



REVIEW ARTICLE

# Diagnostic ultrasound use in physiotherapy, emergency medicine, and anaesthesiology

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## KEYWORDS

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**Abstract** *Background:* Diagnostic ultrasound is traditionally and extensively used within the radiology department. However in recent years its use has expanded outside this traditional area into health professions such as physiotherapy, emergency medicine and anaesthesiology. *Purpose:* The radiology community needs to be aware of the expansion of use of diagnostic ultrasound. This article starts this exploration in the health professions mentioned, however it is acknowledged that diagnostic ultrasound use goes beyond what is covered in this article. As diagnostic ultrasound is a user dependant modality and the outcome of an examination is largely influenced by the skill and experience of the operator,<sup>1</sup> the radiology community should take a guiding role in its use, training and protocol development for health professionals. *Method:* This article explores the literature on the use of diagnostic ultrasound within physiotherapy, emergency medicine and anaesthesiology. Literature was searched for on the databases Medline, Cinahl and Embase. *Results:* Diagnostic ultrasound is being used in health professions such as physiotherapy, where it is being used to provide biofeedback to patients on contraction of abdominal and pelvic floor muscles; emergency medicine, for the investigation of free fluid within the abdomen of a trauma patient and anaesthesiology, for the placement of catheters and nerve blocks. *Conclusion:* As members of the radiology community are considered experts in the field, they need to take the lead to guide and mentor the other health professionals who are now using the modality. To be able to achieve this they must have an understanding of what these professions are using the modality for.

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## Introduction

Diagnostic ultrasound has been traditionally used by radiologists and sonographers within radiology departments as a diagnostic tool for many years. However, over recent years ultrasound imaging has been used by health professionals outside the traditional radiology department.<sup>1,2</sup> Siegel<sup>3</sup> attributes the widespread use and acceptance of ultrasound as an imaging technique to be due to the limited bioeffects of the modality. There are currently no restrictions on who can purchase and use a machine and there are an unknown number of users who do not have any connection with ultrasound societies or their registration bodies.<sup>4</sup> Diagnostic ultrasound does however fall within the scope of practice for emergency medicine and anaesthesiology.

Continued clinical training is required to build user confidence.<sup>1</sup> Users must be able to acquire high quality images and then distinguish normal from abnormal. For this they must have knowledge of the mechanics and physics of the ultrasound machine, good hand – eye coordination and a thorough understanding of anatomy.<sup>5</sup> Ability to use diagnostic ultrasound “is often defined by the number of procedures a resident has performed with little or no regard for the performance itself”.<sup>5(p. 886)</sup>

The Royal College of Radiologists in the UK give advice on ultrasound training stating that “operators are ethically and legally vulnerable if they have not been adequately trained, or use inappropriate equipment”.<sup>6(p. 416)</sup> Cost of equipment and time in training appear to be the two main constraints on diagnostic ultrasound becoming mainstream within all physiotherapy, emergency medicine and anaesthesiology departments.<sup>6</sup>

## Physiotherapy and diagnostic ultrasound

Physiotherapists have used therapeutic ultrasound, mostly to aid repair of soft tissue sporting injuries, for longer than diagnostic ultrasound has been used. They are now branching into diagnostic ultrasound particularly as a means of providing biofeedback to both the therapist and the patient particularly for rehabilitation and the feedback of a task being mastered by the patient. It is important that physiotherapists receive education and training in this modality and most physiotherapists are aware that successful training requires guidance from experts in the field and constant practice.<sup>7</sup> This is where the radiology community has an important role and needs to step in to the void and take charge of training and guidance for this profession. Physiotherapists must always be aware of limitations in their experience and competence when using the modality. For physiotherapists the “advantages of ultrasound include its non-invasiveness, portability, relative inexpensiveness, lack of ionising radiation and its ability to be repeated as often as necessary making it particularly useful for the monitoring of treatment”.<sup>8(p. 641)</sup> The other advantage is that it can be used with the patient in any position, which allows for patient movement and assessment of muscle function in positions such as lying or standing. For physiotherapists the investment in equipment and training is costly, but as it is used more within the field

for biofeedback, the benefits will expand and research in the field by physiotherapists will also increase. Diagnostic ultrasound is a benefit to the physiotherapy profession as well as the patient.<sup>9–12</sup>

The start of diagnostic ultrasound use among physiotherapists has been attributed to “the work of Dr Archie Young and colleagues at the University of Oxford in the 1980s”.<sup>13(p. 434)</sup> Physiotherapists use diagnostic ultrasound mostly for biofeedback looking for such things as changes in associated structures such as the bladder base, tissue deformation and movement; it can however also be used to assess muscle structure and behaviour and perform measurements of muscle thickness and bulk.<sup>13</sup> It is used to evaluate muscles, related soft tissues and function during exercise and physical tasks. It has also been found useful in improving neuromuscular function by assisting the application of therapeutic interventions in patients for rehabilitation.<sup>13</sup>

Physiotherapy use of diagnostic ultrasound has been defined as an emerging field with physiotherapists using the modality “to assist clients in ‘turning on’ specific muscle groups (visual biofeedback)”.<sup>9(p. 10)</sup> Biofeedback is used as a part of motor re-learning in which a patient learns what is required and how to perform a task. With time and practice, the aim is that gradually the task will become automatic and hopefully beneficial to the patients’ problem. Biofeedback is a teaching tool used to improve outcomes and helps the patient reliably perform the task. It allows for confirmation of a task being learnt and performed. If a task is not being performed correctly this can be detected and modifications made until the biofeedback shows that the task has been mastered. Biofeedback can be sensory and physiotherapists do use palpation and electromyography as an indication of muscle change, however diagnostic ultrasound provides a visual feedback as well as an assessment tool as muscle bulk, patterns of motor activation and thickness measurements can be made which all indicate muscle activation.<sup>9,14,15</sup> Also, “the cross sectional area of a muscle is directly related to its ability to produce force”.<sup>16(p. 10)</sup>

Physiotherapists are using diagnostic ultrasound to give the patient visual feedback on their transversus abdominis and spinal multifidus muscles. These muscles are seen to support and provide segmental stabilisation of the spine and therefore have an important role when treating patients for acute and chronic back pain. With just one episode of acute lower back pain both transversus abdominis and multifidus can stop activating, atrophy or show changes in the timing of activation.<sup>15</sup> Physiotherapists train patients with lower back pain to perform an abdominal drawing in manoeuvre which involves activation of the multifidus and transversus abdominis muscles to stabilise the trunk and decrease symptoms associated with the pain.<sup>15</sup> Studies have investigated the benefits of using diagnostic ultrasound for biofeedback with the multifidus muscle and found that the patients who had the biofeedback showed greater improvement and retained their improvement when compared to a control group.<sup>17</sup> Several studies have shown that diagnostic ultrasound biofeedback is a useful method of assisting patients to learn to contract muscles and can be reliably used in the clinical setting.<sup>15–17</sup> The modality is also good for biofeedback and assessment of the deep muscles of the neck, trunk and pelvis.<sup>16</sup>

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