

## Transversus Abdominis Plane (TAP) Block

The innervation of the abdominal wall is derived from anterior divisions of spinal segmental nerves T6 to L1. These nerves run laterally between the transversus abdominis and internal oblique muscle layers of the abdominal wall, the transversus abdominis plane (TAP). There is a lateral branch at the mid-axillary line and anterior branches through the rectus muscle which supply the skin from the midline to approximately the anterior superior iliac spine (ASIS).

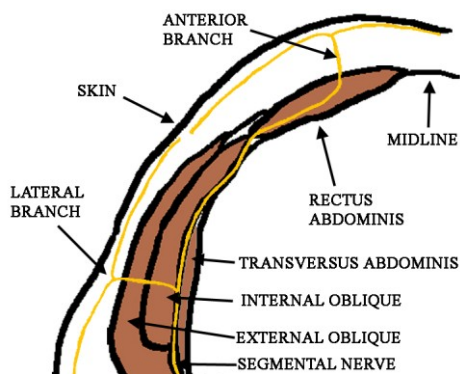


Fig 4.1 diagram of innervation of the mid abdominal wall showing anterior and lateral branches of segmental nerve

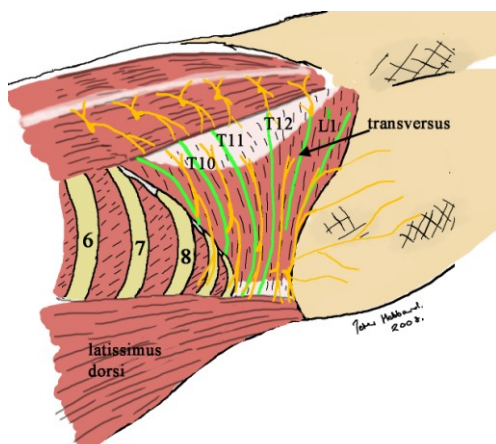


Fig 4.2 anatomy of the abdominal wall, main nerves lying on transversus in green, lateral and anterior terminal branches in yellow.

The nerves are found reliably in the TAP where 3 muscle layers are imaged.

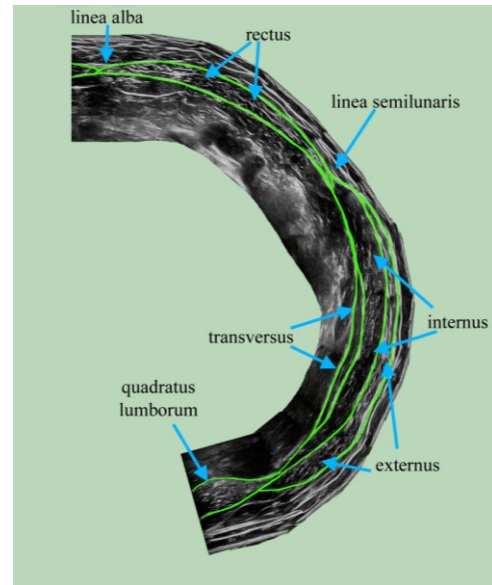


Fig 4.3 composite sonogram of horizontal section through abdominal wall at level of umbilicus

More medially they pass towards rectus abdominis muscle and generally enter the posterior part of the rectus sheath, pass between rectus muscle and the posterior sheath and then penetrate anteriorly through rectus muscle to supply the skin. In a minority of cases the nerves penetrate directly through the lateral edge of the rectus muscle and are not present deep to rectus at all. This is a limitation of block just behind rectus muscle. The transversus muscle attaches to the deep surface of the costal margin and the fleshy part of the transversus muscle extends deep to the edge of rectus abdominis in the upper abdomen near to the costal margin.

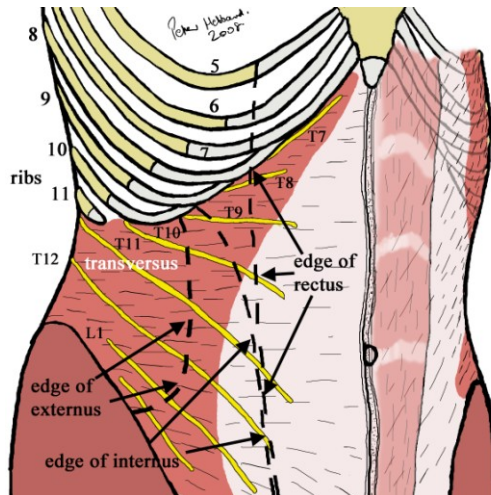


Fig 4.4 diagram of the anterior abdominal wall showing the edges of the main muscles as they relate to transversus abdominis together with the general course and position of the nerves

The intercostal nerves emerge from the costal margin deep to the costal cartilages and pass for a variable distance between rectus sheath and transversus muscle before passing anteriorly through rectus sheath and then into rectus muscle. As in the lower abdomen the nerves may pass into rectus muscle quite laterally and blockade of the medial part of the posterior rectus sheath may entirely miss the nerves. There is often extensive anastomosis between the nerves emerging from the costal margin which rapidly lose their segmental origin. The L1 nerves (ilioinguinal and iliohypogastric) have a different course to the thoracic nerves in that they generally remain deep to the transversus muscle until the anterior one third of the iliac crest (from ASIS to posterior superior iliac spine). In addition the ilioinguinal nerve may have a course over the iliac crest onto the iliacus muscle before re-emerging into the muscular abdominal wall over the anterior one third of the iliac crest.

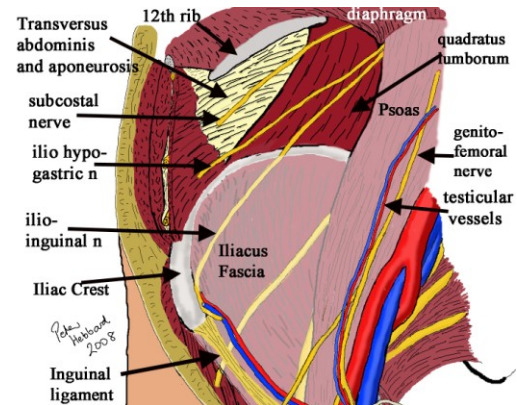


Fig 4.6 diagram of retroperitoneum showing course of ilioinguinal nerve over iliac crest and iliohypogastric nerve deep to transversus abdominis

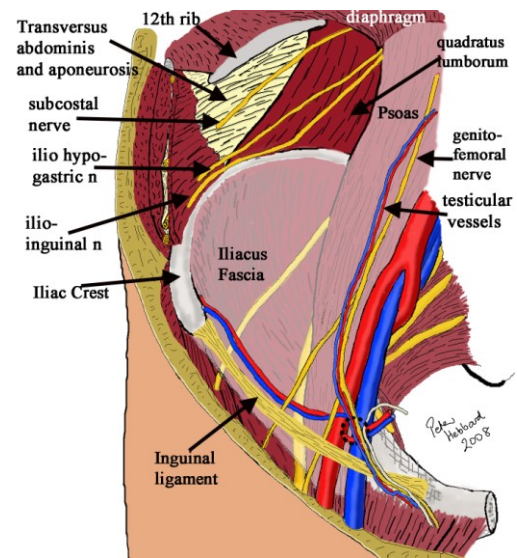


Fig 4.7 ilioinguinal nerve with a course superior to the iliac crest

Therefore a TAP block will not reliably include L1 unless the local anaesthetic is above the anterior third of the iliac crest. Under ultrasound the muscle layers are visible from the rectus medially through the aponeurotic area at the edge of rectus (linea semilunaris) to the 3 distinct layers of external and internal oblique and transversus abdominis in the lateral abdominal wall. Neurovascular bundles may be seen including the ascending branch of the deep circumflex iliac artery



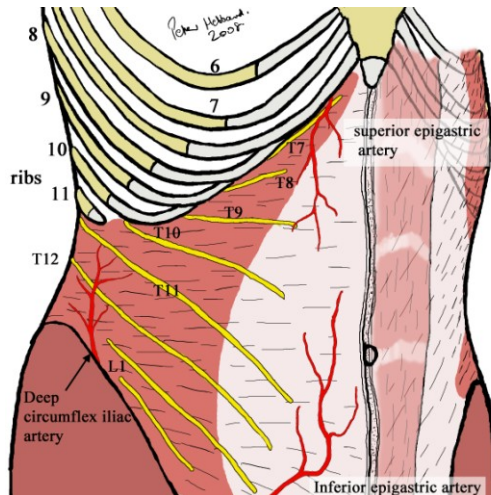


Fig 4.8 diagram of main vascular supply of anterior abdominal wall

If local anaesthetic is placed in the fascial layers it will spread widely. The posterior TAP block under ultrasound is performed between the iliac crest and the most inferior extent of the ribs.

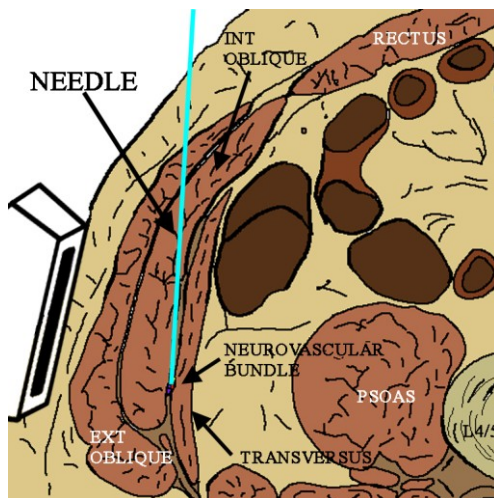


Fig 4.9 needle placement for posterior TAP block

The plane between internal oblique and transversus is located anterior to the mid-axillary line with the probe transverse to the abdomen often partly oblique to pass across the direction of nerves and towards the junction of anterior one third and middle one third of the iliac crest.

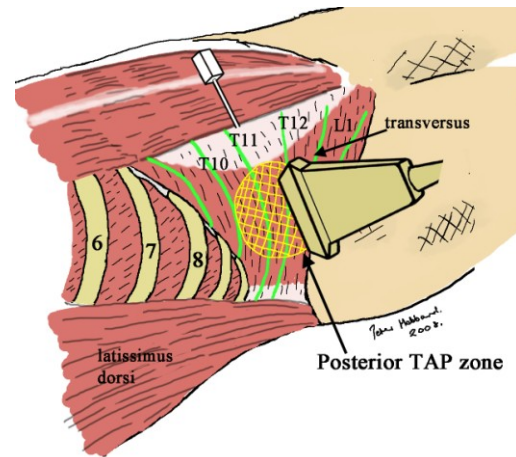


Fig 4.10 diagram of needle and probe position for posterior TAP block.

From anteriorly a 100 mm needle is passed to come perpendicularly into the ultrasound beam and placed between transversus and internal oblique. The skin puncture point is in plane with the ultrasound beam and at the approximate depth to bring the needle perpendicularly into the beam when it is in the transversus plane.

The probe is slid upwards on the lateral abdominal wall after skin puncture to image the needle proximally in its course towards the plane and subsequently guide it into position.

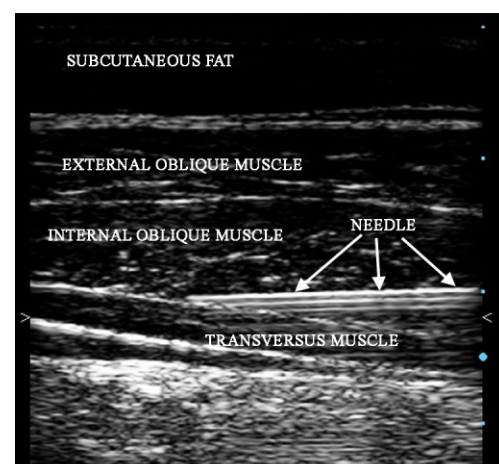


Fig 4.11 TAP block needle approaching the plane in the lateral abdominal wall, the lateral skin of the abdomen is to the top of the sonogram as it appears on the screen.

Ropivacaine 50mg diluted to 20 to 40 ml of is injected each side to spread in the plane. This approach blocks from the symphysis pubis to umbilicus level.

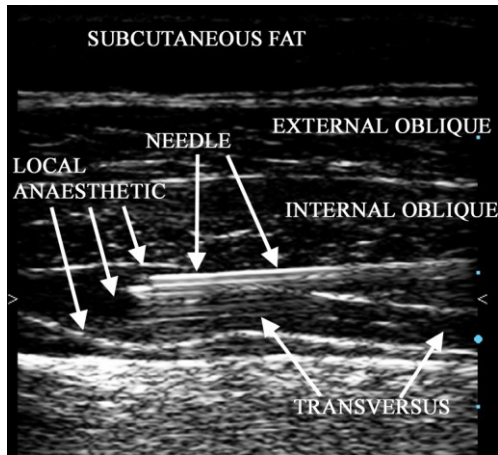


Fig 4.12 local anaesthetic at the start of the TAP block injection as it dissects transversus from internal oblique

The ultrasound guided approach to the TAP block may be performed bilaterally with the operator standing on the same side of the patient and is also suitable for catheter placement

Original descriptions of TAP block involved a landmark, non ultrasound technique. The developers described blockade of the lateral branch of the nerves however experience in the ultrasound guided approach has produced more limited spread than the landmark technique including rarely blocking the lateral branch. If blockade is confined to the anterior one third of the iliac crest to block L1 it is rare to detect lateral branch involvement.

### Transversalis Fascia Plane Block

To block the lateral branch it is possible to pass the needle, in an antero-posterior direction through transversus abdominis posteriorly in the abdominal wall and place local anaesthetic between the posterior part of the aponeurosis of transversus

abdominis and the transversalis fascia which lines the muscular abdominal wall.

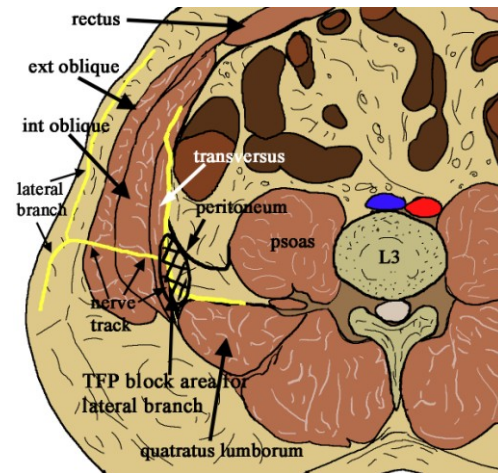


Fig 4.13 transverse diagram of the postero-lateral abdominal wall showing the location for TFP block

In the plane of this block which has been termed the Transversalis Fascia Plane (TFP) the local anaesthetic spreads medially deep to the quadratus lumborum muscle blocking the proximal segments of T12 and L1 anterior to quadratus including the lateral branches. The block should be performed posterior to the point where the peritoneum curves away from the transversalis fascia with extraperitoneal fat deep to the transversalis fascia at that level.

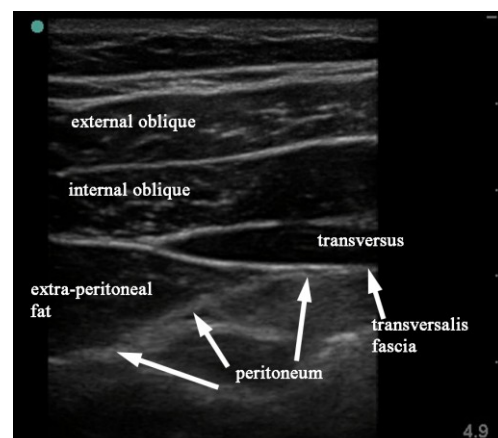


Fig 4.14 sonogram of the postero-lateral abdominal wall showing the posterior extent of transversus, underlying transversalis fascia and extra-peritoneal fat.

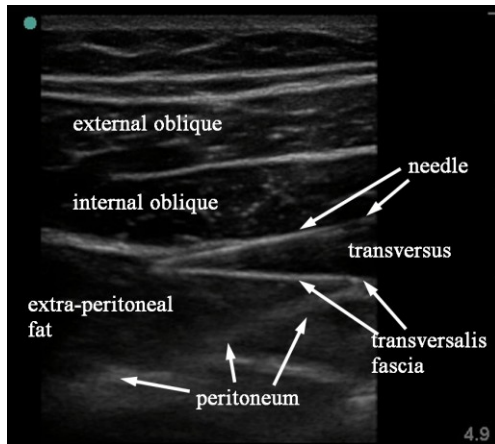


Fig 4.15 sonogram of the same patient as above showing needle in position for TFP block.

On the right the liver is also to be avoided, generally by remaining close to the iliac crest and ensuring that extraperitoneal fat and not liver lies deep to transversalis fascia.

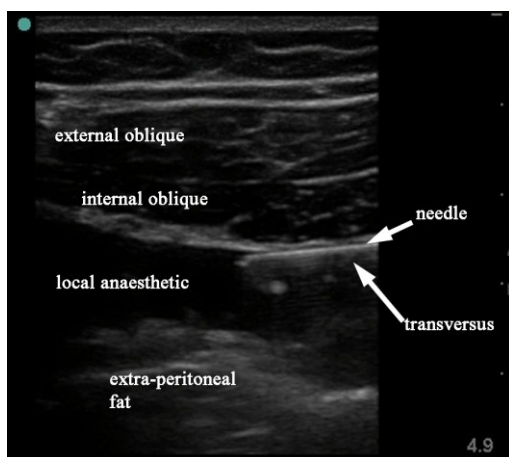


Fig 4.16 sonogram at the conclusion of the TFP block

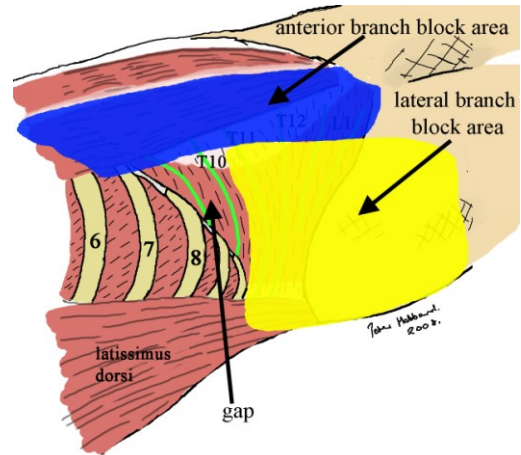


Fig 4.17 diagram of the expected area of analgesia from the TAP block and TFP block.

### Sub-costal and sub-costal oblique TAP block

The transversus plane may also be used for analgesia superior to the umbilicus and as far superiorly as the xyphoid process by deposition of the local anaesthetic into the transversus plane along the costal margin. This subcostal TAP block is performed by identifying the rectus abdominis near the costal margin and imaging the underlying transversus abdominis muscle. The transversus can usually be followed right down the costal margin towards the iliac crest

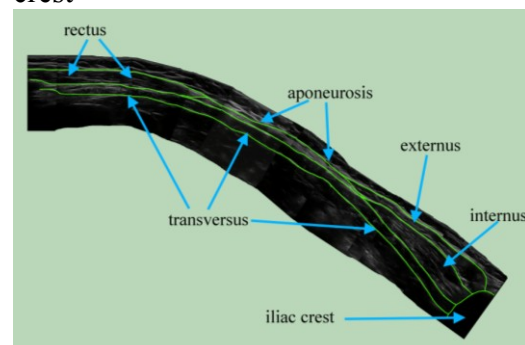


Fig 4.18 composite sonogram of the anterior abdominal wall near the costal margin showing the continuity of transversus abdominis deep to rectus abdominis, internal oblique and the aponeurosis between.



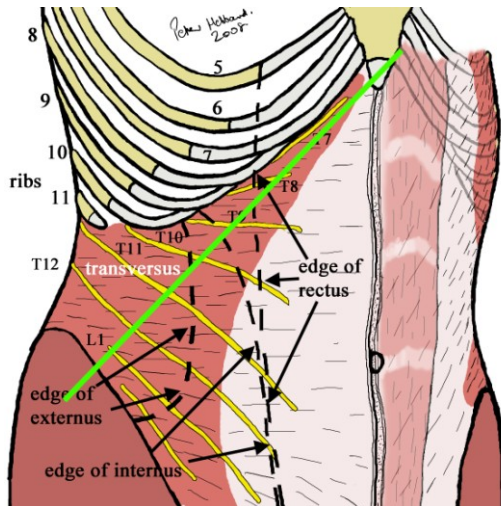


Fig 4.19 plane of composite ultrasound picture above

At the level of the 8<sup>th</sup> or 9<sup>th</sup> costal cartilage there is often an aponeurotic area between the lateral edge of rectus abdominus and the medial edge of internal oblique. In this area transversus is the only muscle between skin and peritoneum.

For subcostal TAP block the needle is introduced several cm from the probe to come into view in plane and near perpendicular to the probe. The block may be continued right along the costal margin to provide the most extensive blockade of the anterior abdominal wall.

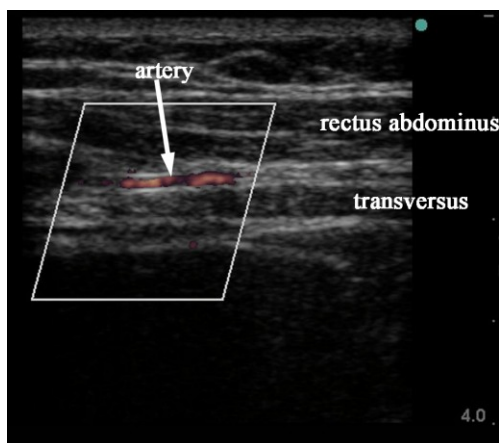


Fig 4.20 sonogram of the superior epigastric artery near the costal margin highlighted by power Doppler

When blocking near the xyphoid care needs to be taken to avoid the superior

epigastric arteries. These may be imaged in many patients with colour Doppler emerging from under the costal margin close to the midline. When blocking in the very uppermost part of the abdominal wall the transversus muscle may be deficient in which case the local anaesthetic may be targeted to the posterior rectus sheath.

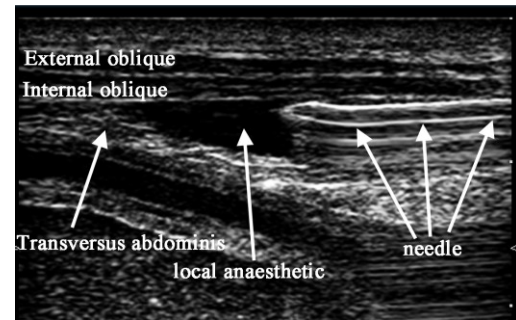


Fig 4.21 subcostal oblique TAP block hydrodissection in a child using a touhy needle prior to catheter placement

Further down the costal margin the local will be effective deposited either superficial or deep to rectus sheath as long as it is placed close enough to the costal margin to achieve block in those patients in whom the nerves have a short course before penetrating into the rectus muscle. Understanding of the anatomy has allowed placement of blocks over selected areas of the abdominal wall to tailor the local anaesthetic block to the incision.

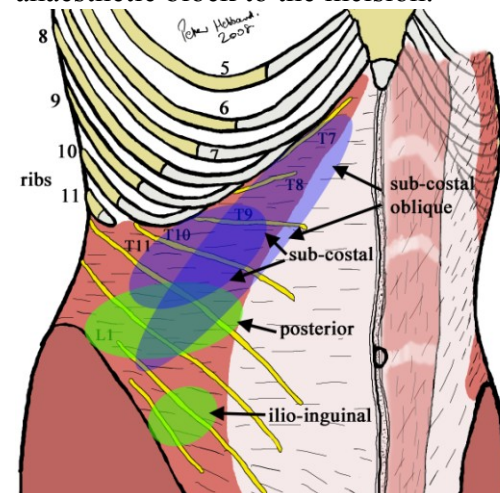


Fig 4.22 diagram of alternative areas to approach the TAP in the anterior abdominal wall

Infusion experience is limited however a block can be maintained in the anterior abdominal wall via bilateral infusion catheters using ropivacaine 0.2% to a total rate of 28mg/hr (14ml/hr) split between the catheters.

For major surgery PCA is still required along with multi-modal analgesia as the TAP blocks only cover the anterior abdominal wall. The visceral pain component of intra-abdominal surgery seems to settle relatively quickly over the first 6 to 12 hours and PCA use is often minimal after that time.

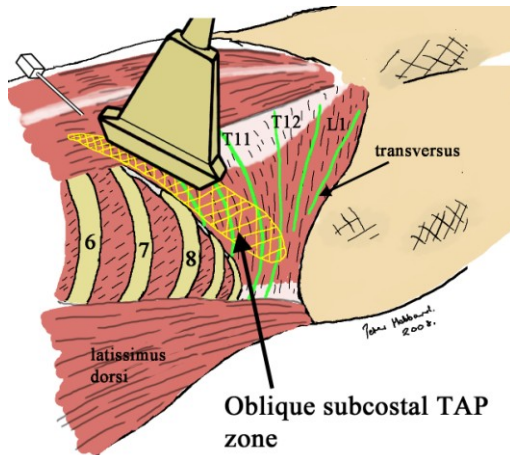


Fig 4.23 diagram of the subcostal oblique TAP block and the target area for insertion of local anaesthetic.

### Lateral Rectus Abdominis block

Around and above the umbilicus an effective block of the anterior branch of the segmental abdominal nerves may be achieved by placing local anaesthetic into the plane between the

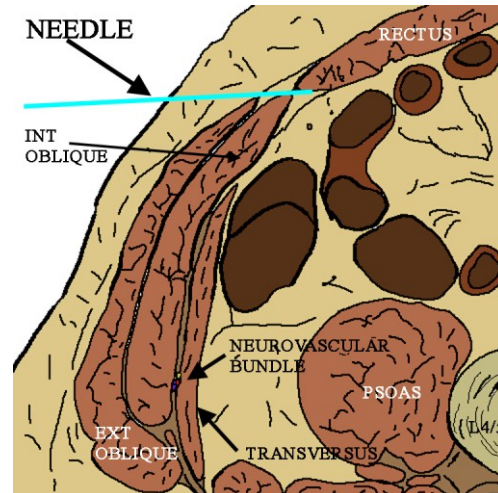


Fig 4.24 diagram of lateral rectus abdominis block

posterior part of the rectus muscle and the posterior rectus sheath at the lateral border of the rectus. Ideal placement is deep to the lateral edge of the rectus although anatomically this approach will be less reliable than TAP block as the nerves may enter directly into the lateral edge of the rectus muscle. 10 ml of 1% ropivacaine used each side produces a block, the local anaesthetic should spread widely forming a 'lens' in the sonogram in the fascial plane.



Fig 4.26 needle and probe position for block at the lateral edge of rectus

The lateral rectus abdominis block performed at the level of the umbilicus can produce widespread blockade over the

central part of the anterior abdominal wall as far laterally as the iliac crest.

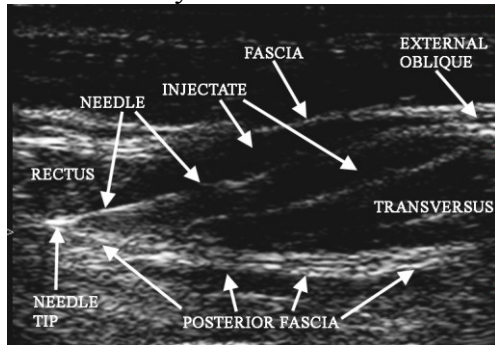


Fig 4.27 Sonogram of lateral rectus abdominis block

The ilioinguinal and iliohypogastric nerves do not conform to the same pattern as the more superior segmental nerves. They become superficial more laterally in the abdominal wall. Suprapubic block should be achieved with the TAP or ilioinguinal / iliohypogastric block

### Ilioinguinal Block

This block is really a very limited TAP block. Medial to the iliac crest the ilioinguinal and iliohypogastric nerves run in close proximity to each other and together with some blood vessels. The nerves are both derived from L1 and leave the neurovascular plane between transversus and internal oblique more laterally than other segmental nerves. They pass between the external and internal oblique muscles until they emerge subcutaneously over the inguinal ligament.

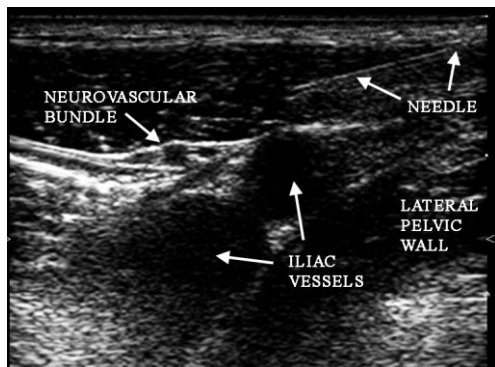


Fig 4.28 Sonogram of ilioinguinal block in a child

The iliohypogastric supplies the skin superior to the pubis over the lower part of rectus. The neurovascular bundle is particularly easy to identify in children and may be blocked for inguinal anaesthesia or analgesia. In small children an out of plane technique is often easier technically.



Fig 4.29 Needle and probe position for ilioinguinal block, in Plane technique in adults

It has been shown as little as 0.075 ml/kg of 0.25% bupivacaine is effective in this site in children for analgesia for inguinal hernia repair.

In describing this ultrasound guided procedure it has been assumed that attention has been paid to appropriate location, personnel, sterility, preparation, doses and technique necessary for the safe conduct of major nerve blocks and other procedures. These medical procedures should not be attempted without suitable qualifications

### Acknowledgements

Thanks go to the Ecole Polytechnique Federale de Lausanne for the excellent anatomical slices that can be obtained from the data set of the Visible Human Project via their website at

<http://visiblehuman.epfl.ch/>