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Fascial Plane Blocks in Regional Anaesthesia: How problematic is simplification?

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The introduction of ultrasound-guidance into the daily clinical practice of regional anaesthesia was revolutionary and brought the potential for superior efficacy and safety compared with the pre-ultrasound area.[1] Fulfilling this potential, however, demands acquisition of new knowledge (sonographic anatomy and physical principles of ultrasound) and technical skills.[2] The transition of non-neuraxial regional anaesthesia from a "hit and miss" approach to a precision image-guided speciality has led to its increasing importance in perioperative medicine. The strength of ultrasound guided techniques in experienced hands is that local anaesthetics can be administered exactly as close as possible to nerve structures while damage of the nerve and adjacent anatomical structures can be safely avoided.[3] The fact that so many anaesthesiologists all over the world have undertaken the necessary learning and training to expand their clinical repertoire to encompass ultrasound-guided regional anaesthesia represents a real triumph for our specialty.

The earliest applications of ultrasound-guided regional anaesthesia were for plexus and peripheral nerve blocks of the limbs.[4, 5] The availability of point-of-care ultrasound machines and sonographic skills soon led, however, to the proposition of an expanding number of approaches to providing regional anaesthesia of the trunk using fascial plane blocks. The underlying aims of these techniques - to provide peripheral regional anaesthesia of the trunk, thereby replicating the advantages seen with widespread adoption of ultrasound-guided regional anaesthesia of the limbs, while avoiding the side-effects and complications of neuraxial anaesthesia – were indeed laudable. Their uptake was probably fuelled by the enthusiasm of anaesthesiologists to broaden the use of their newly acquired sonographic skills. The list of fascial plane blocks, with no claim of it being exhaustive, includes transversus abdominis plane [6], pectoral I and II [7], serratus anterior plane [8, 9], erector spinae plane [10], rectus sheath [11], quadratus lumborum [12] and transversalis fascia blocks.[13] The fundamental problem, however, in the notion that truncal blocks can achieve the same reliable efficacy as ultrasound-guided regional anaesthesia of the limbs is that it neglects the very reason of the latter's success: the precise administration of local anaesthetics as close as possible to the relevant nerve structures. While some blocks of the trunk do involve the nerves coming into direct contact with the local anaesthetic (e.g. rectus sheath block), most do not have a clear anatomical rationale to predict success and efficacy even if local anaesthetic is deposited at the intended landmark.

The current issue of *British Journal of Anaesthesia* publishes a comparative study of the perioperative impact of erector spinae versus serratus anterior plane blocks for minimal invasive thoracic surgery.[14] Finnerty and colleagues treated sixty patients undergoing thoracoscopic surgery with one of the two regional techniques and compared the quality of recovery and overall morbidity. Their results suggest that the erector spinae plane block was superior in all outcomes. In evaluating this study, it is first necessary to appreciate that pain after so-called "minimally invasive surgery" is a clinical problem worthy of investigation. Contrary to the widespread belief, the term "minimally invasive" is only based on the size of skin incision(s), and has nothing to do with tissue trauma ("under the skin incision"), haemodynamic effects and inflammatory reactions. Therefore, it is absolutely necessary to seek to optimise evidence to improve postoperative analgesia for "minimally invasive" surgical procedures through sound clinical trials.

There are indeed previous reports that address this subject and these have been reviewed.[15] Attempts have been made to conduct meta-analyses of trials that investigate the efficacy of erector spinae[16,17] and serratus anterior blocks[18,19] compared with systemic analgesia alone but these are largely inconclusive because the evidence is weak from small, low-quality heterogenous studies. At best, it would appear that erector spinae and serratus anterior blocks provide statistically significant but clinically unimportant changes compared with systemic analgesia alone[16-19]. We would argue that new techniques should be compared with the current gold standard, which in the case of analgesia for thoracic surgery is thoracic epidural or paravertebral analgesia. It is unfortunate that Finnerty and colleagues also did not compare one or both fascial plane techniques to these gold-standards and we have to disagree with their rationale for not doing so. Potential complications of thoracic epidural and paravertebral blocks from needle-damage of related structures can be limited by attentive practice of skilled practitioners and we should be seeking to improve their safety further using ultrasound-assisted and ultimately ultrasound-guided techniques.[20,21] The effects on the autonomic nervous system are predictable and can be effectively pre-empted and managed. The anatomical rationale of these more central regional anaesthetic methods is clear, with the local anaesthetic injected directly adjacent to the relevant neuronal structures in contrast to the anatomical basis of the two regional anaesthetic techniques investigated by Finnerty and colleagues, which is worth considering in some detail.

The erector spinae are the intermediate group of intrinsic back muscles formed by the iliocostalis, longissimus and spinalis muscles on either side of the spine from the sacral region to the base of the skull. The muscle group is covered by the thoracolumbar fascia, which is a complicated anatomical structure, because it consists variably of two or sometimes three layers (anterior or deep, middle, posterior or superficial). The anterior and middle layers insert onto the ribs in the thoracic region[22] with extensions to the transverse processes. The deep and middle layers insert at the costal processes in the lumbar region, where this layer is called the lumbar aponeurosis or quadratus lumborum fascia. The posterior layer inserts onto the tips of the spinous processes. The erector spinae plane block is described as a technique, where local anaesthetic is administered below the muscle group and adjacent to the tip of the transverse processes. The mechanism of an erector spinae plane block assumes that the local anaesthetic diffuses through the superior costotransversal ligament or medial to it passing through the costotransverse foramina in the paravertebral space with a subsequent blockade of spinal nerves (ventral and dorsal rami) and an additional epidural spread through the intervertebral foramina medially. The entire system resembles chain mail, built by oblique and longitudinally oriented muscles in a three-dimensional network creating small loose connective gaps, where resolution by ultrasound can be problematic.

The *serratus anterior* plane block is described as a technique where the local anaesthetic is administered anterior or superficial (superficial serratus anterior plane block) and deep to the serratus anterior muscle (deep serratus anterior plane block) at the lateral chest wall (mid-axillary line).[23] The superficial block reaches the lateral branches of the intercostal nerves piercing the serratus anterior muscle. Close to the fascia, covering the serratus anterior muscle, the long thoracic nerve passes by, which might be affected as well. The deep serratus plane block reaches the space between the thoracic wall and the serratus anterior muscle. This compartment is a space filled with smooth connective tissue forming the thoraco-scapular gliding gap and explains medial spread to the insertion of the thoracolumbar fascia on the ribs. As the lateral branches of the intercostal nerves pierce the intercostal muscles, these nerves will be blocked in any case.[24] Medial spread may also reach the lateral branches of the dorsal branches of the spinal nerves. Large volumes of local anaesthetics diffuse inconsistently in the intercostal spaces with consecutive blockade of intercostal nerves.

These considerations and descriptions illustrate the uncertainty and potential variability of the regional techniques investigated by Finnerty and colleagues. While we congratulate them for exploring outcomes, there are proponents of these blocks who rather highlight the relative simplicity of the technique without appropriate identification of the mechanism of the nerve block. More recent studies have sought to test erector spinae [25] or serratus anterior[26] blocks for non-inferiority compared with thoracic paravertebral block but these studies are not adequately designed to exclude inferiority[27] while the study of Hanley and colleagues[26] also lacked equipoise between the interventions.

Nevertheless, the study by Finnerty and colleagues suggests a greater analgesic effect of the erector spinae block compared with the serratus anterior plane block after thoracoscopic surgery. An understanding of the anatomical basis for these blocks might help to understand if this is likely to be a reproducible and generalisable finding. In the meantime, we should not forget the simple paradigm of regional anaesthesia: "put the right dose of the right drug in the right place" [28] and, where possible perhaps not return to a "hit and miss" approach to regional anaesthesia. Our patients expect excellent perioperative pain therapy with minimal side effects – this is one of the most important parts of our job.

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