Should ultrasound or X-rays be used in chronic pain medicine interventions?

Interventional procedures in pain medicine are a major part of a pain physician's treatment options. X-ray-guided techniques have been the 'gold standard' means of accurate anatomical location, but ultrasound has gained momentum in perioperative regional anaesthesia, critical care, obstetric and now pain settings.

Advantages of ultrasound

The advantages of using ultrasound include real time visualization of the target and the surrounding soft tissue, injectate and most importantly the needle tip. Ultrasound does not rely on cumbersome image intensifying equipment which requires trained personnel to operate. There is also no ionizing radiation from ultrasound use. Ultrasound machines are increasingly lighter and more portable, and wireless probes are being developed. Continued technical improvements give better images. Increased accuracy and efficacy have been linked to decreased rates of procedure-related complications (Narouze and Peng, 2010) although the evidence is not very strong.

Specific advantages

Neck procedures are more suited to ultrasound use as good images are produced at shallow depths. The need to avoid important structures in tightly packed spaces gives ultrasound a clear advantage. A prime example of this is stellate ganglion blocks for neuropathic and ischaemic pain conditions of the upper limbs (Woo et al, 2015). The carotid artery and jugular veins, thyroid, oesophagus and vertebral arteries are seen and can be avoided since X-rays do not show these structures at all. The target for a stellate ganglion block is a plane between the longus coli muscle and internal carotid artery, which can be visualized with ultrasound. The real time deposit of the injectate in this plane is also seen with ultrasound as the needle can easily move with small patient movements and respiratory variations of the structures. In contrast, if using X-rays, the target of injection is approximated using the transverse process of C6 as a surrogate marker. Other shallow anatomical targets in the neck such as cervical facets and nerve root blocks normally located with X-rays can also be seen with ultrasound (Galiano et al, 2006).

Ultrasound-guided specific peripheral nerve blocks are also useful compared to fluoroscopy or nerve stimulator techniques. Many nerves traverse in between muscle planes, and can sometimes be visualized directly. For example the lateral femoral cutaneous and ilioinguinal nerves can often be seen and blocked for meralgia paraesthetica and postoperative inguinal scar pain respectively. Pudendal nerve blocks use the ischial spine as a surrogate marker with fluoroscopy, but successful interligamentous injection with ultrasound has been described (Bellingham et al, 2012). Computed tomography-guided injections for coeliac plexus block are still the gold standard, but successful ultrasound use has been described. Avoiding ionizing radiation is an important advantage.

Disadvantages of ultrasound

Ultrasound shows limited cross sections of the body with a small footprint and requires more interpretive skills and extrapolation. Images become difficult to interpret with increasing depth – as the lumbar region is the most common area for interventional procedures this is a major disadvantage of ultrasound, especially in obese patients. The most common procedures, lumbar facet joint injections and epidurals, still require X-rays for accuracy and safety, although both have been described with ultrasound use. The National Institute of Health and Care Excellence (2008) recommends the use of ultrasound for epidural space catheterization in the peripartum period.

Bony structures and joints are poorly seen with ultrasound. Three-dimensional visualization is also problematic – some structures such as the epidural space can be visualized on different X-ray views (anteroposterior and lateral) to provide accurate needle location in two planes which ultrasound cannot do. X-ray images can currently be stored and retrieved in existing computer systems in hospitals while ultrasound images cannot, so X-ray images are more accessible at later dates. Medical staff are more familiar with X-ray images than ultrasound so interpretation is easier.

Future use

There is growing interest in novel approaches to blocks and a number of ultrasound courses for chronic pain and regional anaesthesia are available in the UK. In pain intervention procedures further studies comparing ultrasound with X-ray guidance in terms of efficiency of block and safety profile are required before widespread implementation of ultrasound can occur. **BJHM**

Bellingham GA, Bhatia A, Chan CW, Peng PW (2012) Randomized controlled trial comparing pudendal nerve block under ultrasound and fluoroscopic guidance. *Reg Anesth Pain Med* **37**(3): 262–6 (doi: 10.1097/AAP.0b013e318248c51d)

Galiano K, Obwegeser AA, Bodner G et al (2006) Ultrasound-guided facet joint injections in the middle to lower cervical spine: a CT-controlled sonoanatomic study. *Clin J Pain* **22**(6): 538–43

Narouze S, Peng PW (2010) Ultrasound-guided interventional procedures in pain medicine: a review of anatomy, sonoanatomy and procedures. Pat II: axial structures. *Reg Anesth Pain Med* **35**: 386–96

National Institute of Health and Care Excellence (2008) Ultrasound-guided catheterisation of the epidural space. Interventional procedure guidance. www.nice.org.uk/guidance/ipg249 (accessed 1 February 2016)

Woo A, Tharakran L, Vargulescu R (2015) Stellate ganglion block for painful congenital venous malformation of the arm. *Pain Practice* **15**(6): E65–E68 (doi: 10.1111/papr.12296)

Dr Adam Woo is Consultant in Pain Medicine in the Department of Anaesthesia, Kings College Hospital, London SE5 9RS

Dr Manojit Sinha is Advanced Pain Trainee in the Department of Anaesthesia, Kings College Hospital, London

Correspondence to: Dr A Woo (gasmanadam@googlemail.com)

Anaesthetic and critical care dilemmas are coordinated by **Dr Matthew Henley**, Anaesthetic Fellow, Royal National Orthopaedic Hospital, Stanmore and **Dr Prashanth Nandhabalan**, Specialist Registrar in Anaesthesia and Intensive Care, King's College Hospital NHS Foundation Trust, London