SENSITIVITY AND SPECIFICITY OF MODERN SCREENING FOR EVALUATION IN MODERN GYNECOLOGIC PATHOLOGY

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Annotation. Diagnostic ultrasound (DUSI) is probably the most common modality used in obstetric practice. From A mode first described by Ian Donald for gynecology in the late 1950s, B mode in the 1970s, real-time and gray scale imaging in the early 1980s, Doppler a little later, sophisticated color Doppler in the 1990s, and 3D/quadruple ultrasound in the 2000s, DUS has not ceased to be closely associated with obstetric practice. The latest innovation is the use of artificial intelligence, which will undoubtedly play an increasing role in all aspects of our lives, including medicine and, in particular, obstetric ultrasound. In addition, new imaging techniques, enhanced training methods, improved workflow and ergonomics may also be developed in the future.

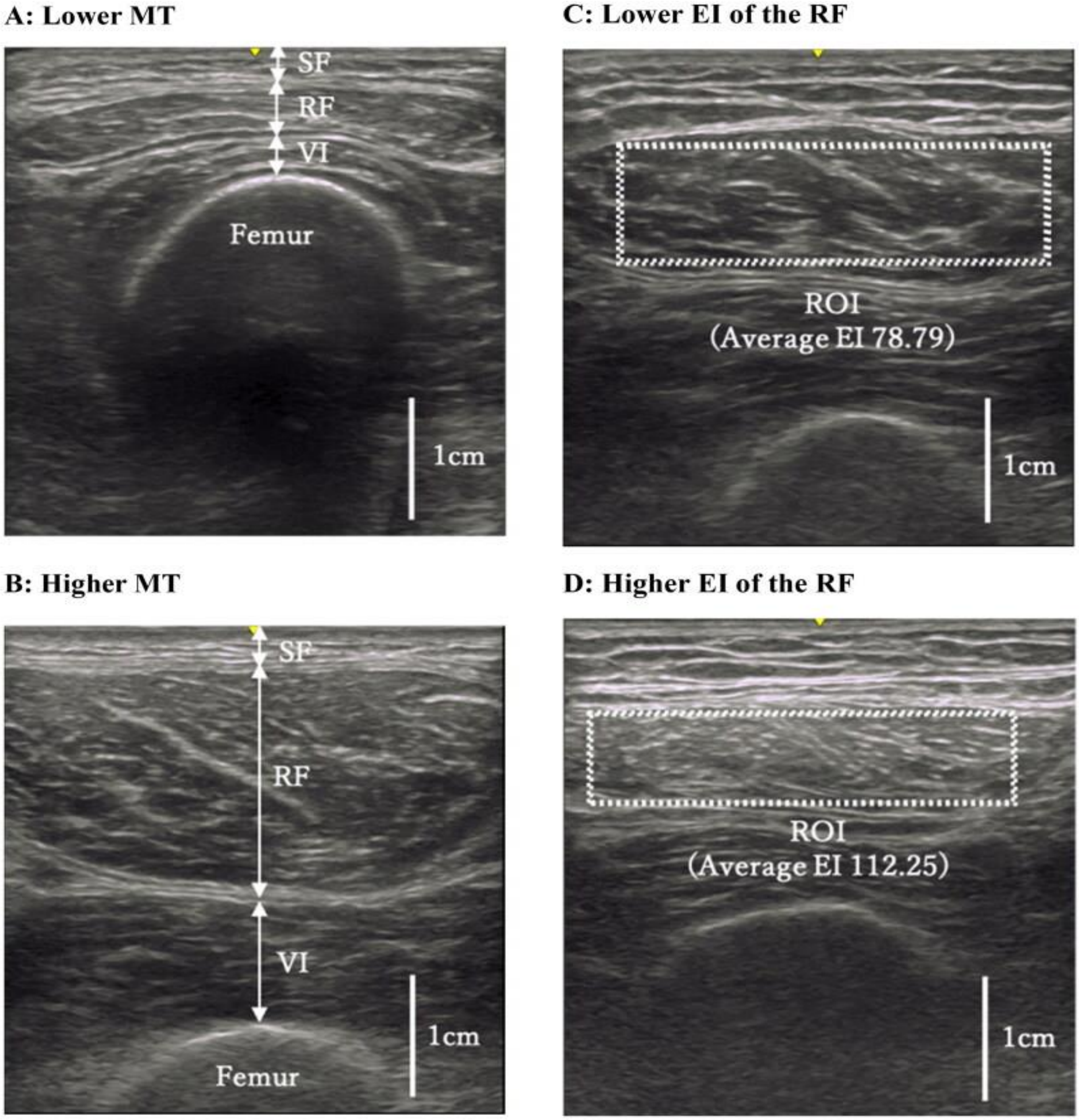
Keywords: Artificial Intelligence, Doppler, obstetrics, training, ultrasound

Ultrasound (US) is a portable and safe imaging technique that uses high-frequency sound waves to visualize structures inside the body. Although most ultrasound examinations are performed outside the body, there is a growing field that utilizes ultrasound devices inside the body during surgery to aid in complex procedures. This review examines the published literature on this technique in benign gynecology and gynecologic oncology. The review shows that the use of intraoperative ultrasound improves visualization and minimizes surgical complications.

Ultrasound is widely used in obstetric practice to detect fetal anomalies in order to provide prenatal opportunities for further evaluation, including genetic testing and discussion of treatment options. In 2010, the International Society for Ultrasound in Obstetrics and Gynecology (ISUOG) published practice guidelines on the minimum and additional requirements for routine mid-trimester ultrasound in pregnancy. Recently, the American Institute of Ultrasound in Medicine (AIUM) suggested a detailed diagnostic scan in the second/third trimester in high-risk pregnancies and fetal echocardiography in high-risk pregnancies. ISUOG has published recent recommendations on the indications and practice of targeted neurosonography. Although the introduction of prenatal cell-free DNA screening for Down syndrome has changed the role of scanning in the first trimester, it should still be offered to women. About 50% of major structural abnormalities can be detected in the first trimester. In addition, a recent study showed that a routine scan at 36 weeks' gestation can detect about 0.5% of previously undetected fetal anomalies as well as fetal growth restriction (FGR).

High-resolution ultrasonography involves the use of a high-frequency transducer as well as image enhancement and signal processing tools, including harmonic imaging (HI), spatial complex imaging (SCI), and speckle reduction imaging (SRI). Compared with the low-frequency band (2-5 MHz) sensor, the high-frequency band (5-9 MHz) sensor can provide higher resolution, albeit with limited tissue penetration. HI, using the physics of nonlinear ultrasound propagation through body tissues, allows for high-resolution imaging with few artifacts. SCI, which combines multiple lines of sight to form a single composite image at real-time frame rates, can reduce angle-dependent artifacts. The use of SCI can reduce speckles or interference resulting from the echo signal that is projected from the ultrasound transducer.

The frequency of detection of fetal anomalies varies according to the anatomical examination protocol, ultrasound equipment and the environment in which the procedure is performed, among other factors [9]. High-resolution ultrasound can facilitate detailed diagnosis and scanning in the first trimester and allow detection of a small or subtle anomaly [10,11,12]. Although detailed diagnostic scanning is not required for all pregnant women,



indications include family history of congenital malformations, maternal age 35 years or older, gestational diabetes mellitus, artificial reproductive technology, body mass index >= 30, teratogenic, fetal occipital translucency >= 3 mm, and many other conditions [2]. Against the backdrop of increasing standards of obstetric ultrasound, there is a need to improve diagnostic capabilities, functional analysis, workflow and ergonomics. Several improvements in ultrasound technology have occurred over the years, including high-resolution ultrasound, linear transducer, radiant flow, three/four-dimensional (3D/4D) ultrasound, speckle tracking of the fetal heart, and artificial intelligence. The purpose of this review is to evaluate the use of these advanced technologies in obstetrics.

Figure 1: Ultrasound images of the quadriceps femoris muscle. (a,b) Thickness of subcutaneous fatty tissue (SF), rectus femoris muscle (RF), and intermediate vastus muscle (IVM) was measured in a position perpendicular to the femur in each image. (c,d) The dotted rectangle indicates the maximum region of interest (ROI) in the RF. All images in Fig.

Ultrasound is a readily available, safe and portable imaging modality that is widely used in gynecology. However, there is limited guidance on its use intraoperatively, especially for complex gynecologic procedures. This review discusses the existing literature published on the use of intraoperative ultrasound (IOUS) in benign gynecology and gynecologic oncology. IOUS can minimize complications and facilitate complex benign gynecologic procedures. It can also be used in oncologic and fertility-sparing surgery. The use of IOUS in gynecologic surgery is an emerging field that improves visualization in the operative field and facilitates minimally invasive techniques.

Ultrasound was originally used in medicine for therapeutic purposes rather than for diagnostic purposes. The effect was achieved by heating and breaking down tissue (This is interesting when you consider that the bioeffects of diagnostic ultrasound are based on two mechanisms: thermal and non-thermal or mechanical, and that modern ultrasound machines display two indices associated with these effects: the thermal index [TI] and the mechanical index [MI]. See "Safety" paragraph below). This was based on laboratory work done in the 1920s by French physicist Paul Langevin, who observed fish dying after being hit by an ultrasonic beam [1], which was later confirmed by Harvey and Loomis [2]. Only later was it discovered that ultrasound allows "visualization" of internal anatomy [3]. Therapeutic applications have been found in various branches of medicine, including gynecology, for example for the treatment of urinary incontinence or ovarian diseases [4]. Although it is beyond the scope of this article to review the details of this huge and booming branch of science, we will describe a few principles. In medicine, the idea is that vast amounts of information ("big data") combined with machine learning can create algorithms that perform as well, if not better and much faster than human doctors [10]. The inspiration was the human brain, hence the designation artificial neural networks and machine learning, where a computer automatically recognizes patterns based on the input of vast amounts of information bits, such as "perfect" ultrasound images of fetal anatomy. The computer can then perform automatic measurements such as fetal biometry [6]. In devices from several manufacturers, automatic image recognition is already used to measure fetal BPD, head circumference (HC), abdominal circumference, and femur length. For example, automatic estimation after deep learning achieved 91.43% and 100% success rates for HC and BPD estimation, respectively, with an accuracy of 87.14% for plane acceptance verification.

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