The Need for Evidence-Based Quality Assurance in the Modern Ultrasound Clinical Laboratory

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Abstract:

A quick review of the specification sheets for new technologically intensive diagnostic ultrasound systems reveals a substantial number of fairly impressive operational performance claims. In at least one manufacturer's published material, the system specifications boasts of a dynamic range of 180 dB. To put that number in perspective, a device capable of 180 dB of dynamic range of resolution would be able to detect the flutter of a butterfly's wing in the middle of a thermonuclear explosion. How does one verify such an astounding performance claim using currently available ultrasound testing devices such as a tissue-mimicking phantom and what is the explicit clinical significance of such dynamic range? Additionally, while most of us were focused with amazement in leapfrog advances in system technology, diagnostic ultrasound transducers were also undergoing radical changes in array material composition and design. Most modern composite transducer specifications claim fractional bandwidths of 85%, and more and element counts as high as 2500. While the great technological strides made in ultrasound system design have been impressive, all of the computational and processing power of the 'all-digital' ultrasound device is singularly dependent on the output and input characteristics of the ultrasound transducer. Published data shows that the ultrasound transducer is subject to degradation in performance, as well as element failure, potentially leading to patient misdiagnosis or under-diagnosis. The need to regularly test transducers for performance variances will be explored within this paper. Additionally, the key areas of transducer performance as they relate to image and Doppler quality will be defined.

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