Point-of-Care ultrasound (POCUS) has due to the portability, simplicity and excellent image quality of modern ultrasound equipment become a highly relevant skill for all anesthesiologists to better evaluate patients in the perioperative period and help diagnose and manage relevant complications.

The presentation will demonstrate how ultrasound can be used to answer relevant focused questions about the lungs necessary for critical decision-making in the perioperative setting.

### ADVANTAGES AND LIMITATIONS

In the last two decades high resolution ultrasound (HRU) revolutionised our approach to regional anaesthesia and interventional pain management. Author of this manuscript has witnessed and actively taken part in development, clinical assessment, and teaching of new ultrasound guided techniques.

Ultrasound guided procedures have their strengths and weaknesses and in this narrative review author critically looks specifically at spinal procedures which were originally performed under fluoroscopy guidance.

Introducing ultrasound to daily pain practice has unquestionable benefits: portability of device, cost effectiveness in regards of system purchase and maintaining, no need of an assistant/radiographer, and avoidance of radiation.

The main questions to answer however are:
1. Is it doable and easier under US guidance?
2. Is it safer under US guidance?
3. Is it more precise under US guidance?

### Abstract SP34 Figure 1

Demonstrates longitudinal scan in patient’s lateral position. Red circle depicts vertebral artery cranially. Yellow lines highlight facet joints, asterixis show MB position including TON on top of C2-C3 joint. Yellow arrows simulate needle direction out of plane

Scanning longitudinally from cranial to caudal starting with C2–3 facet joint which has characteristic appearance identified by the presence of a steep step at its upper border, indicating the lamina of C2 and third occipital nerve (TON) crossing over the joint. Following ‘hills’ (joints) and ‘valleys’ (waist of articular pillars with medial branches), from cranial to caudal one reaches superior articular process of C7 with C7 MB crossing over.

It is simple and elegant technique suitable for diagnostic block but less so for radiofrequency denervation as needle/electrode is perpendicular to the course of the nerve. Newer electrodes such as ‘trident’ and ‘venom’ may allow for OOP approach in experience hands.

Finlayson et al described in plane technique from posterior approach visualising the whole needle trajectory through posterior neck muscles and resting safe on the articular pillar.\(^1\)\(^,\)\(^6\)\(^,\)\(^7\). One can assess structures cranial and caudal from the needle as well as in the front identifying posterior tubercle, nerve root and vessels prompting needle reposition. Precise electrode position close to articular pillar and along the medial branch could make it very safe technique, suitable for radiofrequency ablation with good outcome.

There is a drawback of this technique requiring constant checking of the cervical level often requiring longitudinal scan as described previously.

For safety, accuracy, precision and time efficiency at St George’s University Hospital Chronic Pain Service (author’s institution), combined fluoroscopy- ultrasound technique has been introduced and widely taught.\(^7\)\(^,\)\(^8\). Since 2012 we performed more than 500 CMB blocks and CMB RF\(^6\)\(^,\)\(^9\).

For patient in prone position, fluoroscopy helps to define the desired level and initial direction of the needle to achieve ‘tunnel vision’ and further progress to the upper middle part of articular pillar (Fig 2 a). Ultrasound helps to confirm the final needle position, parallel to the medial branch close to the articular pillar. Surrounding neurovascular structures such as the vertebral artery, radicular artery and the anterior nerve root can be identified before proceeding to perform a thermal lesion as illustrated in Figure 2 c. The needle position is verified in both longitudinal and transverse scan.

**Cervical Roots** Cervical peri radicular injections or selective nerve roots blocks (SNRB) have been well established in interventional pain practice. Sufficient evidence exists to support such an intervention in clinical situation of radicular pain as both diagnostic and therapeutic measures. One study demonstrated that more than 70% patients who responded to cervical nerve root block avoided surgical intervention.\(^9\)

**Cervical region with complex anatomy** spinal cord and emerging neural structures, vertebral artery, radicular artery, spinal segmental artery, the ascending cervical artery, deep cervical artery has been potentially vulnerable. More than 100 neurological complications involving brain or spinal cord infarction have been reported. It has become an established practice to
avoid particulate steroids at least in the cervical region as intraarterial injection of aforementioned may lead to fatality. Direct needle trauma could be another common cause of complications and in author’s humble opinion fluoroscopy guided intervention lacks the safety with no appreciation of the surrounding structures chiefly nerves and vessels. Ultrasound is not an ultimate solution, and it may lead to image misinterpretation and wrong needle position but potentially makes it less likely.

Figures 3 and 4 demonstrate both ultrasound and fluoroscopy imaging for the most performed C6 and C7 nerve root both following characteristic pattern of recognition.

The other safety measure advocated by the author of this review is applying injection pressure monitoring to avoid pressure higher than 15 psi as a detection of intraneural needle positioning. Too vigorous injection may also increase injection pressure resulting in untoward spread. Finally, motor response at low current 0.2–0.3 mA indicates needle-nerve contact and should be avoided.

The discussion may spark about terminology of transforaminal and extraforaminal needle position. Intra foraminal nerve course varies between 6–8mm. Ultrasound guided injection are extraforaminal as needle does not advance beyond the point where it cannot be seen. This is paramount for safety of ultrasound guided interventions. To author’s knowledge there is no data comparing the clinical outcome of both techniques. From author’s own data there is more than sufficient dye spread along nerve root with extraforaminal injection and further needle advancement into tight foramen may bring the risk of vascular or neural damage including spinal cord injury as presented in figure 5.

Thoracic Spine
Thoracic spine and surrounding structures are amenable for US guided interventions, the most advanced being thoracic nerve root, epidural injections, paravertebral block. The least erector spinae plane block with its various descriptions and outcomes. Ventral ramus (intercostal nerves)
and dorsal ramus giving off medial and lateral branch are frequent targets along with costotransverse ligaments being common pain triggers.

Chronic pain interventions are often diagnostic, searching for the source of pain and ultrasound helps to identify anatomical topography.

In the middle: transverse probe position at the level of paravertebral space limited posteriorly by superior transverse ligament. At the bottom sagittal paramedian probe position at the level of paravertebral space. The latest often leads to too lateral probe position and in fact intercostal nerve block.

Following the golden rule of not advancing the needle beyond the point of visibility, the combination with fluoroscopy and assessment of contrast spread seems like a good practice.

One will find difficult to identify exact thoracic level with ultrasound only - fluoroscopy can be of a great help here.

**Lumbar Spine** Pain procedures at the lumbar level has been traditionally performed under fluoroscopy guidance. The most common interventions include facet joints, medial branch blocks, transforaminal epidural (selective nerve root block, SNRB) together with lumbar sympathectomy and superior hypogastric plexus block.

Greher et al described ultrasound guided approach to MB and facet joints. They are perfectly doable techniques but have a few practical limitations.

US image greatly depends on patient BMI and spine degeneration. Spinal level determination requires probe to be reposition with significant force applied on transducer making it physically demanding exercise. For SNRB, although foramen with exiting nerve can often be visualised, resolution at the given depth (7–8 cm) is poor and benefit of US is lost.

Surprisingly for lumbar sympathectomy at the L2 and L3 level and superior hypogastric plexus US has proved to be of great help in guiding needle at the right angle and maintaining visualisation all the way to antero-lateral surface of vertebral body.

**Sacrum** Sacrum lies more superficial and is more amenable for ultrasound guided procedures. There are characteristic bony landmarks which allow to follow the pattern of recognition.
TRANSITIONAL PAIN AND PREVENTION OF PAIN CHRONIFICATION

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Introduction Persistent pain after surgery is common and may even progress to a chronic pain condition i.e. chronic postsurgical pain, CPSP. Any chronic pain condition decreases the quality of life because pain impairs functional status and causes psychologic distress. Furthermore, psycho-social problems, sleep disturbances often are associated to pain and to persistent analgesic drugs intake either pain killers or psycho-tropic medicines. For the aforementioned reasons, the WHO in collaboration with the IASP has sought to include chronic pain in the new international classification of diseases i.e. ICD-11. Among the common chronic pain conditions, chronic post-surgical pain (CPSP) and chronic post-traumatic pain have deserved their own classification as a formal recognition of the existing problem. Being included in the ICD-11 will CPSP visibility as an important socio-economic problem which deserves collaborative efforts of prevention.

REFERENCES


In summary

Introduction of the ultrasound into contemporary pain practice in the last 20 years has broadened our knowledge and understanding of many pain syndromes and has improved the management, precision, safety, and outcome of our interventions. Some procedures can be office based therefore reducing the cost, while others remain under fluoroscopy as a golden standard. Initial trend aimed at comparison of ‘new’ ultrasound guided procedures to ‘old’ fluoroscopy guided, lately embraced progressively musculoskeletal ultrasound in search of diagnosis and treatment.

Both fluoroscopy and ultrasound have their strengths and weaknesses therefore combined, hybrid techniques, especially for higher risk spinal procedures seems to be a logical choice as highlighted in each subsection.

Time will show how interventional pain practice will develop in the next 20 years.