EDITORIAL VIEW

Imaging in chronic pain: May the force be with US

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ABSTRACT

Not very long ago ultrasound (US) was introduced into routine clinical practice and became the prime diagnostic tool in case of many diseases. The radiologists embraced it whole heartedly, but its advantages were soon dawned to many other specialties. Interventional radiology lead to expand its scope in operating rooms, from vascular access to nerve localization to spinal or epidural space identification. It has been regarded as a safer portable medium as compared to its counterparts. Its routine use, in the hands of anesthesiologists, interventional pain management specialists and intensivists, is here to stay.

Key words: Ultrasound; Interventional radiology; Pain management; Anesthesia; Flouroscopy

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Ultrasound (US) was once the coveted imaging tool of radiologists and their skilled sonographer allies. More recently, however, it has been embraced with fervour across the medical fraternity as a diagnostic and therapeutic aid. Its use has relegated traditionally taught techniques to lesser-thumbed texts and the ephemeral memory of the examination candidate. Our anesthetic colleagues, whose orbits align with ours, have been amongst the most enthusiastic disciples. US is now de rigueur for difficult vascular access. Debates as to its use for peripheral nerve blockade have now surely been settled. The silent revolution predicted has occurred, the change being driven by the enthusiastic practitioners.[1] The common sense intuition, that a procedure performed with our eyes wide open is better than that undertaken blindly, propagates the faith. Nerve stimulation in experienced hands may use evidence to dispute this, but these hands are becoming ever more experienced. The common quote 'seeing is believing' has never been so true, and our next generation shall learn with the probe.

In chronic pain, adoption of US has been a bit slow. In our land, fluoroscopy is king. It must be remembered that as a specialty, we are still in our infancy. The current generation of practitioners (with their founding fathers) has developed an offshoot of anesthesia into the specialty of pain management that we can appreciate today. Interventionalists have served their time. Long before the proliferation of courses that enhance our skills today, practice was developed through long hours spent with the textbooks or in operating rooms. Procedures learnt and mastered using anatomy and the fluoroscopy tube did not come easy, and they should not be dispensed with without a real good reason. US must, therefore, justify its place on the scene. It appears to put forth some compelling arguments.

US avoids exposure to radiation. Radiation is something we could all do better with less of it. Its effects are cumulative, and dangerous to both our patients and to us. For some categories of patients (e.g. obstetric population) it denies therapy. For all, it demands respect. As practioners, we must cloak in lead. Regardless of the protective equipment it endangers our own wellbeing. It may indeed create patients from therapists.[2] It may also endanger our patients. The doctors' white coat was largely dispensed with due to infection control concerns. The coats of lead outside operating room should not escape similar scrutiny. Radiation administration also necessitates radiation control. This requires

additional staffing, a radiographer at least. The old term of 'operation theatre' begins to justify its name. Each one has his/her part to play.

US is joyously portable. It can be taken to the bedside, introduced to the office. Facilitation of therapy there avoids the need for special room, a boon for patients as well as for doctors and the institutions. Portability lends US another great advantage. It allows for dynamic assessment of our patients, focusing our examination and enhancing our diagnostic capabilities. In contrast to static images, US allows us to see what lies beneath, in real time, in positions of comfort or indeed discomfort for our patients. Answers may be found from probing questions.

What we see is indeed the compelling argument for the use of US. High resolution of soft tissue structures renders it the imagery of choice for much musculoskeletal pathology. Where fluoroscopy uses bone landmarks as surrogate targets, assuming anatomy is standardized, US allows the visualization of target structures in the individual. Assumptions here can be unforgiving.

Needle trajectories can be planned to not only land on target but to arrive there safely, leaving adjacent structures unharmed. Precious cargoes of therapeutic substance may then be released, as we watch via screen, challenging ourselves to sustain effect with lower volumes. In contrast to fluoroscopy, there is no contrast. Its allergy making mischief has no place here.

Doppler mode further allows us to identify vascular structures. US 'prevents' whereas fluoroscopy 'detects' intravascular injections[3]. In critical areas, detection may offer no cure. More accurate needle placement with reduced local anesthetic (in the right place) should result in safer and more successful procedures. Hot theories, however, must be backed by cold evidence. Again, US does appear to walk the walk.

A point in case is blockade of the stellate ganglion, formed by a fusion of the inferior cervical and first thoracic ganglia. Sympathetic blockade, at this level is indicated in patients suffering from sympathetically mediated upper extremity pain or vascular insufficiency. Traditional anatomical and fluoroscopic techniques employ a paratracheal approach at the level of the anterior tubercle of C6 (Chassaignac's tubercle). Such an approach is fraught with underlying pitfalls, risking damage to oesophageal, thyroid and carotid structures. US was used to map the trajectory potentially employed using a blind paratracheal approach. It demonstrated that the oesophagus would be traversed in over 1/3 of patients.[4] Such risk is unacceptable.

An US-guided approach, visualizing (and avoiding) vascular, neural and parenchymal structures, allows needle advancement to the prevertebral fascia on the surface of the longus colli muscle. Accurate deposition of local anesthetic subfascially, rather than suprafascially, may increase the incidence of successful sympathetic blockade and lower the incidence of complications such as hoarseness.[5]

If the neck region, with its myriad of soft tissue structures appears an ideal region for US to demonstrate its prowess, there are multiple others. We can adopt the practice of our colleagues in anesthesia and rheumatology when peripheral nerves and joints require our attention. Trigger points, tendons and trochanters may be inspected, and then injected.

Application of US is, however, not limited to peripheral targets. Previously, bone acoustic shadowing had kept spinal targets off the radar. Novel approaches combined with enhanced technology have, however, opened new viewing planes. Such windows of opportunity offer exciting new therapeutic applications. Caution must be advised here. This is a work in progress. Nevertheless, the right procedure, in the right patient may be safely undertaken with US-guidance. Evidence is rapidly gathering to support this.

Beginning with the lower spine (for this is a more forgiving place to begin), use of US to facilitate caudal epidural injection is established. The technique is well described and its application is found to ensure accurate needle entry to the epidural space.[6]

Lumbar medial branch blocks, undertaken between the transverse process and superior articular process are also amenable to visualization with US. A study, using fluoroscopy control confirmed correct placement of US-guided blocks in 95% of patients.[7]

Similar success may also be achieved in the cervical region. Here, use of US has been shown to result in successful identification of medial branch targets and a reduction in treatment time when compared to conventional (fluoroscopic) RF techniques.[8]

Deeper structures require more caution, and as

yet US cannot replace fluoroscopy for procedures encroaching the neural foramen. Likewise, deeper patients pose problems. In patients with a BMI over 30, just over 60% of patients had successful medial branch blocks with the use of US.[9] Waistbands are unlikely to improve anytime soon. It may, however, be expected that technology will.

Developments in the field include three-dimensional imaging, already providing fascinating images in obstetric and cardiac imaging. Their real time, 4D, application in pain medicine seems to be promising, although bone structures may continue to cast a shadow. Combination with a second imaging modality, such as CT/MRI, may allow for enhanced accuracy. Deeper structures may be accessed in real time, using superimposed mapping from pre-procedural studies.

In conjunction with advances in needle technology, star wars may yet come to the small screen. GPS guidance systems mounted in sensors in the needle tip communicate positional information to the transducer. Such information is superimposed on the screen to guide the operator to the intended target. 'Smart' needles may detect intravascular placement, photon emission or reflectance spectroscopy used to prevent. The 'hypodermic' has come a long way.

Until the launch of our GPS guided projectiles, use of US will be operator dependent. Technical skills and experience require development. Opponents will cite this as a challenge. They must remember that fluoroscopy skills are not acquired overnight. Appropriate sonographic competencies must, similarly, be acquired.

Courses provided by experts may serve to facilitate this and are proliferating. Accreditation via examination and application is also available in keeping with that applied to interventions performed with fluoroscopy.[10]

The high standard to which interventional pain medicine is undertaken is testament to the skills developed by its practitioners. It is unlikely that comparative studies shall herald US as a modality conferring significant safety or technical advantages. There will be procedures for which fluoroscopy shall continue to guide our needles. Tunnel vision here should not prevent us viewing the bigger picture. Advantages conferred by US are multiple. With increasing technology, and decreasing costs, its practical application will continue to develop. We are constantly driven to improve.

With US the force appears strong. May it be with us. May it guide us.

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