 hours after an uneventful coronary artery bypass grafting procedure. Anesthetic drugs include fentanyl 3000mcg, diazepam 35mg, and pancuronium 20mg. Which of the following is the most appropriate next step in management?
 - A) administration of edrophonium
 - **B) administration of flumazenil** → because administered a lot of diazepam which has active metabolite
 - C) administration of naloxone
 - D) CT scan of head
 - E) measurement of core body temperature
- Be careful with giving flumazenil to people chronically on benzodiazepines because could precipitate seizures
- Question: a patient being mechanically ventilated in the ICU requires wound debridement twice daily. Each of the following agents would be appropriate for induction for brief general anesthesia except:
 - A) NO
 - **B) etomidate** → adrenal suppression with repeated doses
 - C) ketamine
 - D) methohexital
 - E) midazolam

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Notes by [April Liu](#)