

# Truncal Blocks

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March 30, 2017

- ## Outline
- Discuss Truncal Blocks (Old and New)
    - Pectoralis 1 and 2
    - Serratus anterior
    - Transversus abdominis plane
    - Rectus sheath
    - Iliioinguinal/iliohypogastric
    - Quadratus lumborum
  - Discuss evidence for each block

- ## Benefits of Peripheral Nerve Blocks/Catheters
- They work – Lower pain scores, reduced opioid analgesic use (Anesthesiology 2012;116:248-73)
  - Peripheral nerve blocks/catheters
    - Provide superior analgesia, reduce opioid consumption, reduce opioid-related side effects – nausea/vomiting, sedation, pruritis (RAPM 2006;31:1-42)
    - High patient satisfaction – 90% based on survey of >1000 patients in 2011-2013 (RAPM 2014;39:48-550)
  - Poorly controlled post-operative pain leads to increased likelihood of chronic pain (RAPM 2006;31:1-42)

## Why Bother with Opioid Sparing Techniques?

On an average day in the U.S.:

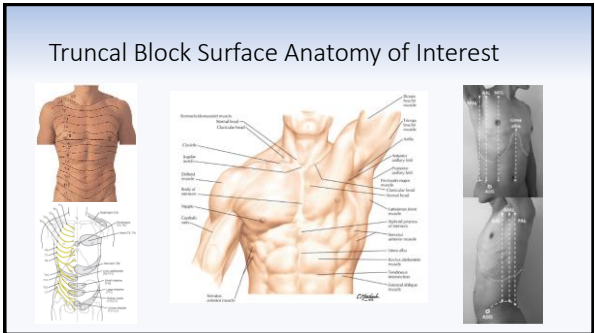
- More than **650,000 opioid prescriptions** dispensed<sup>1</sup>
- **3,900 people** initiate nonmedical use of prescription opioids<sup>2</sup>
- **580 people** initiate heroin use<sup>3</sup>
- **78 people** die from an opioid-related overdose<sup>4,5</sup>

\*Opioid-related overdoses include those involving prescription opioids and illicit opioids such as heroin.  
Source: 1) IMS Health National Prescription Audit<sup>1</sup> / 2) SAMHSA National Survey on Drug Use and Health / 3) CDC National Vital Statistics System<sup>3</sup>

- Each day, more than 1,000 people are treated in US emergency departments for misusing prescription opioids
- In 2014, almost 2 million Americans abused or were dependent on prescription opioids
- In 2015, ~33,000 people died of opioid overdose (15,000 of which were prescription opioid overdose); up from ~28,000 in 2014
- The most common drugs involved in prescription opioid overdoses: oxycodone/hydrocodone (methadone declining over past few years)
- Overdose deaths are highest among:
  - Ages 25-54 years old
  - Non-Hispanic whites and American Indian/Alaskan natives
  - Men
- 14 patients who receive long-term opioid prescriptions for non-cancer pain in the primary care setting struggles with addiction

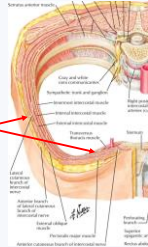
CDC 2017 Data

- ## Risks of Regional Techniques
- Failure (1:15)
  - Falls with continuous peripheral nerve catheter in hips and knees (applicable to quadratus lumborum block) (1:30)
  - Neurologic injury (1:1000 to 1:3300)
  - Infection (1:6500 to 1:500,000)
  - Local anesthetic systemic toxicity (1:200 to 1:5000)
- | Block/Technique              | Incidence/Complication               |
|------------------------------|--------------------------------------|
| Thoracic Paravertebral Block | 1:1000 to 1:3300 (neurologic injury) |
| Thoracic Epidural Block      | 1:1000 to 1:3300 (neurologic injury) |
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- ASRA

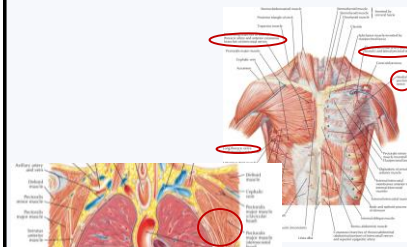


### Pectoralis and Serratus Anterior Innervation

- Pectoral nerves – from brachial plexus cords
  - Lateral pectoral nerve – from C5-7; runs between pectoralis major and minor to supply pectoralis major
  - Medial pectoral nerve – from C8-T1; runs deep to pectoralis minor to supply pectoralis major and minor
- T2-T6 spinal nerves – run between intercostal muscles and give off anterior and lateral branches
  - Anterior – pierces intercostal muscles and serratus anterior anteriorly to supply medial breast
  - Lateral – pierces intercostal muscles and serratus anterior mid-axillary line to give off anterior and posterior cutaneous branches
- Long thoracic nerve – from C5-7; runs on outer surface of serratus anterior to axilla where it supplies serratus anterior
- Thoracodorsal nerve – from C6-8 via posterior cord; runs deep in the axillary wall to supply latissimus dorsi

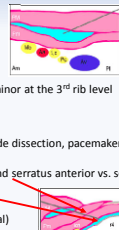


### Pec 1 and 2 Anatomy



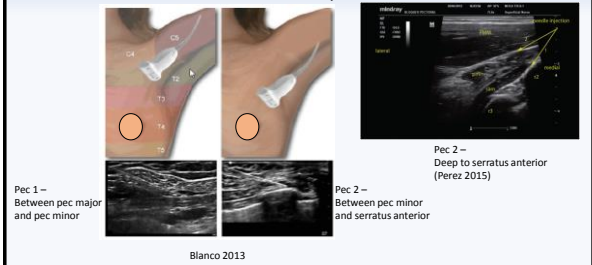
### Pecs 1 and 2 Block

- Pec 1
  - Indication – Surgery limited to pectoralis major
  - Technique – Injection between pectoralis major and minor at the 3<sup>rd</sup> rib level
  - Distribution – Lateral and medial pectoral nerves
- Pec 2
  - Indication – Tumor resection, mastectomy, axillary node dissection, pacemaker insertion, upper limb fistula surgery
  - Technique – Injection between the pectoralis minor and serratus anterior vs. serratus anterior and intercostals at the 3<sup>rd</sup> rib level
  - Distribution – Lateral branch of T2-4 spinal nerves (Anterior branch if penetration into external intercostal)



Blanco 2013, Abrahams 2016

### Pecs 1 and 2 Sonoanatomy



Pec 1 – Between pec major and pec minor

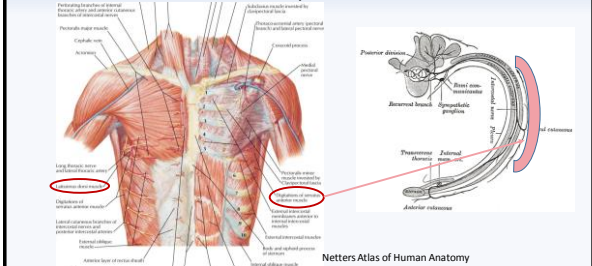
Pec 2 – Between pec minor and serratus anterior

Blanco 2013

### Pecs 1 and 2 Tips for Success

- Start with linear probe perpendicular to clavicle slightly lateral to midaxillary line (“p” cephalad)
  - Identify infraclavicular view of artery and vein
  - 2<sup>nd</sup> rib just deep
  - Slide probe caudad with inferolateral rotation ~45° to identify 3<sup>rd</sup> and 4<sup>th</sup> ribs
  - Identify thoracoacromial artery between pec major and minor (location of lateral pectoral nerve)
  - Block performed between 3<sup>rd</sup> and 4<sup>th</sup> rib with intended spread over 4<sup>th</sup> rib
- Volume
  - Pec 1 – 10 mL
  - Pec 2 – 20 mL

### Serratus Plane Anatomy



Netters Atlas of Human Anatomy

### Serratus Plane Block

- Indication – Chest wall pain (rib fractures, chest tube, thoracotomy)
- Technique
  - Orient probe in cephalad to caudad direction at mid-axillary line at thoracic rib level of interest, usually 5 (superolateral breast) or 6 (inferolateral breast)
  - Visualize latissimus dorsi, serratus anterior, ribs, intercostals
  - Bupivacaine 0.25% or Ropivacaine 0.2% 30 mL injection (pay careful attention to weight if injection at deep location due to intercostal local anesthetic uptake)
- Location
  - Superficial – injection superficial to serratus anterior (just deep to latissimus dorsi (shown))
  - Deep – injection deep to serratus anterior
- Distribution – Thoracodorsal nerve, thoracic intercostal nerves, lateral thorax



Blanco 2013

### Block Distribution

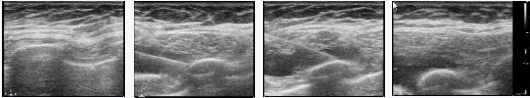


Figure 4. Area of sensory loss following superficial (top) or deep (bottom) serratus plane block.

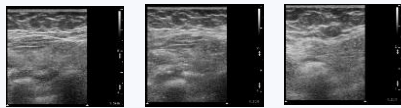
Blanco 2013

### Serratus Anterior Sonoanatomy

Patient 1



Patient 2



### Patient Experience (n=3)

Patient 1

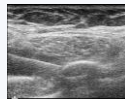
	Pain scores		
	Before	After	
Immediate	10	5	
Average	10	4	
Median	10	3	
Lowest	7	4	
Highest	10	10	
	Opioids		
PCA Hydromorphone	15 mg/14 hrs	12 mg/24 hrs	
PCA Per Hour Equivalent	1	0.5	
Oral Morphine Equivalent	335 mg/20 hrs	280 mg/24 hrs	
Oral Morphine Hourly Equivalent	17	12	

Patient 2

	Pain scores		
	Before	After	
Immediate	10	5	
Average	10	4	
Median	10	6	
Lowest	9	5	
Highest	10	8	
	Opioids		
	Before	After	
Oral Morphine Equivalent	130 mg/24 hrs	20 mg/18 hrs	
Oral Morphine Hourly Equivalent	5	1	

### Serratus Plane Tips for Success

- Orient probe cephalad to caudad at the midaxillary line, with “p” side cephalad for needle entry
- Advance needle in cephalad to caudad direction
- Identify latissimus dorsi (superior and posterior), teres major (superior), serratus anterior (deep and inferior), and 3 intercostal layers (between ribs)
- Make sure not to breach external intercostal




### Abdominal Wall Musculature

- External oblique runs superoposterior to anteromedial
  - Exterior ribs 5-12 → iliac crest/pubis tubercle and forms inguinal ligament to ASIS
- Internal oblique runs inferolateral to superomedial
  - Iliac crest → inferior rib 10-12 and linea alba
  - Fleshy/thickest layer on ultrasound
- Transversus abdominis runs lateral to medial
  - Internal ribs 7-12, thoracolumbar fascia → linea alba
- Rectus abdominis runs inferior to superior
  - Pubic symphysis → xyphoid process
  - 3-4 transverse tendinous insertions form “6 pack”
  - Rectus sheath formed from blended aponeuroses of obliques and transversus fascia



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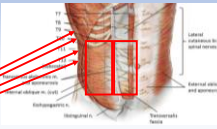
### Abdominal Wall Innervation



- Dorsal spinal nerves
  - T6 enters lateral to linea alba and fans out (not shown)
  - T7-9 enter anterior to anterior axillary line
  - T10-L1 have multiple communicating branches that form TAP plexus
  - T12-L1 terminal branches form iliohypogastric and ilioinguinal nerves (occasionally L2/3 contribute)
- Course
  - Posterior division – innervates spinal musculature and continues into midaxillary line
  - Lateral cutaneous branch – from continuation of posterior division innervates lateral abdominal wall
  - Anterior branches – continuation that travels into transversus abdominus plane between internal oblique and transversus muscle
- Continue medially through TAP to enter lateral edge of rectus abdominis in rectus sheath
  - Innervation to anterior abdominal wall
  - Branches communicate to form longitudinal rectus sheath plexus

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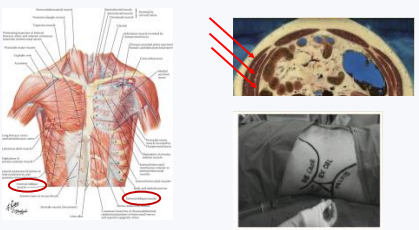
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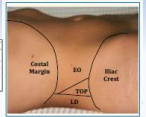
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### Transversus Abdominis Plane Anatomy



Netters Atlas of Human Anatomy

### TAP Block Landmark Technique



- Identify Triangle of Petit
- Advance with blunt needle until two “pops” are felt
  - First pop through external oblique
  - Second pop through internal oblique

The needle tip and local anesthetic spread were in the correct plane (TAP) in only 21 (24.6%) of the injections. In the remaining 55 (28.6%), the needle was in the subcutaneous tissue (13.8%), external oblique muscle (14.28%), plane between the external and internal oblique muscle (9.09%), internal oblique muscle (8.18%), transversus abdominis muscle (9.09%), and peritoneum (11.27%) (Fig. 13).

**You are only right 20% of the time!**


Should we perform External Oblique & Transversus Abdominis Plane Blocks?

Editor's key points:
 

- 1) External oblique and transversus abdominis plane blocks are useful for analgesia in the abdomen.
- 2) External oblique and transversus abdominis plane blocks are useful for analgesia in the abdomen.
- 3) External oblique and transversus abdominis plane blocks are useful for analgesia in the abdomen.
- 4) External oblique and transversus abdominis plane blocks are useful for analgesia in the abdomen.

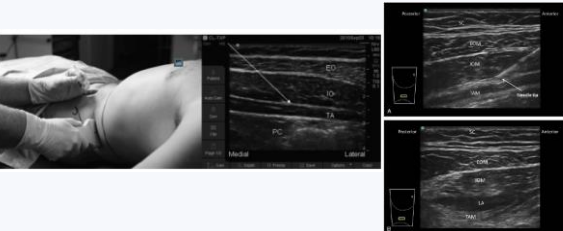
Volume 128, Issue 3 March 2022

### TAP Block (Mid-Axillary Location)



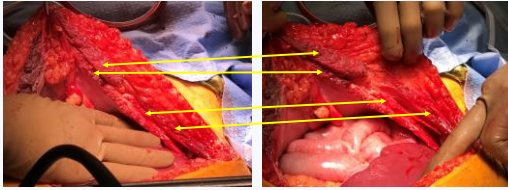
- Indication – Abdominal wall pain (laparotomy/laparoscopy, hernia repair, appendectomy, C-section, intrathecal pump implantation)
- Distribution – Abdominal wall skin, muscles, and ±parietal peritoneum from T10-L3 (reliably), T7-T10 (sometimes)
- Location – Midaxillary line deep to internal oblique and fascial layer superficial to transversus abdominis
- Technique – Orient probe anterior to posterior direction at mid-axillary line directly between costal margin and iliac crest
- Landmarks – Visualize external oblique, internal oblique, and transversus abdominis
- Bupivacaine 0.25% or Ropivacaine 0.2% 30 mL injection per side
- Drawback

### Mid-Axillary TAP Sonoanatomy



Borglum, 2013

### Subcostal TAP Anatomy

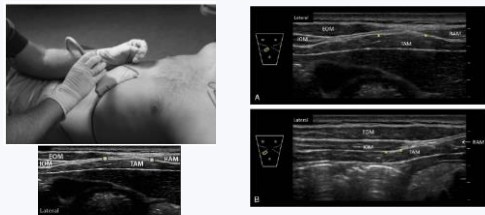


Dr. Bower "clamshell incision" for partial hepatectomy

### TAP Block (Subcostal Location)

- Indication – Abdominal wall pain, especially in upper abdomen (laparotomy/laparoscopy, nephrectomy)
- Distribution – Abdominal wall skin, muscles, ±parietal peritoneum from T7-T10
- Location – Orient probe parallel and just inferior to costal margin
- Technique – Inferior to costal margin deep to fascial layer superficial to transversus abdominis
- Landmarks – Visualize rectus sheath and transversus abdominis or traditional 3 layers (depending on how lateral the location)
- Bupivacaine 0.25% or Ropivacaine 0.2% 15 mL injection per side

### Subcostal TAP Sonoanatomy

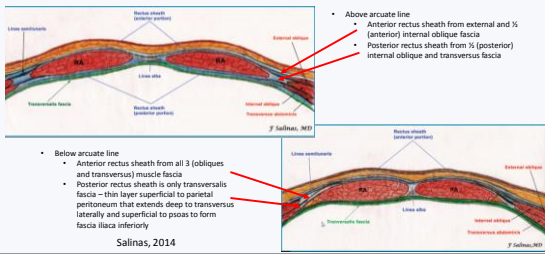


Borglum, 2013

### Transversus Abdominis Plane Tips for Success

- Bilateral dual TAP
  - Subcostal tilt of probe aimed posteriorly (do not aim cephalad)
  - Track muscle layers to rectus abdominis and find the external oblique, internal oblique, and transversus abdominis fascial layers at linea semilunaris
- Single-stick approach
  - Enter at linea semilunaris
  - Cephalad and medial along costal margin for subcostal block
  - Caudad and lateral for lateral block
  - Won't cover lateral cutaneous branches
- Studies recommend 15 mL per location for the bilateral dual TAP blocks
  - Calculate maximum local anesthetic doses and dilute solution to get adequate volume
- Use epinephrine additive
  - Bupivacaine 3 mg/kg with 225 mg/dose max
  - Ropivacaine 3 mg/kg or 250-300mg dose max

### Rectus Sheath Anatomy



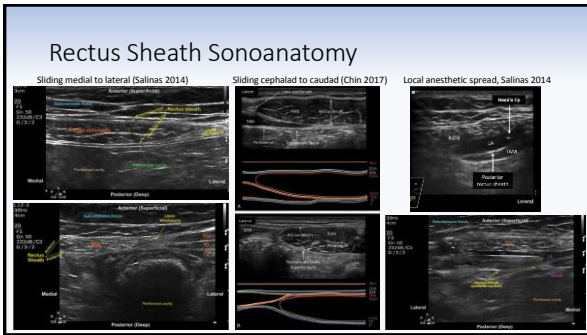
- Above arcuate line
  - Anterior rectus sheath from external and 1/2 (anterior) internal oblique fascia
  - Posterior rectus sheath from 1/2 (posterior) internal oblique and transversus fascia
- Below arcuate line
  - Anterior rectus sheath from all 3 (obliques and transversus) muscle fascia
  - Posterior rectus sheath is only transversalis fascia – thin layer superficial to parietal peritoneum that extends deep to transversus laterally and superficial to psoas to form fascia ilica inferiorly

Salinas, 2014

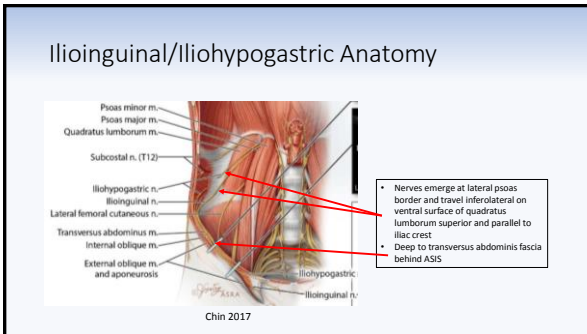
### Rectus Sheath Block



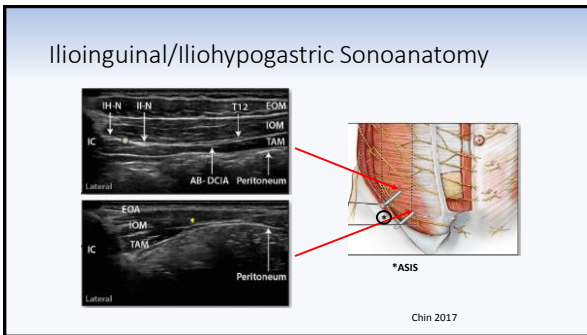
- Indication – Midline abdominal wall pain, (laparotomy/hand-assist laparoscopy, C-section)
- Distribution – Abdominal wall skin and muscles
- Location – Orient probe lateral to medial at the level of, above, or below the umbilicus to identify rectus abdominis
- Technique – Injection deep to the rectus abdominis superficial to the posterior fascia in the lateral 1/3 of the muscle to avoid epigastric vessels
- Landmarks – Visualize rectus abdominis, superficial and deep rectus fascia
- Bupivacaine 0.25% or Ropivacaine 0.2% 15-20 mL injection per side



- ### Rectus Sheath Tips for Success
- Orient linear probe in the transverse plane
    - Identify the rectus abdominis muscle
    - Rotate the probe 90° (cephalad to caudad with "p" cephalad)
    - Inject posterior to rectus abdominis muscle, superficial to posterior fascia
    - Inject in the caudad direction and advance to the caudad portion of the incision (blocks entire distribution in 1 needle entry)
  - Always block as lateral as possible (lateral 1/3 of muscle)
    - Superior and inferior epigastric arteries run in the medial 2/3 (progressively more lateral as you move caudad)
    - Terminal ends of nerves pierce rectus abdominis medially to supply skin and superficial layers




- ### Ilioinguinal Block
- Indication – Open inguinal hernia repair, appendectomy
  - Distribution – Abdominal wall skin and muscles
  - Location – 2 cm medial and cephalad to ASIS
  - Technique – Injection deep to internal oblique, through fascia superficial to transversus abdominis muscle
  - Landmarks – ASIS, external oblique, internal oblique, transversus abdominis, peritoneum
  - Bupivacaine 0.25% or Ropivacaine 0.2% 20 mL injection

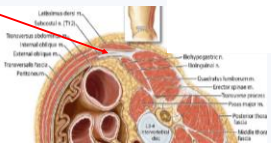


- ### Ilioinguinal/Iliohypogastric Tips for Success
- Course of nerves widely variable
    - Run deep to transversus abdominis fascia at ASIS (just before and after external oblique turns into inguinal ligament)
    - Inferomedial, they ascend to lie deep to the internal oblique fascia
  - Orient linear probe parallel to inguinal ligament at ASIS
  - Track in all directions to identify muscle layers
    - 2 cm medial and cephalad to ASIS – inject deep to TAP
    - 3-5 cm medial and 1 cm caudad to ASIS – inject deep to IO

### Posterior Abdominal Anatomy




- External oblique ends as free edge that abuts latissimus dorsi
- Internal oblique and transversus taper posteriorly into origins at thoracolumbar fascia
- Quadratus lumborum
  - 12<sup>th</sup> rib → iliac crest
- Psoas major
  - Anteromedial to quadratus lumborum

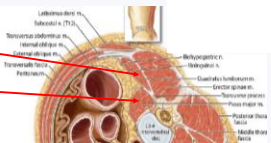


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### Posterior Abdominal Anatomy

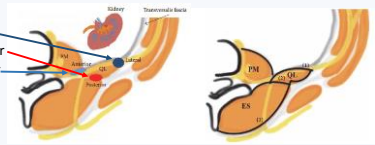


- External oblique ends as free edge that abuts latissimus dorsi
- Internal oblique and transversus taper posteriorly into origins at thoracolumbar fascia
- Quadratus lumborum
  - 12<sup>th</sup> rib → iliac crest
- Psoas major
  - Anteromedial to quadratus lumborum



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### Quadratus Lumborum Nomenclature



- Nomenclature
  - QL1 – Lateral
  - QL2 – Posterior
  - QL3 – Anterior
  - Intramuscular
- Local anesthetic spread differs based on location of block

Ueshima 2017

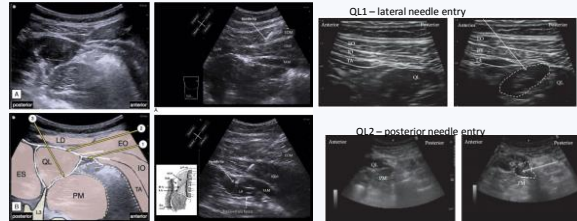
### Quadratus Lumborum Block

- Indication – Laparoscopic hysterectomy, C-section, hip surgery
- Distribution
  - Lower abdominal wall skin and muscles
  - Sometimes femoral nerve with resultant quadriceps weakness
- Location – Iliac crest at posterior axillary line
- Technique – Variable surrounding quadratus lumborum
- Landmarks – Iliac crest, external oblique, internal oblique, transversus abdominis, psoas, quadratus lumborum, erector spinae
- Bupivacaine 0.25% or Ropivacaine 0.2% 30 mL injection

Chin, 2017; Ueshima, 2017

### Quadratus lumborum Sonoanatomy



Chin 2017, Ueshima 2017

### Quadratus Lumborum Tips for Success

- Curvilinear probe usually gives best penetration and detail
- Identify all relevant anatomy to avoid accidental peritoneal cavity puncture
- Needle entry should be at posterior axillary line or through back to avoid accidental peritoneal cavity puncture
- Spread and coverage improves as you move posteriorly
- Do not perform landmark approach (wrong 80% of time)



## Clinical Efficacy (Ultrasound Guided)

- Pec 1 and 2 – Breast cancer surgery, including axillary node dissection (?dialysis access)
- Serratus plane – Rib fractures, thoracotomy, chest tube placement
- Transversus abdominis plane – Laparotomy, laparoscopy, colorectal surgery, C-section (heterogeneity of studies makes evaluation difficult)
- Subcostal TAP – Laparoscopy cholecystectomy (higher efficacy but low utility due to low pain scores)
- Rectus sheath – Umbilical hernia, colorectal surgery
- Iliioinguinal/iliohypogastric – Open appendectomy, inguinal hernia
- Quadratus lumborum – Laparoscopic hysterectomy, C-section, hip surgery

Bashandy 2014, Blanco 2015, Baeriswyl 2015, Chin 2017

## Potential/Reported Complications

- Pec 1 and 2, serratus anterior – Intrapleural injection, pneumothorax, local anesthetic systemic toxicity (intercostal uptake)
- TAP – Liver injury, splenic injury, intraperitoneal injection
- Rectus sheath – Bowel injury, intravascular injection if medial
- II/IH – Bowel injury, retroperitoneal hematoma
- Quadratus lumborum – inadvertent femoral nerve block with resultant weakness

## Recommendations

- Add epinephrine
- Prefer ropivacaine for high volume blocks
- Use dilute solution (0.2% rather than 0.5%)
- Use ultrasound
- Use lean body weight to calculate maximum
- Monitor for 30-45 minutes (average time to peak plasma concentration)

Chin 2017

## Conclusion

- Abdominal wall blocks
  - Simple and effective
  - Reduce side effects compared to neuroaxial approach and oral opioids
  - Catheters are complex and cumbersome
  - Analgesia varies
    - Even though they look similar, spread differs
    - Even with adequate spread, plexus formation anteriorly can cause "hot spots"
    - Very effective for somatic, less or none for visceral
- Quadratus lumborum – Only ultrasound-guided block that has coverage extending posterior to anterior axillary line
- Multimodal analgesic approach improves pain management no matter which block is used

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