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Editorial
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Ultrasound-guided central neuraxial blocks: breaking barriers to greater adoption

Iskandar **Khalid**[1], Shahridan **Mohd Fathil**[2], Manoj Kumar **Karmakar**[3]

[1]Department of Anaesthesiology and Intensive Care, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia; [2]Department of Anaesthesia, Gleneagles Hospital Medini Johor, Malaysia; [3]Department of Anaesthesia and Intensive Care, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong

Abstract

Central neuraxial blocks (CNB) remain a cornerstone of modern anaesthesia, yet traditional landmark-based techniques carry inherent limitations in accuracy and safety. Ultrasound-guided CNB has emerged as a transformative technique, offering improved first-pass success, shorter procedure times, fewer needle passes, and decreased incidence of complications such as inadvertent dural puncture and paraesthesia. Despite compelling evidence supporting these advantages, global adoption of ultrasound-guided CNB remains limited. Surveys across North America, Europe, and Asia consistently reveal underutilisation, suggesting significant barriers to implementation. This editorial explores the multifactorial impediments to wider ultrasound-guided CNB adoption, including logistical issues such as cost and equipment access, workflow disruptions in high-volume settings, the complexity of spinal sonoanatomy, and a steep learning curve requiring structured training. Cultural resistance to change and inadequate institutional support further hinder progress. Drawing from change management models, we propose strategies to overcome individual and systemic inertia. The proliferation of portable ultrasound devices and training dissemination by younger, ultrasound-proficient practitioners are expected to drive change. Ultimately, formal certification pathways and sustained advocacy will be essential to achieving mainstream adoption of ultrasound-guided CNB.

Correspondence: Dr. Iskandar Bin Khalid, Department of Anaesthesiology and Intensive Care, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, Cheras, 56000, Kuala Lumpur, Malaysia.
E-mail: iskandar.hctm@ukm.edu.my

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Introduction

Central neuraxial blocks (CNB), encompassing spinal and epidural anaesthesia and analgesia remain a fundamental component of modern anaesthetic practice. While traditional landmark-based approaches to CNB have enjoyed long-standing acceptance, the integration of ultrasound guidance (USG) to CNB represents a paradigm shift towards greater precision and safety.[1,2] USG CNB can be performed either as a preprocedural scan (often termed ultrasound-assisted CNB, UA CNB) to preview neuraxial anatomy and outline the optimal needle insertion site, depth, and trajectory, or as real-time USG during needle insertion.[1] The use of UA CNB has been shown in randomised trials and meta-analyses to increase first-attempt success rates, decrease procedure time, and reduce the number of needle passes when compared to landmark-based approaches.[3-6] The rate of spinal- and epidural-related complications, including inadvertent dural puncture, paraesthesia, and epidural hematoma, frequently associated with a greater number of needling attempts, may also be reduced with UA CNB, underscoring its potential to significantly enhance patient safety.[4,7,8] Additionally, 2 systematic reviews, performed in a general surgical and obstetric population, respectively, have demonstrated the advantage of UA CNB in increasing first-pass success rate when a difficult CNB was anticipated compared to a landmark technique.[9,10] The latter review also revealed that UA CNB decreased the incidence of a "bloody tap" as well as postpartum back pain and headache. Furthermore, patients report greater satisfaction with UA CNB, which is expected when neuraxial procedures are completed more quickly and successfully, avoiding the need for repeated needle punctures, and ultimately leading to timely pain relief or effective anaesthesia.[5]

Real-time USG has also been shown to be a feasible approach to CNB, with some evidence indicating improved first-pass success rate compared to the landmark technique.[5,11,12] Conversely, there are also data demonstrating that real-time USG when compared to UA CNB results in a lower rate of first-attempt or first-pass success during spinal injections in the elderly.[13] The number of needle passes required is also greater, procedure time is longer, and patients report poorer satisfaction with real-time USG. Furthermore, operators rate the real-time USG CNB to be technically more difficult than the standard landmark-based approach. These findings should be interpreted with caution, since no well-defined learning curve for real-time USG CNB has been established, and the success of this advanced technique likely depends heavily on the operator's experience and training.

Nevertheless, despite the growing body of evidence supporting its clinical advantages, adoption of USG CNB has been lukewarm at best. A 2022 survey of anaesthetists on the use of ultrasound for CNB on parturients found that only 9.8% of respondents were confident in their ability to perform USG despite 93.0% acknowledging that ultrasound decreases number of attempts and improves identification of the vertebral level.[14] Moreover, surveys from various countries have consistently shown that ultrasound has not yet become routine, nor commonplace, for performance of CNB. Despite a 2008 National Institute for Health and Care Excellence (NICE) guidance supporting the role of ultrasound in epidural space catheterization, a survey performed in the same year found more than 90% of United Kingdom (UK) anaesthesiologists had never used USG CNB, while another UK survey in 2015 revealed that only 1 in 5 obstetric anaesthesia units utilized USG CNB for labour pain or caesarean sections.[15,16] In North America, findings from surveys mirror the low utilisation of USG CNB observed in Europe. A 2019 survey of anaesthesiologists in Ontario, Canada, found that although 68% used ultrasound on a "regular" basis in their general practice and 89% used ultrasound "always" or "frequently" for central venous catheterization (CVC), 85% "seldom or never" used USG CNB, and 0% reported using USG CNB on a routine basis.[17] This was despite the majority of respondents having access to ultrasound machines and being aware of its benefits in CNB. USG CNB has also seen slow, incremental uptake in Asia. Although Malaysian data remains elusive, a recent survey of anaesthesiology residents in India showed that the vast majority had yet to embrace USG CNB; when faced with a difficult spinal or epidural, 85% of respondents said they would rather proceed with general anaesthesia than re-attempt the CNB under USG.[18] This survey reveals that even among a newer generation of practitioners, reliance on landmark-based CNB remains the norm and USG is often seen as a last resort. In short, current evidence suggests that a significant proportion of anaesthesia providers worldwide appear to rarely use USG CNB or have never used it at all. This stands in stark contrast to the near-universal adoption of ultrasound for other procedures such as CVC insertion and peripheral nerve blocks (PNB).

Barriers to adoption of USG CNB

The benefits of USG CNB are clear, yet several barriers have emerged to slow its widespread adoption. Cost and resource limitations are often cited as the initial hurdle in many healthcare settings. At the very least, provision of USG CNB requires an ultrasound machine with a low-frequency curvilinear probe suitable for spinal imaging.[19] Additionally, though minor in comparison to the capital investment, there are running costs of device maintenance, ultrasound gel replenishment, and sterile ultrasound-probe covers to be factored in. Nevertheless, anaesthesiology provider access to ultrasound machines have increased significantly over the past decade, in concert with increased portability and affordability of these machines and a greater awareness on their importance among stakeholders.[20] While an ultrasound

machine dedicated for CNB alone may not seem a sound investment, the skyrocketing utility of ultrasound for other purposes related to anaesthesia and critical care, *i.e.*, PNB, vascular access, and point-of-care ultrasonography implies that a single platform suited to perform these various tasks will likely offer an expedited return of investment.[21]

An often-cited barrier to routine or greater use of USG CNB when a difficult spinal or epidural is not expected are concerns about time and workflow pressures, *i.e.*, the increased time required to perform the neuraxial procedure, especially in high-volume settings.[22] Proponents to this viewpoint argue that in a busy operating theatre environment, routine addition of USG will lead to an "unnecessary" use of precious time for extra setup and scanning. However, systematic reviews and meta-analyses comparing conventional landmark palpation and UA have found no difference in total time taken to perform the CNB.[9,10] As the individual practitioner's proficiency improves and the team gains familiarity with the technique, USG may potentially lead to a decrease in time taken to perform the block. In the interim, fears regarding a potential increase in operating room time with wider application of USG CNB can be resolved by introduction of a parallel processing "block room" model, which has been shown in a systematic review to decrease anaesthesia-controlled time, turnover time, and post-anaesthesia care unit length of stay, in addition to potentially increasing daily operating room throughput by 1.7 cases per day.[23] Performance of USG regional anaesthesia in a dedicated block room also facilitates and concentrates training opportunities in a more conducive environment without the pressures of the main operating room.[24] Cultural resistance, *i.e.*, the need to convince all stakeholders (namely surgeons, support staff, and administrators) of the benefits of adopting USG CNB represents a more intangible challenge. Nevertheless, similar obstacles were encountered and overcome with greater application of USG PNB.[25] Value-based healthcare, defined as "the equitable, sustainable and transparent use of the available resources to achieve better outcomes and experiences for every person", has become an increasingly popular subject and metric.[26] Over time, the demonstrable clinical and institutional benefits of USG PNB, such as improved pain outcomes, fewer complications, and enhanced recovery, have largely won over sceptics. With sustained advocacy, it will be a question of "when" rather than "if" a similar perception towards USG CNB develops in the future.

Another significant barrier is the steep learning curve associated with mastering spinal sonoanatomy. Due to the spine's bony structures, sonographic visualisation is more complex compared to PNB, necessitating specialised training and experience in recognising subtle anatomical details.[27] Structured educational programs have emerged as essential for overcoming these barriers. The American Society of Regional Anesthesia and Pain Medicine (ASRA) and the European Society of Regional Anaesthesia and Pain Therapy recommend standardised training curricula that integrate simulation-based training, supervised clinical practice, and competency

assessments.[26,28] Studies employing cumulative sum analyses indicate significant variability among trainees in achieving proficiency in USG CNB, underscoring the individualised nature of learning this technique and highlighting the need for tailored, comprehensive training programs with expert mentorship, simulation exercises, and repeated hands-on experience.[26] Simulation-based training has emerged as an essential component of competency-based education, mainly due to high complication rates, an increasingly litigious society, and suboptimal traditional training methods.[29] Use of a virtual spine model in teaching neuraxial anatomy and sonoanatomy has been shown to improve anaesthesia trainee test scores after just 1 hour of self-study with the model.[30]

A commonly overlooked, yet important barrier to greater adoption of USG CNB is simply individual resistance to change in practice, even in the face of compelling evidence. Introduction of change requires an understanding of how the process of change occurs, which is well-described from an organisational viewpoint by Kurt Lewin's "Change Management Model".[31] This 3-stage model, which uses a block of ice as an analogy, begins with the process of "Unfreezing", which involves challenging the status quo and preparing stakeholders to accept that a change is necessary. The next step, "Change", marks the implementation of new processes, whilst understanding that adaptation occurs at a varying pace and with different consequences across individuals. "Refreeze", the final phase of the model, describes how the change in behaviour or practice is solidified and accepted as the new norm. Rampersad *et al.* described 3 ways in which those affected by a potential major change may respond; "early adopters", who do not require much convincing and can play an important role in a team promoting the change; "safe followers", who will be initially hesitant towards change until they are certain that it is a safe thing to do; and "outliers", who either tend to resist the proposed change, remain sceptical, or are well entrenched in their old pattern of practice or behaviour.[32] Strategies to overcome resistance and outliers include gradual implementation of the change one step at a time, involvement of those affected in development and feedback, emphasising the ease and benefit of the new processes, as well as use of coaching instead of punishment as a motivational tool. Effective change management is a crucial step towards increased acceptance of USG CNB, and success hinges on leadership, inclusive team strategies, and addressing human behaviours empathetically.

The Malaysian perspective and future directions

Despite these challenges, the prospect of greater adoption of USG CNB in Malaysia appears positive. Guidelines and protocols have already been developed by the Malaysian anaesthesia community to promote and ensure the safe and effective use of ultrasound. Notably, the Malaysian Society of Anaesthesiologists (MSA) and College of Anaesthesiologists (COA) have published key documents, including the Recommendations for Peripheral Nerve Blocks (2019) and Recommendations for

Ultrasound-Guided Vascular Access (2022), which aim to guide and standardise practice in these domains.[33,34] A nationally-endorsed guideline on USG CNB will serve a similar purpose to promote the acceptance and utilisation of neuraxial ultrasound among the anaesthesia fraternity as well as the healthcare system as a whole. The importance of such a guideline cannot be understated, as full integration of ultrasonography into anaesthesia training and practice appears to be the likely trajectory when looking ahead.[35] Ultrasound has been increasingly incorporated into our anaesthesia curriculum, with many recent graduates already proficient in its use; thus, the critical mass needed for widespread adoption of USG CNB could already be present. Seeing that these younger anaesthesiologists will disseminate among the district and secondary hospitals throughout Malaysia, we can expect increased adoption of USG techniques as teaching and training diffuses, and portable ultrasound machines become more affordable and accessible. To formally recognise competency, increased access to certification in ultrasound techniques (including USG CNB) by national specialist training bodies will represent the next natural and necessary step towards greater adoption.

Conclusion

In conclusion, the use of ultrasound by anaesthesiologists has evolved remarkably over recent years: from early adoption among a small group of enthusiasts and in a handful of centres to broad utilisation of USG in PNB, vascular access, and other novel applications across public and private hospitals at present. USG CNB represents the next leap forward in terms of improved procedural success, superior analgesia, and enhanced patient safety. Barriers to greater adoption and challenges such as resource limitations, training gaps as well as individual and institutional resistance to change need to be actively addressed, which will result in steady increase in proficiency and application among practitioners as well as demand among patients and healthcare systems. As technology and training continue to advance, anaesthesiologists are well-positioned to fully harness the power of ultrasound in their practice, ultimately leading to better outcomes and experiences for the patients under their care.

Declarations

Ethics approval and consent to participate
Not required as this is an editorial.

Competing interests
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