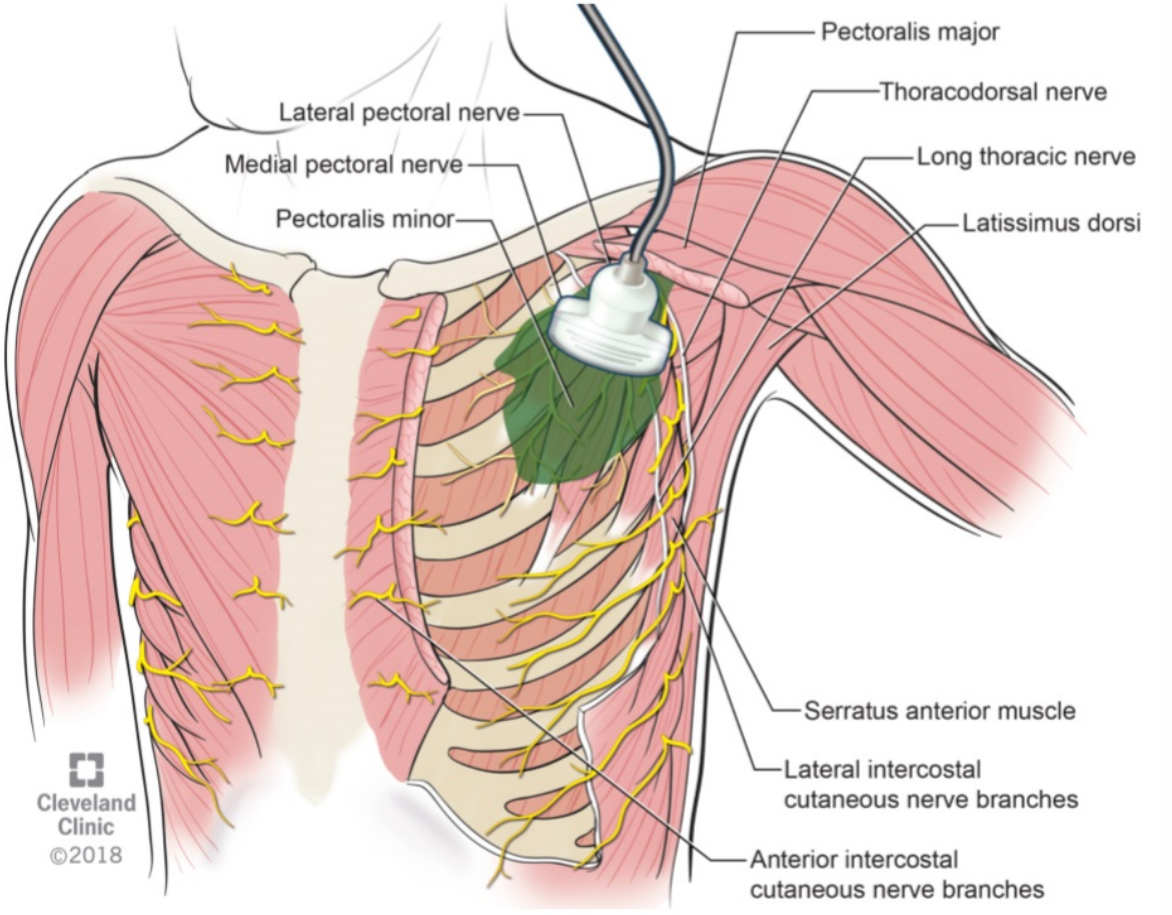
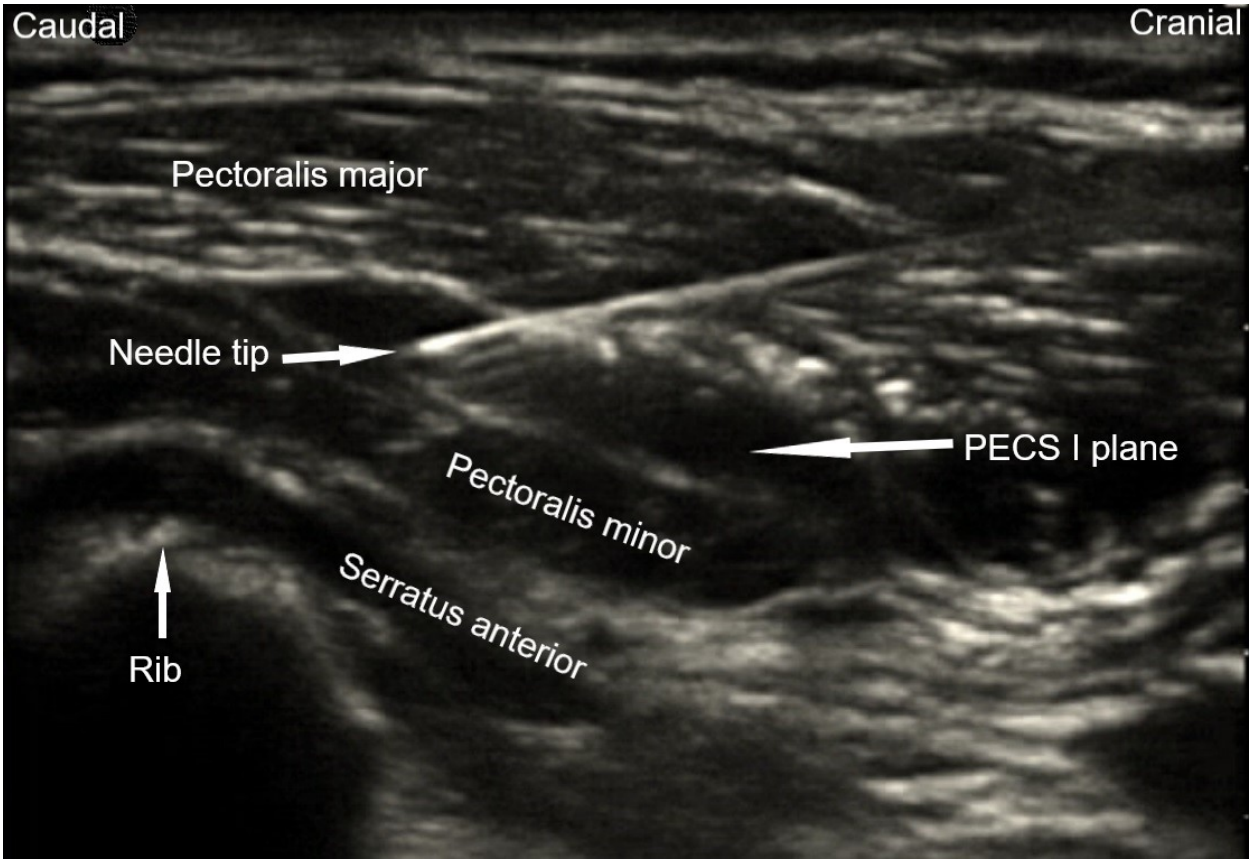
Supplemental Digital Content

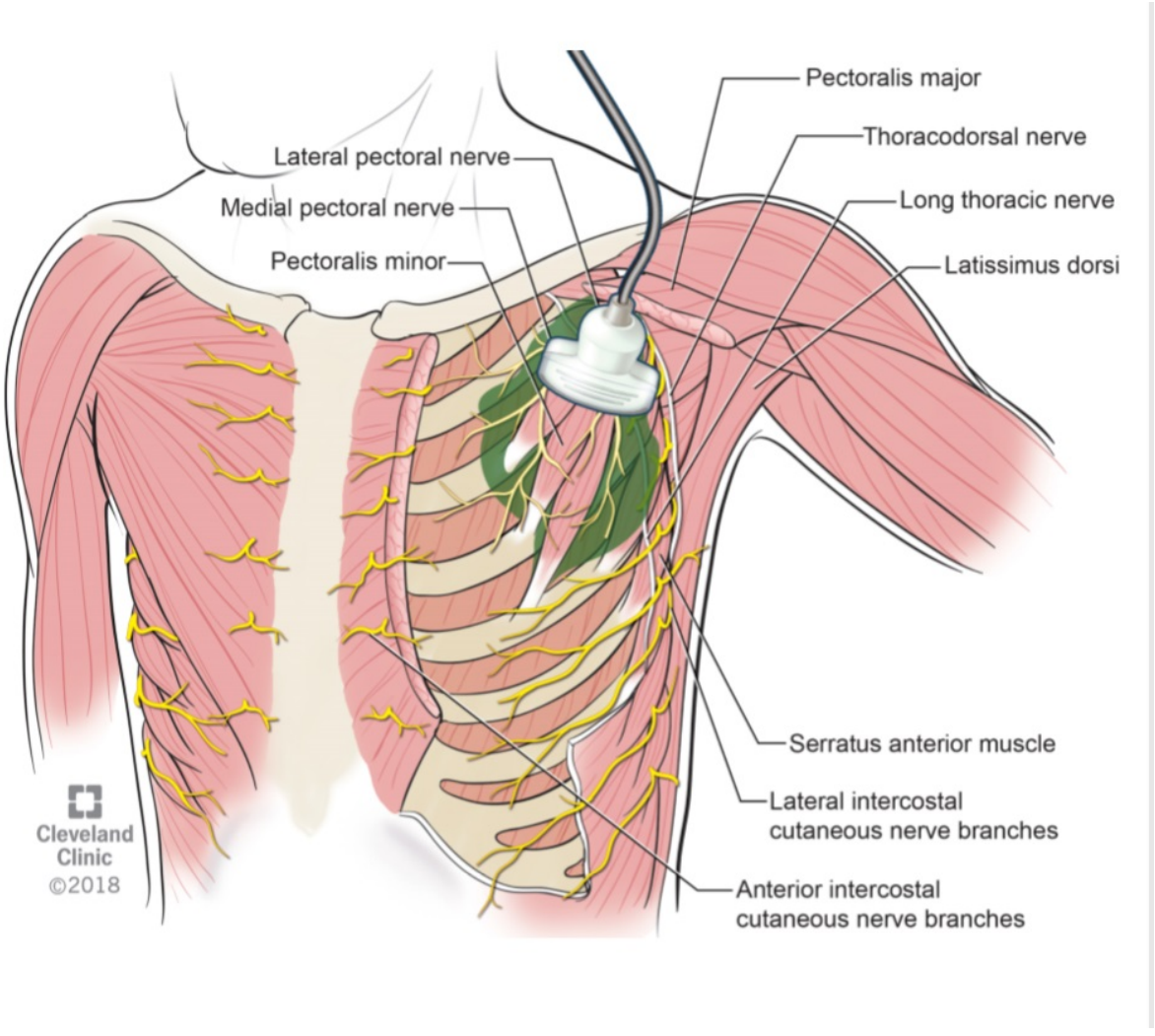
Supplemental Figure 1. Anterolateral chest wall anatomy muscles and nerves with an ultrasound probe position for the PECS I block. The probe is first placed right below the clavicle (subclavian artery and vein may be identified), and it is then moved inferolaterally to the level of the 3rd rib. Thoracoacromial artery may be visualized within the PECS I block plane (between pectoralis major and minor muscles). Slight medial tilt helps to identify fascial planes. The needle is inserted in a craniocaudal direction. The shaded area illustrates approximate interfascial local anesthetic spread between pectoralis major and pectoralis minor muscles.



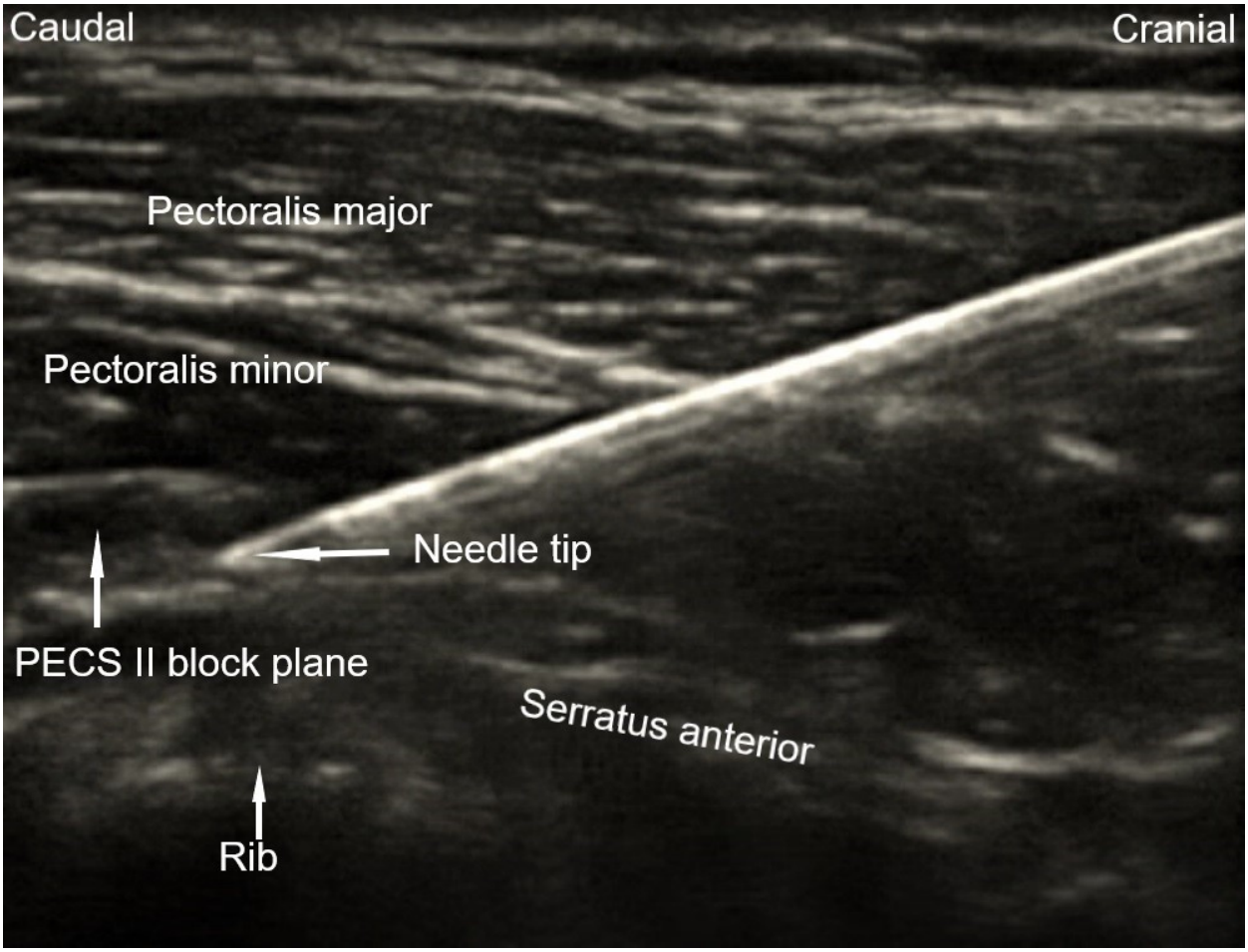
Supplemental Figure 2. Ultrasound image during PECS I block. Needle tip is positioned between the pectoralis major and pectoralis minor muscles and separation of muscle layers with local anesthetic injection is visualized.



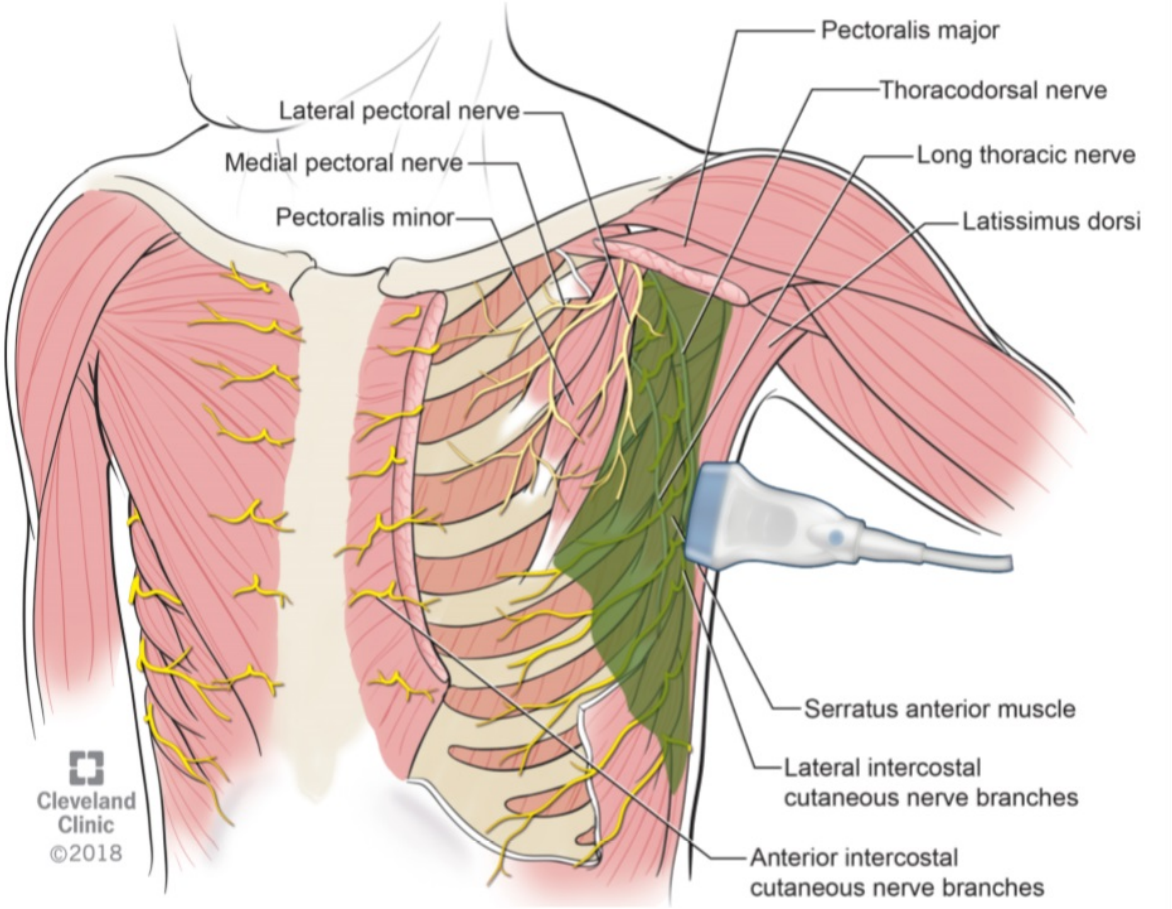
Supplemental Figure 3. Anterolateral chest wall anatomy muscles and nerves with an ultrasound probe position for the PECS II block. The probe is first placed right below the clavicle (subclavian artery and vein may be identified), and it is then moved inferolaterally to the level of the 3rd rib. Slight medial tilt helps to identify fascial plane between serratus anterior and pectoralis minor muscles. The needle is inserted in a craniocaudal direction. The shaded area illustrates approximate interfascial local anesthetic spread between pectoralis minor and serratus anterior muscles. PECS I and II blocks are frequently performed with a single skin puncture site by first injecting the local anesthetic in the PECS II plane, followed by needle withdrawal and injection into the PECS I plane.



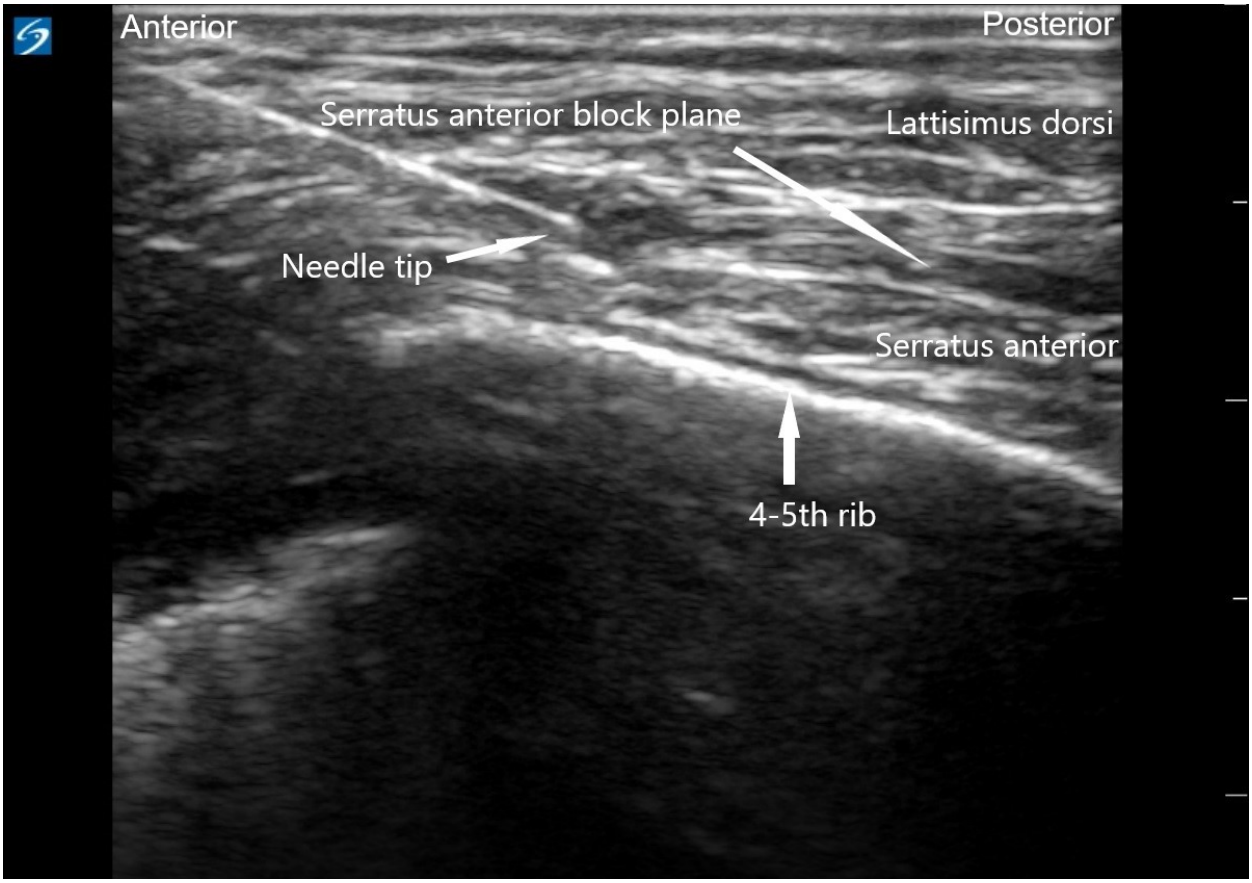
Supplemental Figure 4. Ultrasound image during PECS II block. Needle tip is positioned between the pectoralis minor and serratus anterior muscles and separation of muscle layers with local anesthetic injection is visualized.



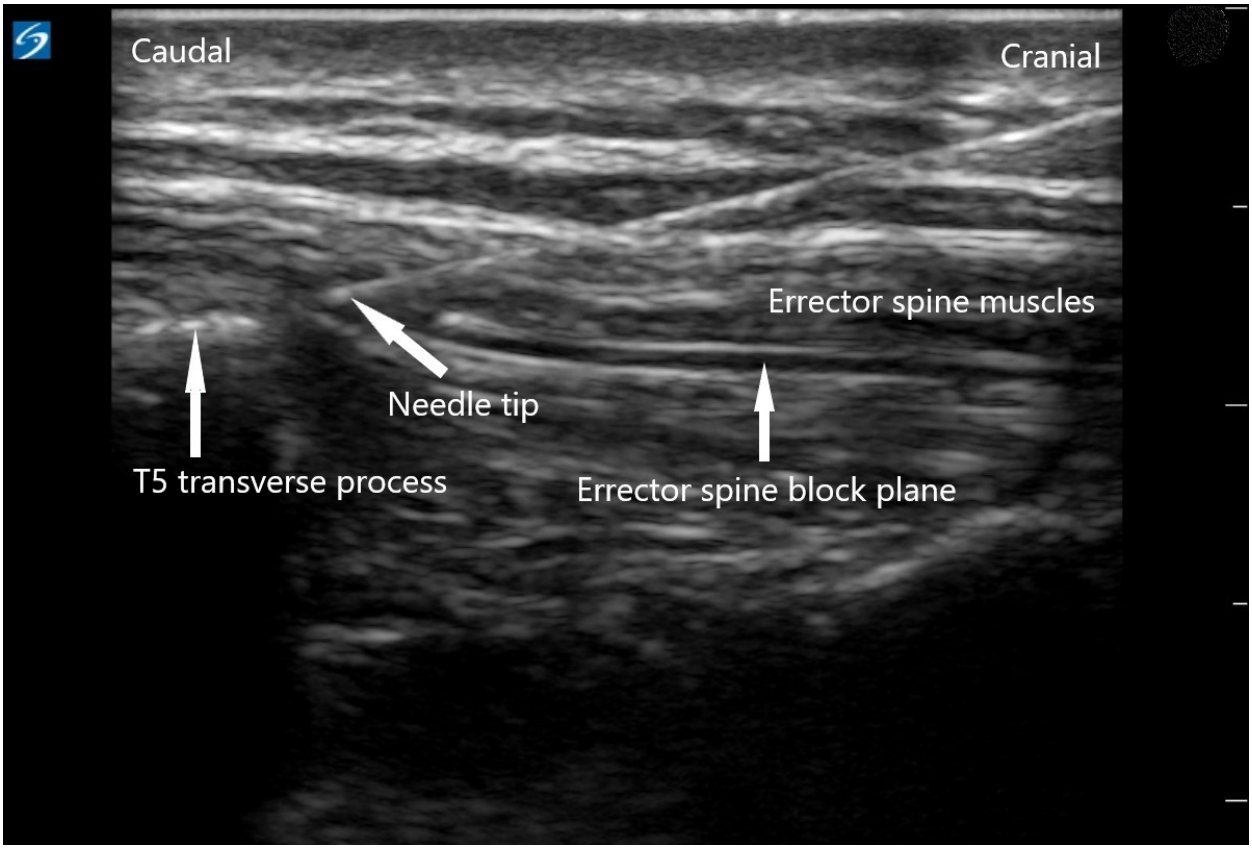
Supplemental Figure 5. Anterolateral chest wall anatomy muscles and nerves with an ultrasound probe position for the SAP block. Scanning starts at the midclavicular line just below the clavicle and the ultrasound probe is moved caudally and laterally until the 4th and 5th ribs are identified in the midaxillary line. Injection is performed in anteroposterior direction in the fascial plane above (SSAP) or below (DSAP) the level of the serratus anterior. The shaded area illustrates approximate interfascial local anesthetic spread between the serratus anterior and latissimus dorsi muscles (SSAP).



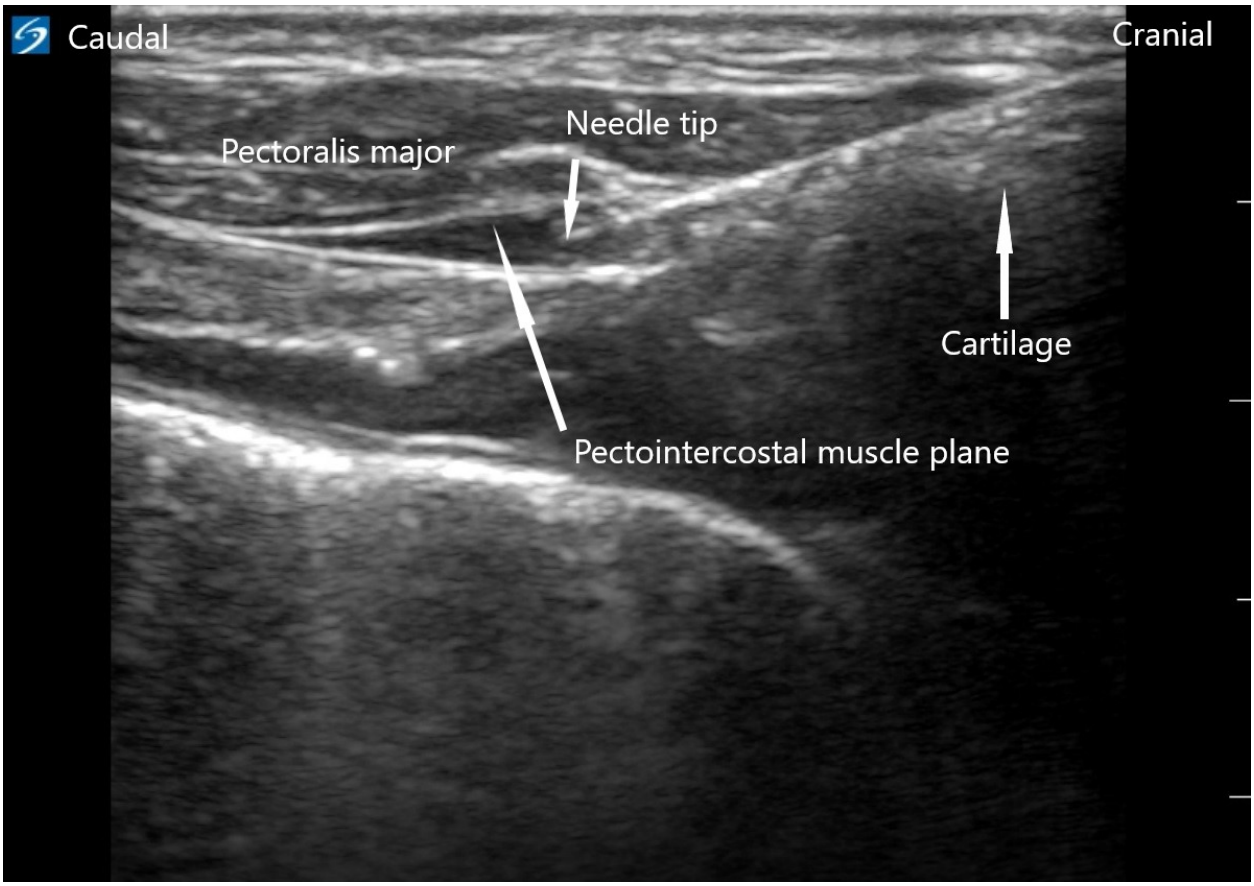
Supplemental Figure 6. Cadaveric ultrasound image during SSAP block. Needle tip is positioned between the serratus anterior and latissimus dorsi muscles and separation of muscle layers with local anesthetic injection is visualized.



Supplemental Figure 7. Cadaveric ultrasound image during ESP block. Needle is inserted craniocaudally targeting T5 transverse process. Needle tip is positioned anterior to the erector spine muscle plane and separation of the erector spine off the transverse process is visualized.



Supplemental Figure 8. Cadaveric ultrasound image during PIF block. Needle is inserted from lateral to medial at approximate T4-5 costal cartilage level. Separation of the pectoralis major and intercostal muscles after local anesthetic injection is visualized.



Supplemental Figure 9A. Transverse section of the anterior thorax at approximate level of mid-sternum. The needle tip and injection are located between the Pectoralis Major and Internal Intercostal muscles (Pectointercostal fascial Plane block).

Supplemental Figure 9B. Parasternal sagittal section of the anterior thorax with ultrasound probe and needle position for Pectointercostal fascial plane block. The needle tip and injection are located between the Pectoralis Major and Internal Intercostal muscles.

Supplemental Figure 9C. Transverse section of the spine and paraspinal muscles at approximate level T5. Needle is inserted in the craniocaudal direction and advanced below the erector spine muscles with the tip contacting the T5 transverse process. Lifting of the erector spine muscles off the transverse process and approximate spread of local anesthetic is depicted.

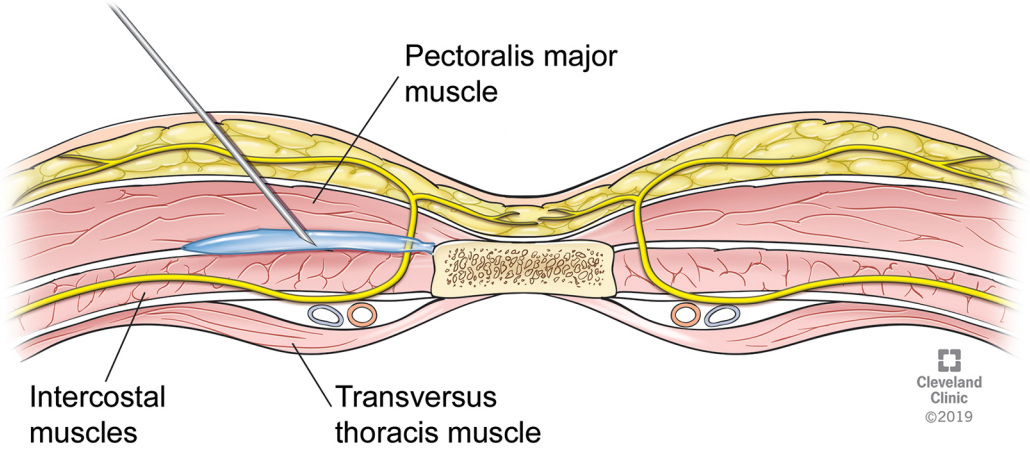


Figure-09A_pecterali injection.tif

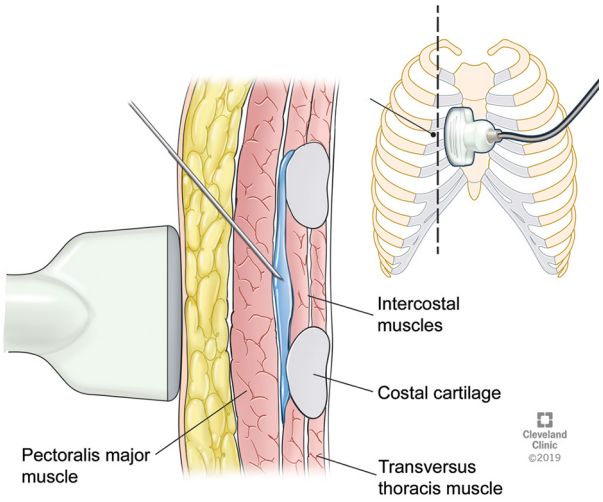


Figure-09B_Intercostal injectional anterior.tif

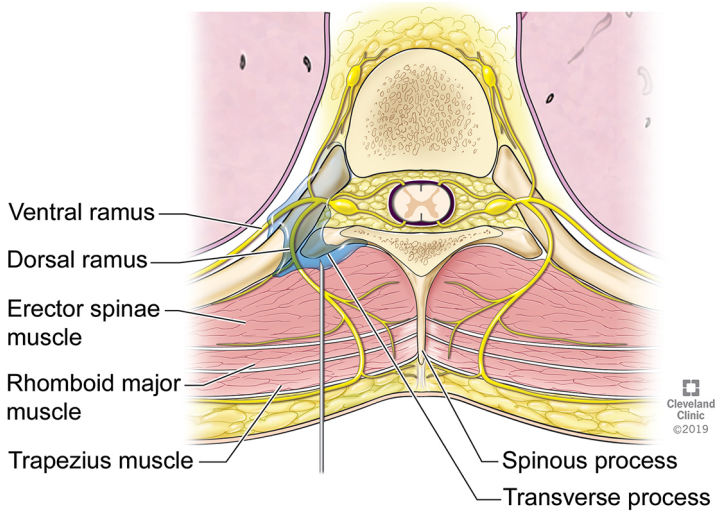


Figure-09C_spinal injection.tif

Supplemental Table 1. Summary of literature on types of local anesthetic used and dosing for various fascial plane blocks.

PECS I - pectoralis I block, PECS II - pectoralis II block, SAP - serratus anterior plane block, SSAP - superficial serratus anterior plane block, DSAP - deep serratus anterior plane block, ESP - Erector spine plane block

Reference	Block type	Local anesthetic type and dose used	Surgery	Duration and efficacy
Blanco et al. 2012 [13]	PECS I and II	• Levobupivacaine 0.25% PECS I 10mL PECS II 20 mL	• Mastectomy • Case series	• 8 hours of analgesia • No objective pain score recorded
Yalamuri et al. 2017 [21]	PECS I and II	• Ropivacaine 0.2% with 1:400000 epinephrine • Liposomal bupivacaine 266 mg with 10 mL 0.25% bupivacaine PECS I 10mL PECS II 20 mL	• Minimally invasive mitral valve repair (right anterior thoracotomy) • Case report	• 24 hours pain score 2/10 • 48 hours pain score 0-4/10
Bashandy et al. 2015 [16]	PECS I and II	• Bupivacaine 0.25% PECS I 10mL PECS II 20 mL	• Modified radical mastectomy • Randomized trial comparing block vs. control (general anesthesia alone)	• Lower intraoperative fentanyl consumption with the block • Lower pain scores and postoperative morphine consumption in

				the first 12 hours
Corso et al. 2016[32]	PECS I and II SAP	• Ropivacaine 0.375% PECS I 10mL PECS II 20 mL • Ropivacaine 0.25% SAP 30 mL	• Awake video assisted thoracic surgery	• 2 trocars in the 4th intercostal space. • 90 min procedure with median (NRS) pain score 2 • No rescue analgesic in the first 24 hours
Gupta et al. 2017[74]	SSAP	• Bupivacaine 0.5% SSAP 20 mL	• Modified radical mastectomy • RCT comparing paravertebral block (PVB) and SAP.	• Analgesia duration in the SAP group: 245.6 ± 58 min • Analgesia duration and opioid consumption favoring PVB
Khalil et al. 2017 [28]	SSAP	• Levobupivacaine 0.25% SSAP 30 mL • Levobupivacaine 0.125% <u>5 mL/hr continuous infusion</u>	• Thoracotomy • RCT comparing SAP to thoracic epidural	• Comparable efficacy to epidural (VAS scores and total morphine dose)
Madabushi et al. 2015 [29]	SAP	• Lidocaine 1% SAP 6 mL • Bupivacaine 0.1% with 1mcg/mL fentanyl	• Thoracotomy • Case report	• Significant decrease in VAS

		7 mL /hr continuous infusion		
Okmen et al. 2016 [75]	DSAP	• Bupivacaine 0.25% DSAP 20 mL	• Thoracotomy • Case report	• Duration approximately 7 hours
Zocca et al. 2017 [76]	SSAP	• Bupivacaine 0.25% with 40 mg methylprednisolone acetate SSAP 10 mL	• Postmastectomy pain syndrome • Case series	• Analgesia duration ranging from 2-3 days-12 weeks • Improvement in pain ranging from 25% to near complete resolution
Kunigo et al. 2017 [24]	SSAP	• Bupivacaine 0.375% SSAP 20 mL SSAP 40 mL	• Mastectomy (total and partial) • Randomized study comparing 20 vs 40 mL single injection	• Median 3.6-3.7 hours to first rescue analgesic in 20 and 40 mL groups respectively
Fu et al. 2017 [26]	SSAP	• Ropivacaine 0.25 % SSAP 40 mL • Bupivacaine 0.2% 10 mL/hr continuous infusion	• Conservative management of multiple rib fractures • Case report	• NRS score from 7 to 0 after the block
Kunhabdulla et al. 2014 [27]	DSAP	• Bupivacaine 0.125% DSAP 20 mL • Bupivacaine 0.0625% with 1mcg/mL fentanyl 7-12 mL/hr continuous infusion	• Conservative management of multiple rib fractures • Case report	• Static and dynamic VAS score 60 and 100 before the block, and 00 and 10-20 after the block

Forero et al. 2017 [45]	ESP	• Ropivacaine 0.5% ESP 25 mL • Ropivacaine 0.2% 8 ml/hr continuous infusion (optional bolus q 60 minutes 5 mL)	• Thoracotomy • Case report	• Complete pain relief from 10/10 NRS to 0/10
Forero et al. 2016 [43]	ESP	• Bupivacaine 0.25% ESP 20 mL • Ropivacaine 0.5% ESP 20 mL • 2% lidocaine and ropivacaine 0.5% 1:1 ESP 20 mL	• Postherpetic neuralgia • Chronic pain post rib fractures • Thoracoscopy • Case reports	• NRS from 10/10 to 0/10, average duration 12 hours • Complete pain relief up to 7 hours • Numbness over the anterior chest up to 24 hours
Kelava et al. 2018 [47]	ESP	• Bupivacaine 0.25% ESP 15 mL • Ropivacaine 0.2 % 10 mL/hr continuous infusion (optional bolus q 60 minutes 12 mL)	• Thoracotomy • Case report	• Average postoperative pain score NRS 2/10
Nagaraja et. al 2018[48]	ESP Continuous	• Bupivacaine 0.25% ESP 15mL • Bupivacaine 0.125% 0.1 ml/kg/hr continuous infusion	• Sternotomy • Randomized trail comparing ESP vs thoracic epidural	• Comparable VAS scores at 0 h, 3 h, 6 h, and 12 h
Krishna et al. 2018[51]	ESP	• Ropivacaine 0.375%	• Sternotomy • Randomized trail comparing ESP to	• Duration of analgesia with NRS score

		ESP 3mg/kg bilaterally	conventional treatment	<4/10 was around 8 hours in the ESP and around 4 hours in the conventional group, pain scores at each hour were less in the ESP group
Nakamura et al 2018[58]	ESP	• Ropivacaine 0.375% ESP 30mL	• Sternotomy • Case report	• NPS 0/10 at rest and 5/10 with movement with first rescue tramadol 9 hours after the surgery • NPS 0/10 at rest and 3/10 with movement 12 hours after the surgery • No rescue analgesia after POD 2 (after chest tubes removal)
Tsui et al. 2018 [57]	ESP Continuous	• Ropivacaine 0.5% 12 mL bilaterally auto-intermittent, alternating, catheter boluses of 10 mL ropivacaine 0.2% every 90	• Sternotomy • Case report	• Median pain score 2/10 during hospital stay, minimum opioid requirement

Wong et al. 2018[77]	ESP Continuous	• Ropivacaine 0.5% ESP 10 mL • Ropivacaine 0.1% <u>Intermittent, alternating, catheter boluses of 10 mL every 60 min</u>	• Sternotomy • Case report	• 0/10 pain score in the first 24 hours, 0-3/10 on POD 1 with ambulation
Leyva et al 2018[50]	ESP Continuous	• Bupivacaine 0.5% with epinephrine 5 µg/mL ESP 20mL • Bupivacaine 0.125% <u>Continuous infusion at 7 mL/h</u>	• Minimally invasive mitral valve surgery (right thoracotomy) • Case report	• NRS<4 in the first 20 hours, increased pain scores with activity between 20-48 hours, but no need for additional opioids
Macaire et al 2019[49]	ESP	• Ropivacaine 0.5% ESP 0.25 mL/kg • Ropivacaine 0.2% <u>Automatic boluses q 6 hours 2mL/kg</u>	• Sternotomy • Controlled before and after trial	• Improved analgesia with continuous bilateral ESP