A Short Degustation of Regional Anaesthesia

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At AQUA I have chosen to discuss 1) IV vs perineural dexamethasone for postoperative pain 2) an anatomical update for the adductor canal block, 3) phrenic nerve sparing regional anaesthesia of shoulder surgery and 4) a useful tip with lumbar spinal sonography. Other hot topics in regional anaesthesia include ultrasound education, stop before you block, awake vs asleep blocks, paravertebral alternatives for breast surgery, and epidural alternatives (trunk block) regional anaesthesia for abdominal surgery including Erector Spinae, Quadratus Lumborum and TAP blocks.

Dexamethasone: IV or Perineural

For those regionalists who are not routinely placing perineural catheters, there is always interest in finding local anaesthetic additives to increase the longevity of a single shot block. Dexamethasone has emerged as the most promising of the potential additives currently available. There are now many studies showing its benefit over placebo prolonging analgesia by an extra 10 hours **Choi BJA2014;112(3):427-39**. This is highly significant because it allows a patient to get through the first night post-operatively without requiring transitional analgesia at an unfavourable time. IV dexamethasone is known to have an anti-inflammatory and significant analgesic effect. **DeOliviera Anaesthesiology 2011; 115:575-588**. Interestingly, it then emerged that dexamethasone given intravenously was just as effective as dexamethasone administered perineurally. ***In 2013 Desmet. BJA 2013;111(3):445-53, Abdallah et al RAPM 2015;40(2)125-132.*** This created uncertainty as to the optimal route of dexamethasone administration particularly since perineural dexamethasone is an off licence indication and has an unproven long term safety record. Recently more light has been shed on this topic with a meta-analysis by **Chong et al RAPM 2017;42(3)319-326.** They found that the time to first analgesic request was 3.77 hrs longer in the perineural group. However, subgroup analysis showed no difference in the interscalene group. The decision to use perineural dexamethasone should be on a case by case basis based on surgery location, type, transitional pain timing, discharge planning and surgical and anaesthesia culture and perceived safety.

Adductor Canal Block: Anatomical update

There has been much interest recently in the adductor canal block for post knee arthroplasty analgesia either as a stand-alone analgesic technique or in combination with local anaesthetic infiltration. The movement away from the usual quadriceps paralysing femoral nerve block is due to a greater emphasis on early post-operatively mobilisation, and has been made possible by the availability of ultrasound.

Studies show the adductor canal block is equi-analgesic for post knee arthroplasty, with less quadriceps weakness. **Jaeger RAPM 2013;38(6):526-532** To date there is limited evidence that this has made a difference in falls or improved function **Elkassabany Anesth Analg 2016; 122:1696-703** as significant multi-factorial post-op quadriceps weakness still occurs independent of anaesthetic technique.

Initial studies describe a “mid-thigh” sub sartorial injection half way between ASIS and the base of the patella calling it an “adductor canal block”. **LUND Acta Anaesthesiol Scand 2011; 55:14-19** However this is technically in the low femoral triangle above the beginning of the adductor canal. Case reports of local anaesthetic spreading cephalad and causing a true femoral nerve block have been described. **Chen RAPM 2014; 39:170-171. Veal. Acta Anesthesiol Scand 2014; 58:362-364.** Despite this anatomical fact being pointed out in 2014 **Bendtsen et al. RAPM 2014 39(3):253-254, RAPM 2014;39(5):442-443** there has been subsequent confusion in the literature about the terminology for the regional anaesthesia being provided, the definition of the adductor canal block, its contents and their relative significance in sensory innervation of the knee joint. This has made meta-analyses on the topic difficult and further

definition of the anatomy needs to be confirmed to allow useful comparisons. (**Hussain RAPM2016;41(3):314-320**. Recently there have been several anatomical studies conducted trying to shed light on this issue. (**Bendtsen RAPM 2016;41(6)711-719, Burkett RAPM 2016;41(3):321-327, Wong RAPM 2017;42(2):241-245**

The adductor canal begins at the intersection of the medial border of the sartorius and adductor longus muscles. This point is easily determined using ultrasound landmarks **Fig 1** (**Wong RAPM 2017;42(2):241-245)** and is distal to the midpoint of the thigh previously explained. **Fig2**. (**Wong RAPM 2017;42(2):241-245)** It finishes at the adductor hiatus where the vessels dive deep into the popliteal fossa. It is bound anteromedially by vasto-adductor vastus medialis and posterolaterally by adductor longus then adductor magnus. **Bendtsen RAPM;39(5):442-443.**

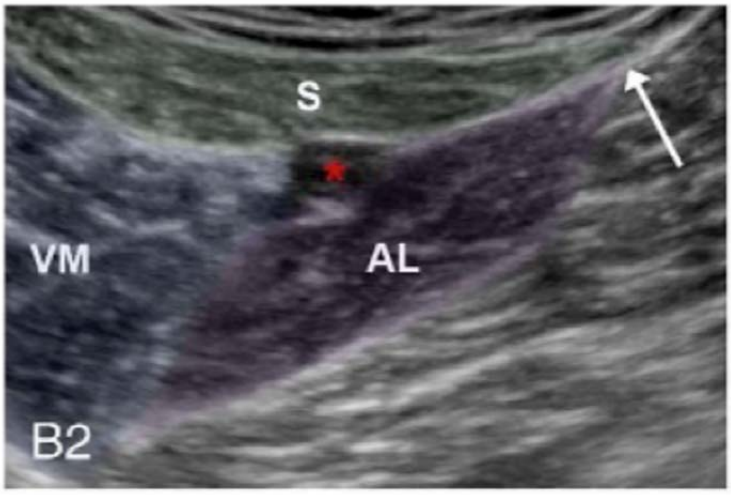


Fig 1: Depicts the beginning of the AC defined as the apex of the FT, where the medial border of the sartorius muscle intersects the medial border of the adductor longus muscle (white arrow in B2). This level corresponds to the blue arrows in Figure 2. AL (purple), adductor longus muscle; AM (orange), adductor magnus muscle; asterisk (red), femoral artery; F, femur; S (green), sartorius muscle; SM (yellow), semimembranosus muscle; VM (blue), vastus medialis muscle.

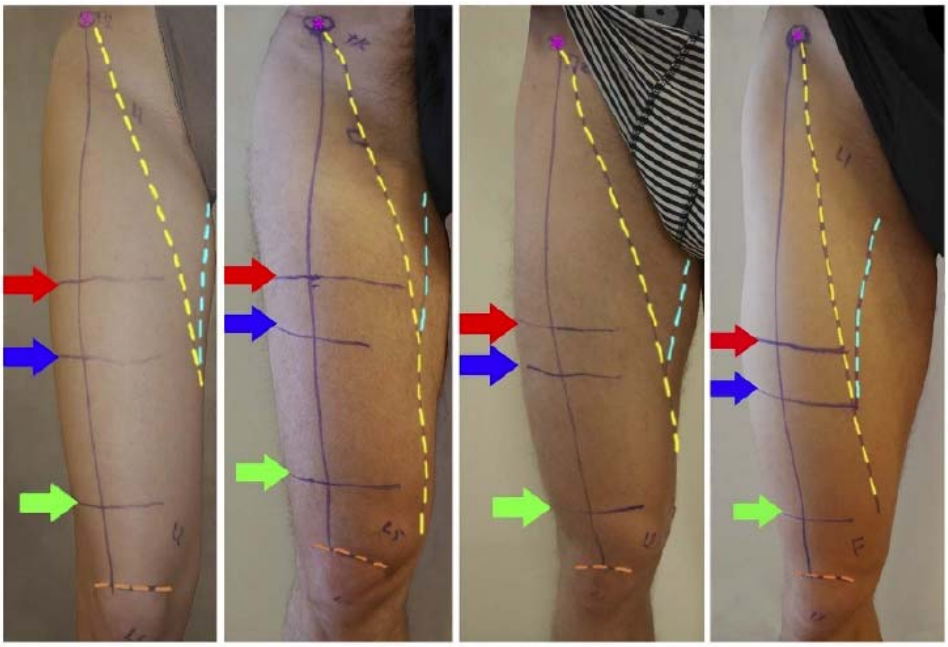


FIGURE 2. The figure shows the thighs of 4 volunteers. The midpoint of the thigh (red arrow) is defined as half the distance between the ASIS (pink asterisk) and the base of patella (orange stippled line) corresponding to the ultrasound images in Figure 1A. The proximal end of the AC (blue arrow) is defined by the intersection of the medial border of the sartorius muscle (yellow stippled line) and the medial border of the adductor longus muscle (cyan stippled line) corresponding to the ultrasound images in Figure 1B. The distal end of the AC is defined as the adductor hiatus (green arrow) corresponding to the ultrasound images in Figure 1C.

There is debate and inter-individual variability about which nerves travel through the adductor canal and the significance of these nerves in post knee arthroplasty nociception.

These nerves include the saphenous nerve, the nerve to vastus medialis and the obturator nerve.

Local anaesthetic injected into the low femoral triangle above the beginning of the true adductor canal will reliably block the saphenous nerve and the nerve to vastus medialis however volumes >20mL run the risk of causing quadriceps weakness. **Jaeger P. Br J Anaesth 2015;115(6): 920-926**
A distal adductor canal block just proximal to the adductor hiatus runs the risk of missing the nerve to vastus medialis, and potentially the infrapatellar branch of the saphenous nerve in a small group but also spreading through the adductor hiatus posteriorly and causing a sciatic nerve block with resultant foot drop.

The optimal adductor canal block is a low volume <20mL proximal adductor canal or low femoral triangle block. The best way to determine this location is to use ultrasound landmarks **Fig 1** rather than traditional external anatomical landmarks.

Phrenic nerve sparing regional anaesthesia for shoulder surgery

The interscalene block is the gold standard regional anaesthetic technique for shoulder surgery. Unfortunately despite dose reduction it cannot reliably be provided without a coinciding phrenic nerve block and hemiparalysis of the diaphragm. Most of the time this is extremely well tolerated and of no clinical significance. Unfortunately in a small subset of the population with minimal respiratory reserve, a phrenic nerve block can be a significant clinical problem.

The phrenic nerve is derived from C3,4,5 and runs down the ventral surface of the anterior scalene muscle. Its proximal end lies very close to the brachial plexus and interscalene groove, but its path diverges from the brachial plexus as it descends. The innervation of the shoulder joint significant in post-operative nociception includes the suprascapular and axillary nerves with a lesser contribution from the lateral pectoral, upper and lower suprascapular nerves. The suprascapular nerve leaves the brachial plexus proximally at the level of the trunks. Therefore, a single injection intending to block these nerves needs to be near the trunks i.e. a interscalene or supraclavicular block.

Recently there has been increased interest in solving this problem with a number of excellent review articles. **El-Boghdadly Anaesthesiology 2017;127(1)173-191, Tran RAPM 2017;42(1):32-38.** All of these strategies aim to deposit local anaesthetic more peripherally away from the phrenic nerve.

The strategies presented include

a) **Low dose interscalene block:** Interscalene block causes phrenic nerve block via cephalad or ventral spread. Ultrasound has allowed smaller doses to be used. Despite many attempts the lowest incidence was 27% with 5ml Ropivacaine 0.75% **Studner BJA2016;116(3):405-412.**

b) **Extra-fascial interscalene block**: 20ml Bupivacaine 0.5% deposited 4mm lateral to C5+6 nerve roots in belly of middle scalene muscle has been shown to reduce the incidence to 21% **Palhais BJA 2016;116(4):531-537.**

c) **Low dose C7 nerve root block**: In 2009 Renes et al showed that 10mL Ropivacaine 0.75% posterolateral to the C7 nerve root reduced phrenic nerve block to 13%. **Renes RAPM 2009; 34:498-502.** The C7 foramen is known to a highly vascular area so further studies need to confirm its safety as well as efficacy for surgical anaesthesia.

d) **Supraclavicular brachial plexus block**: The supraclavicular approach has a lower incidence of phrenic nerve palsy however it is still significant with high volume multi-injection techniques affording an incidence of phrenic nerve blockade of up to 34%. This incidence can be reduced to 0% with reduced volume 20ml and targeting of local anaesthetic posterolateral to the brachial plexus. **Renes RAPM 2009; 34:595-599** Unfortunately this was not in patients undergoing shoulder surgery so its utility in providing

complete shoulder anaesthesia is still untested. Cornish et al achieved similar results by depositing local anaesthetic lateral and inferior to the brachial plexus with a novel bent needle technique. **Cornish et al Anaesthesia. 2007;62:354-358.**

e) **Combined suprascapular and axillary nerve blocks:** This combination has the advantage of no phrenic nerve blockade, minimal motor block, less transitional analgesia issues however less reliability at providing complete anaesthesia for major shoulder procedures. **Dhir RAPM 2016;41(5):564-571.**

f) **Variations of Suprascapular nerve and posterior and lateral cord blocks:** Recently there have been several new approaches to anaesthetise the suprascapular nerve and posterior and lateral cords. **Rothe** (**Casanova BJA 2016;117(6):835. Taha BJA 2017;119(1)110-171 Sondekoppam BJA 2016; 117(6):831-832: not studied.** Theoretically they should provide excellent shoulder anaesthesia with no phrenic nerve blockade. Further studies are required to see whether this is true and how they stack up against the interscalene block.

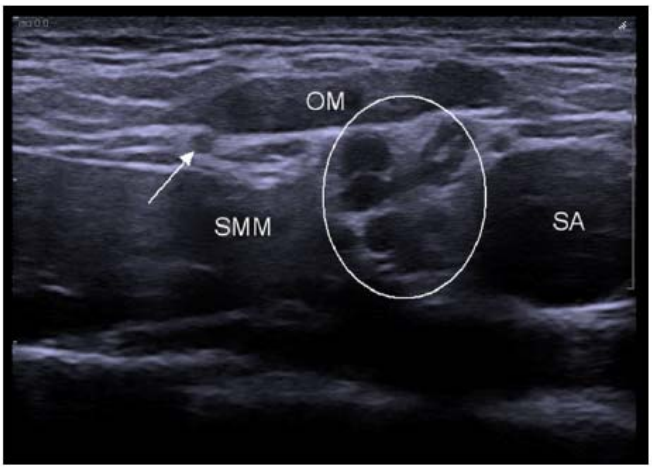


Fig. 1. Ultrasonographic image of the supraclavicular fossa. The transducer is positioned in an oblique sagittal plane. The left side of the image is oriented posterolaterally. Important landmarks are the subclavian artery (SA), the omohyoid muscle (OM), the scalenus medius muscle, and the supraclavicular part of the brachial plexus (encircled). The arrow marks the suprascapular nerve (SSN) in a fascia layer under the OM in close relation to the brachial plexus.

Fig. 2. Volunteer, transducer, and needle position. Lateral view of the shoulder region demonstrating in-plane needle insertion at the upper margin of the trapezius muscle. The transducer is orientated in the oblique sagittal plane and the hand of the operator is resting on the clavicle. The shoulder joint is in neutral position and the hand of the volunteer is resting on the thigh.

Lumbar Spine Sonography

Clinical palpation is the mainstay for performance of lumbar neuraxial blockage despite lumbar spine sonography being available for over a decade. There is good evidence that in patients with unpalpable or abnormal anatomy, lumbar spine ultrasound pre-scan reduces overall procedure time, needle passes, allows accurate interspace selection and depth calculation**. Perlas RAPM 2016; 41:251-260** Despite this, it is my impression this tool is rarely practiced amongst colleagues. I am finding myself using an ultrasound pre-scan more and more useful and now do it routinely for anyone with unpalpable or abnormal anatomy.

My approach was initially developed in Perth under the guidance of Dr Chris Mitchell. This is the same technique described by **Carvalho. (anaesth clinics 2008;26:145-148)** with greater emphasis on the anterior wall of the spinal canal.

My Routine

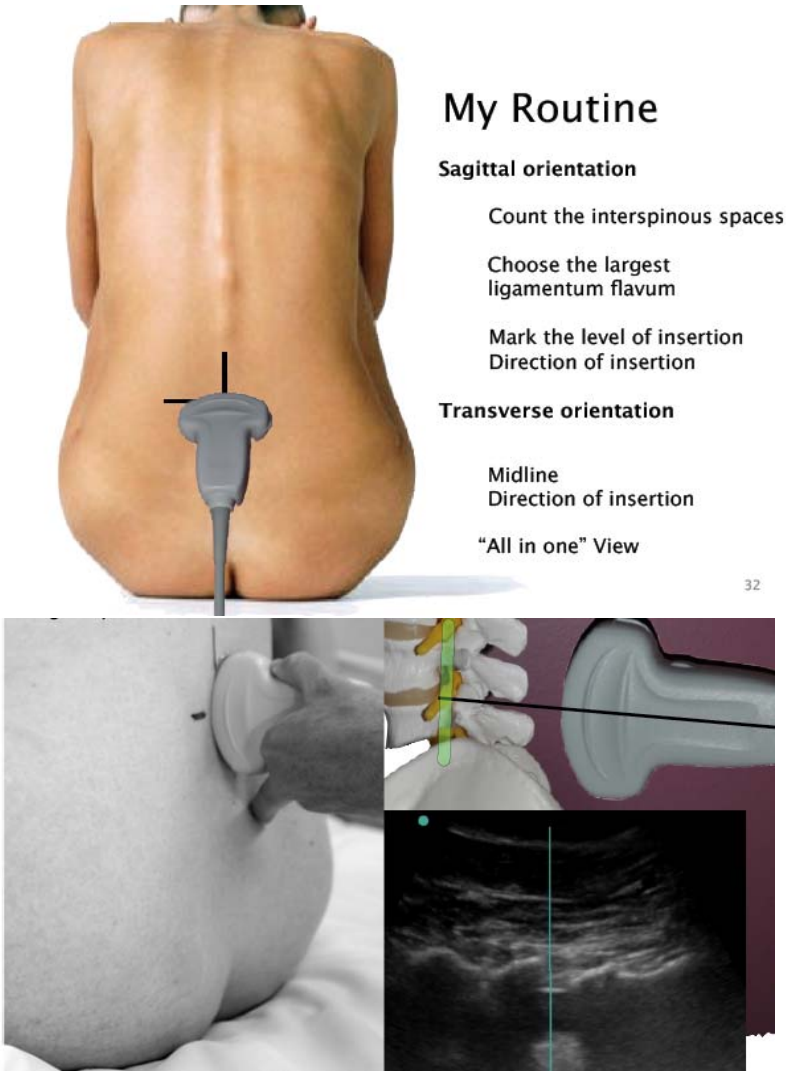
Firstly, I make sure I have an ultrasound with a low frequency curvelinear probe, sterile probe cover and sterile pen. I then get scrubbed, gowned, gloved, prepared and position the patient for the procedure. I think this is important to scan the patient in exactly the position of the procedure and immediately before.

Saggital paramedical view (see figure)

With the probe in the saggital paramedian orientation the smooth line leading into the saw tooth pattern of the lamina can be seen. This allows accurate inter vertebral space numbering. I focus my attention on looking through these spaces to the reflection of the anterior wall of the spinal canal. The size of this acoustic signal is proportional to the size of the boney acoustic window. This indicates which interspace is largest and most favourable. In a young patient, there may be many favourable spaces. In an older patient or one with abnormal anatomy there may be fewer choices.

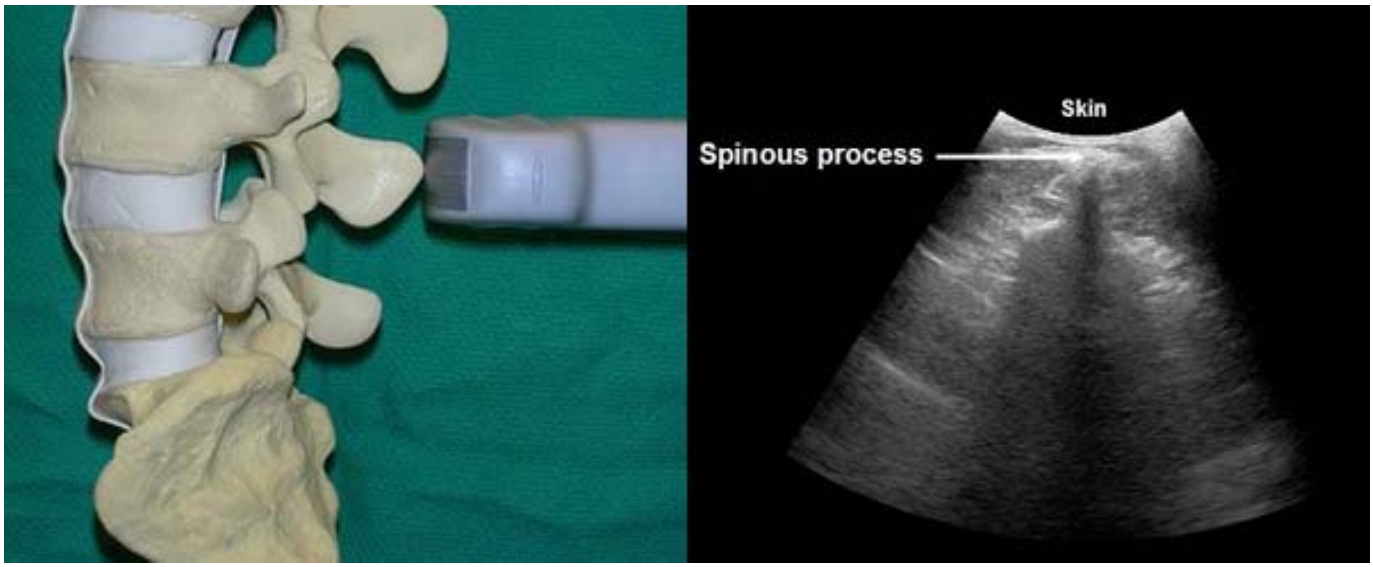
Transverse medial view

With the probe in the coronal view, one can assess the midline, angle of insertion in the horizontal and vertical plane, and depth of the epidural space. Determining the midline and interspace in best done by firstly finding a spinous process. This forms a bright hyperechoic signal close to the surface in the midline with a cone shaped acoustic shadow underneath. The probe can then be slowly moved cephalad or caudad off the spinous process into the intervertebral space where the acoustic shadow is replaced by bat head shaped shadow of the facet joints. . The anterior wall of the spinal canal is then visible in the midline. One visible this gives the “all in one view”

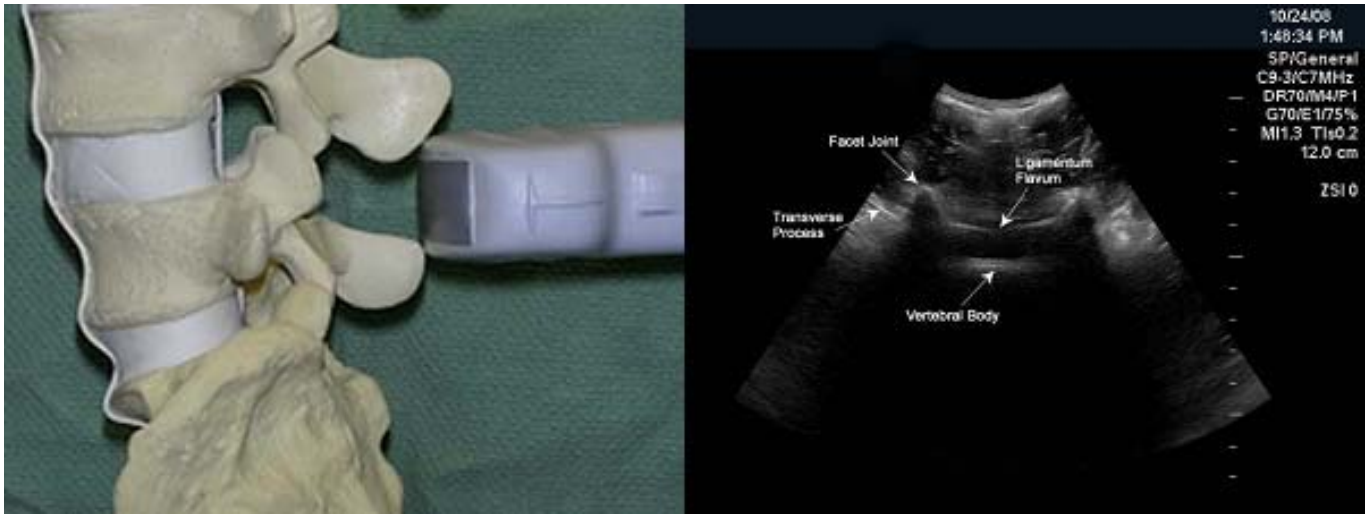


Saggital paramedical view. The green line in the ultrasound image passes down between the saw tooth appearing laminae, through the intervertebral spaces and spinal canal and shows the acoustic signal from the anterior wall of the spinal canal

Transverse medial view of spinous process



Transverse medial view showing bright line of vertebral body aka anterior wall of the spinal canal. I use this as an indicator of a large acoustic window.



Conclusion

Perineural dexamethasone prolongs the time for first analgesic request compared to intravenous dexamethasone by about 3.5 hours. However there is no difference with interscalene blocks.

The adductor canal can be defined using ultrasound landmarks at the intersection of the medial borders of adductor longus muscle and sartorius muscle. This is distal to the usual mid-thigh location traditionally used when performing an adductor canal block. The exact components and relative contribution of nerves to post knee arthroplasty nociception is still being defined.

Phrenic nerve blockade cannot reliably be avoided with a single block regional anaesthetic technique for shoulder surgery. There has been an advance in different approaches for blocking peripheral nerves to provide complete anaesthesia for shoulder surgery.

When performing lumbar spinal ultrasound pre-scan for epidural and spinal anaesthesia, emphasis on the acoustic signal of the anterior wall of the spinal canal helps choose the most favourable space.

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