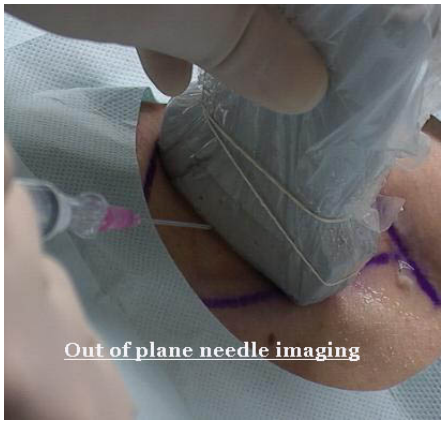
Technical Aspects of Ultrasound Guided Regional Anaesthesia

Background

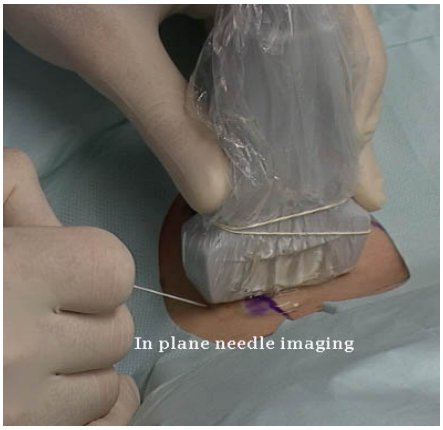
The US beam is very narrow (1-2mm wide). For a needle to be seen some part of the needle must be crossing this beam and reflecting waves back to the probe. Reflected energy will be greatest when the needle is passing horizontally across the beam and progressively less as needle angulation increases. Larger needles may aid visualization, and special surface coatings or indentations may improve the scatter from the needle.
There are two methods for visualising the needle; short axis (out of plane) and, long-axis (in-plane) imaging.

Out of plane (short axis) needle imaging

With this method, the needle approaches the target perpendicular to the ultrasound beam. The needle will be seen as a bright spot on the image, along with a dark shadow deep to it. It is vital that you appreciate that this bright spot denotes the point at which the needle intersects the 2mm wide ultrasound beam, and may not indicate the needle tip. When using this method it is important to slide or angulate the probe to check where the needle tip lies. Movement of tissue helps guidance and a steep angle of needle entry is preferred.



In-plane (long axis) needle imaging



With in-plane needle imaging, the needle is in the same plane as the US beam. The advantage is that the whole needle can be seen as it is guided towards the nerve. Needle positioning can be very precise and local anaesthetic (LA) injection around the nerve can be very accurate. Aligning the needle with the US beam is quite tricky. The best needle images are achieved when the needle is at right angles to the US beam.

Key components of the “BATS” technique for UGRA

1. In-plane (long axis) imaging

As described above, the advantages to this approach include;

a) visualisation of the entire needle (shaft and tip),
b) accurate positioning on needle tip in relation to nerve,
c) precise visualisation of the spread of LA around the target nerve,
d) avoidance of other non-nerve structures (vessels, pleura).

Long axis needle imaging does present a challenge; maintaining alignment between the US beam and needle during the block is difficult. The following techniques can aid in making needle imaging easier to achieve.

2. Positioning

Attempting to align the narrow US beam with the narrow needle is difficult. If care is taken to position all the components of the block procedure, block performance can be greatly enhanced. The patient must be positioned in a way that allows the operator to reach the block area comfortably. The height of the bed and the position of the patient on the bed should be optimized for operator comfort.

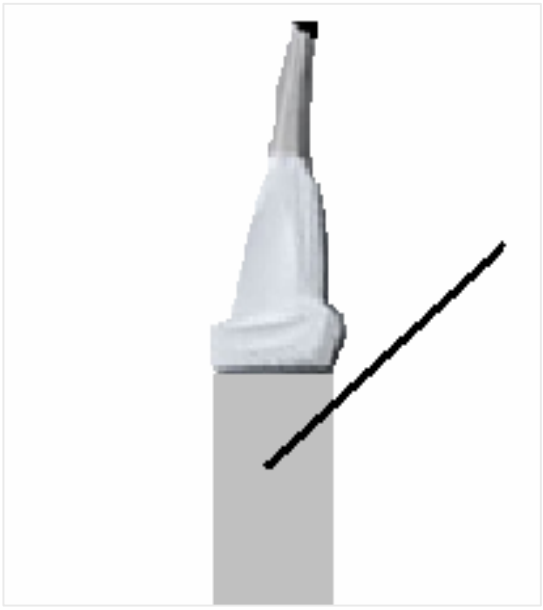
The screen of the US machine should be positioned directly in-front of and above the block area. This “line of sight” positioning means the operator only has to move his eyes and hands during the block procedure. Nothing else needs to be moved at all.

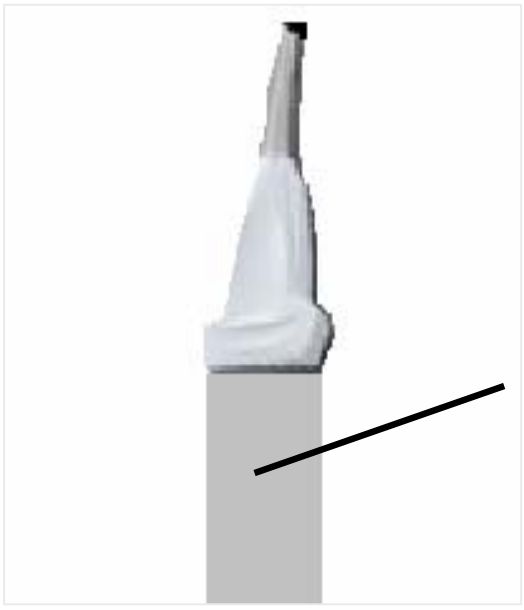
The operator can look down at the needle-probe alignment, and then up at the image on the US screen. In some situations, it is difficult to achieve line of sight with the US image An slave LCD screen positioned over the block area can assist in aligning needle probe and screen in the same line of sight .

3. Low needle angle

The best US image is obtained when the US beam hits the needle at right angles as the reflected energy is greatest (brightest image). This is hard to achieve if the needle is inserted immediately adjacent to the US probe. When inserted in this position, the needle will often take a fairly steep angle to wards the nerve with a relatively poor needle image as a consequence. If the needle insertion point is adjusted to produce a flat needle angle, the needle imaging can be improved considerably. An additional advantage is that the entry point is remote from the probe and therefore sterility issues are less of a concern. It is therefore possible to perform a block without using a probe sheath.

Due to the longer needle path with this technique it is important to ensure that the area is scanned to prevent inadvertent damage to other structures, and to anaesthetize the area with local.





4. Make small movements of needle and probe

Novice practitioners tend to make large movement of the needle and the probe often together. Experts are able to achieve close alignment of the US beam and needle and recognise that very small movements of ***either*** the needle ***or*** the probe are required.

If the needle imaging is excellent, the needle can be moved towards the target nerve. If needle image quality declines, the needle is fixed in position and the probe is moved either across the skin surface (translation) or angled slightly over the needle (angulation).

Once the needle image is optimised, the needle can be advanced once more.

5. Local anaesthetic injection is part of the block procedure: hydro dissection.

When the needle tip is close to the nerve and small amount of LA can be injected. The LA will usually create an open space around part of the nerve. This potential space can then be used to safely advance the needle into. In this manner, the LA can be used to open the way for the needle, and to help achieve the optimal LA spread around the nerve, confirmed by the ‘Doughnut sign’, where a dark ring of LA completely surrounds the nerve.