EDITORIAL

The Expanding Role of Ultrasound in Pain: A Paradigm Shift from Diagnosis to Treatment

Tolga Ergönenç

DOI:https://doi.org/10.62848/bjpain.v5i1.1576

Received: 12 May 2025
Accepted: 11 June 2025

The last twenty years have brought significant progress to pain management through ultrasound technology, which now serves as a tool that connects patient assessment to therapeutic interventions. Academic studies on ultrasound demonstrate that this development creates a new tool for pain management. Healthcare providers with limited budgets need to utilize affordable diagnostic and therapeutic solutions for pain management to operate effectively.

The first use of musculoskeletal ultrasound (MSKUS) in pain management occurred in 1977 when Mayer[1] showed ultrasound images of rotator cuff injuries at the American Institute of Ultrasound in Medicine convention. The development of transducer technology since then has led to a transformation in our ability to view superficial structures with unmatched precision. The resolution of modern high-frequency transducers operating above 15 MHz reaches two hundred micrometers, which exceeds the capabilities of standard Magnetic Resonance Imaging (MRI) for imaging superficial tissues[2]. The advancement of technology has evolved ultrasound from its fundamental diagnostic role into a comprehensive system that performs interventional procedures.

The advantage of ultrasound in pain medicine stems from its unique combination of advantages that no other imaging modality can match. The real-time imaging capabilities of ultrasound distinguish it from static imaging methods, including MRI and Computed Tomography (CT), because they provide dynamic examination possibilities. Ultrasound, as a dynamic modality, enables the diagnosis of pathologies that emerge when patients move. The procedure of ultrasonography provides non-invasive safety and speed, along with broad availability and no recorded adverse effects or treatment restrictions. The ability to perform bilateral imaging allows for direct comparison of the affected side with the unaffected side, which provides essential diagnostic information for better clinical choices[3]. The healthcare systems of developing countries achieve significant economic benefits through their adoption of ultrasound technology. The development of smartphone-compatible transducers allows remote and resource-limited areas to access this technology through their ultraportable design.

The use of ultrasound in pain management depends on the operator's skills, which require extensive training and practice to achieve proficiency. Sonoanatomy demands special learning methods because practitioners need

Associate Professor
Republic of Turkey Ministry of Health Akyazý Hospital
Anesthesiology and Reanimation, Traditional and Complementary Medicine Unit

Correspondence
Tolga Ergönenç
Email: tolgaergonenc@gmail.com
ORCID: 0000-0002-4325-695X

to acquire fresh skills and methods that differ from standard anatomical education. Doctors face their most challenging experience during MSKUS education when they need to move from interpreting two-dimensional ultrasound images to understanding three-dimensional anatomy.

Ultrasound also has limitations, including reduced resolution at deeper operating depths, and it cannot penetrate through bone structures, resulting in restricted viewing capabilities. The quality of images decreases due to patient-dependent factors, such as obesity[4].

The clinical applications of ultrasound in pain medicine continue to experience an ongoing increase throughout all major joint systems, despite these restrictions. The diagnostic tool of choice for shoulder pathology includes ultrasound because it shows 92% sensitivity and 95% specificity for detecting full-thickness rotator cuff tears[5]. The technology provides better evaluation of calcifications than MRI, which makes it essential for diagnosing and treating calcific tendinopathies. The dynamic examination capabilities of real-time assessment enable doctors to diagnose impingement syndromes and frozen shoulder through diagnostic information that static imaging methods cannot detect.

The ultrasound technology provides assessment capabilities for the entire musculoskeletal system while also evaluating the shoulder region. The elbow joint allows for the early detection of epicondylitis, triceps tendinitis, and olecranon bursitis, and precise identification of septic versus aseptic joint infections[6]. The ultrasonography of the wrist and hand includes the diagnosis and treatment of De Quervain's tenosynovitis and carpal tunnel syndrome, with the unique advantage of performing therapeutic interventions during the same visit as diagnosis. The hip joint ultrasound enables the identification of effusion and synovitis at their initial stages, facilitating the diagnosis of septic arthritis through ultrasound-guided aspiration[7].

Ultrasound is an essential radiologic modality for assessing the knee joint because dynamic testing with stress evaluation reveals meniscal injuries and joint instability, which static imaging methods often fail to detect. The diagnostic ability of ultrasound surpasses conventional radiographic imaging because it can detect osteoarthritis symptoms before radiographs show any changes[8]. MSKUS enables complete evaluation of ankle and foot structures to diagnose tendon and ligament pathological changes, including the Achilles tendon, while allowing immediate treatment during the examination.

The main revolutionary feature of ultrasound technology lies in its ability to perform both diagnostic procedures and therapeutic interventions during a single clinical appointment. Ultrasound guidance has revolutionized interventional pain management by enhancing the accuracy and safety of procedures, ranging from simple corticosteroid injections to complex radiofrequency ablations. Ultrasound provides real-time visualization of target structures and needle placement, leading to improved treatment delivery and decreased procedural complications.

Healthcare providers operating in developing nations must consider the core worth of ultrasound technology because it delivers sophisticated imaging solutions that work without MRI or CT equipment. The portable nature and affordable price of ultrasound technology enable its use for providing specialist care to underserved communities, which could transform rural and remote pain management services.

The future of ultrasound technology in pain management will continue to progress toward achieving full integration. The adaptation of artificial intelligence technology in ultrasound solves the operator dependency issues by utilizing automated image interpretation and guidance systems. Virtual reality and augmented reality applications in enhanced training platforms demonstrate the ability to accelerate learning speed and improve skill acquisition. The diagnostic capabilities of the modality are further expanded through the development of contrast-enhanced ultrasound techniques and elastography applications.

Educational institutions need to create a strategic plan with implementation teams to introduce new technology successfully. Healthcare organizations need to establish complete training systems that deliver practical experience together with theoretical

education. The maintenance of current skills and acquisition of new ones for practitioners requires participation in workshops and online resources for continuing education. The medical education system needs to require ultrasound training for pain management because it will provide doctors with the necessary skills for their practice.

The delivery of high-quality patient care requires standardized training protocols and competency evaluation systems, and quality measurement tools for ultrasound in pain medicine. Professional certification programs will support the establishment and preservation of standards of excellence in ultrasound pain management.

The implementation of ultrasound technology in pain medicine leads to a total transformation of healthcare delivery, as it establishes an efficient and accessible system for integrated pain management. Ultrasound is a crucial tool for modern pain management, as it provides both diagnostic assessments and treatment, with significant economic benefits. Even though healthcare providers face ongoing training and implementation challenges, they can deliver substantial benefits for patient care and system operational efficiency through the use of ultrasound.

Healthcare providers in developing countries, with their limited resources, can utilize ultrasound technology to enhance pain management delivery while maximizing their available resources. The technology provides excellent portability and safety features, and affordable costs, which make it an ideal solution to deliver specialist care to populations who lack access to healthcare services. The program needs continuous support for educational programs, training sessions, and quality control systems to achieve its success.

The future of ultrasound in pain management will depend on adopting new technologies that improve both diagnostic accuracy and treatment effectiveness. The implementation of ultrasound will become essential for our mission to treat pain and improve patients' quality of life as we develop new skills and broaden its applications in pain management.

References

1. Mayer V. Ultrasonography of the rotator cuff. J Ultrasound Med. 1985; 4: 607-608.
2. Erickson J. High-resolution imaging of the musculoskeletal system. Radiology. 1997; 205: 593–618.
3. McNally Eugene. Practical Musculoskeletal Ultrasound. 2nd ed. Churchill Livingston, USA: Elsevier; 2014.
4. Narouze SN. Ultrasound-Guided Interventional Procedures in Pain Management. Reg Anesth Pain Med. 2010; 35 (Suppl 1): S55-S58.
5. Drakeford MK, Quinn MJ, Simpson SL. et al. A comparative study of ultrasonography and arthrography in evaluation of the rotator cuff. Clin Orthop Relat Res 1990; 118-122.
6. Levin D, Nazarian LN, Miller TT. et al. Lateral epicondylitis of the elbow: US findings. Radiology 2005; 237: 230-234.
7. Givon U, Liberman B, Schindler A. et al. Treatment of septic arthritis of the hip joint by repeated ultrasound-guided aspirations. J Pediatr Orthop 2004; 24: 266-270.
8. Kane D, Balint PV, and Sturrock RD. Ultrasonography is superior to clinical examination in the detection and localization of knee joint effusion in rheumatoid arthritis. J Rheumatol 2003; 30: 966–971.