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A New Clinical Spectrum in Ultrasound: Opportunities Expand for Radiology

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Ultrasound (US) has a long history within medicine since 1798, when Spallanzani suggested that bats move using their ears. With a mean annual growth rate of 8% in recent years, it has since metamorphosed into lucrative business. For example, a 2007 survey conducted in France, showed that US is the second greatest of imaging expenses for private radiology with a rate of 31.8%, just behind CR/DR (38.8%) but far ahead of CT (12.2%), MRI (9.4%) and nuclear medicine (4.5%) for a total of 2,986 million euros. Furthermore, the global US market represented an income level for industry of approximately 4.5 billion dollars in 2006. In this article, I will provide an overview of the latest advances and explain why radiologists should capitalise on this expanded market.

The global ultrasound market is roughly twice that of CT (in dollars). The reasons are clear: US machines, although much less expensive than CT, MRI and PET machines, enjoy much greater diffusion. There are, in most countries, no restrictions on equipment purchase, and every physician may have access, with little need for sharing equipment. In addition, patients enjoy similarly rapid access to machines, real-time imaging and close contact and cooperation between the operator and the patient. This explains why, apart from radiologists, many clinicians consider ultrasound to be a useful evaluation in a wide spectrum of pathological conditions. For some, the US machine is expected to become the "new stethoscope".

Advances in Image Quality

Image quality improvements have come about from factors like the sophisticated architecture of probes and ceramics, a fully-digital acquisition chain, wideband transducers, complex pulse generation, and the introduction of compound and harmonic modes. For a given case, the total examination time remains approximately similar, but provides a better image quality and more confident diagnosis. Investment costs are stable for high-end machines (100 – 200,000 euros), and have decreased for middle-range machines (50 - 80,000 euros). Revolutionary portable units are characterised by low weight, electrical autonomy and image storage capabilities, and good image quality. Available for a reasonable price (10 – 60, 000 euros), this new segment represents approximately 10% of the global US market.

Improvements in Flow Imaging

Improvements in flow imaging are due mainly to the increase in doppler sensitivity to slow flow, allowing demonstration of flow in small and/or deep vessels. The main question with doppler is the "human cost" of the US exam, which usually lasts long and requires expertise. This cost has be balanced with the cost of a CT or MRI exam, which is more expensive but appears less operator-dependent and unhampered by obesity, bones or gas. In that regard, doppler modes would be used as a complement for the evaluation of haemodynamics of a lesion detected on CT or MRI. This management should be considered by radiologists, though only presently emerging.

3D Imaging

3D imaging is a well-assessed modality for foetal imaging since a few years, providing striking images of prenatal anomalies. More recently, Beryl Benaceraf from Boston showed that this new mode would improve both efficiency and confidence. She found that “The standard foetal anatomic survey can be performed in less than two minutes with 3D volume US, and the volumes can be interpreted in six – seven minutes, compared with a mean of 19.6 minutes to perform standard 2D US”.

This opens the door for a tremendous change in daily practice and workflow, being associated with a short acquisition time and a delayed post-treatment and reporting phase. This allows more convenient comparison between successive exams and improves patient follow-up. 3D techniques are slowly moving to general radiology, with increasing applications in the urinary and biliary tracts, the heart, etc. Some papers have already reported a lower interobserver variability using 3D versus 2D traditional techniques.

Contrast-Enhanced Ultrasound

Contrast-enhanced ultrasound (CEUS) is based on the intravenous administration of microbubbles, which increase the backscattered signal. Despite important disparities between countries, this technique is slowly maturing with the increasing use of second-generation agents, allowing realtime imaging of organs at very low output levels. Using specific non-linear sequences, it is possible to display macro and micro-vascularisation with a high frame rate.

Primary clinical applications include focal liver lesions’ characterisation and detection, renal parenchyma lesions, pancreatic tumours, vesico-ureteral reflux, abdominal blunt trauma and transcranial doppler. The market for the main agent labeled in Europe for general imaging and cardiology (Sonovue® from Bracco, Italy) shows a current annual growth rate of approximately 17%.

The consequences on patient management are significant and need an adaptation of the workflow in imaging departments: e.g., placement of an IV line, assistance of a nurse or a technician for injection, longer examination time, need for long clips storage (total exam often > 1 Go), and time for the radiologist for the post-treatment phase. Unfortunately, there is no economic model covering all the expenses in most European countries, and generally only the cost for the contrast agent (~ 90 euros per vial) is reimbursed. Multicentre medico-economic studies are ongoing in several countries, and should justify an appropriate reimbursement price for the CEUS examination itself.

Where Will These Advances Lead?

Each of these advances potentially lead to new turf battles between radiologists and clinical specialists. An example is musculoskeletal ultrasound, which is increasingly used by rheumatologists. Also, US is now widely recommended as a control method for IV line placement. Therefore, there is recent pressure from anaesthesiologists and ICU physicians to acquire machines, with potential competition with the radiology department. Portable units are used increasingly outside the traditional hospital circuit, including emergency cases, with the expectation of better management of many patients in the most critical situations, as recently supported by emergency specialists.

What Do Radiologists Need to Do?

In this competitive world, the contribution of radiologists should be firmly assessed. For radiologists, ultrasound is and should stay as an imaging technique. Radiologists often have the best technical expertise, and are in the best position to propose the most appropriate diagnostic imaging method in a given case, without any interest in self-referral. As a result of subspecialisation, they offer expertise in all clinical fields, and are highly trained in post-treatment in different imaging modalities.

Most radiology departments as well as private radiologists offer a 24/24h service. However, the increasing clinical demand for ultrasound as well as new technical capabilities should be taken into consideration. Department organisation should be adapted, and resources optimised. Radiologists should be ready to more widely delegate some tasks to close staff members, e.g, in some countries sonographers have been introduced. Communication is also essential, with the objective to show the fiability of ultrasound data, often demonstrated but ignored by referring physicians! This can easily be achieved by circulating selected information through the institution or regional networks.

Win-win solutions with corresponding clinical teams are often more productive than turf battles, but radiology needs to stay a strong actor in the ultrasound field. Each radiologist has to promote the increased quality and visibility of radiological US in his/her environment.

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