Enthusiasm for ultrasound for osteoporosis screening is premature

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IN THIS ISSUE of the *Journal*, Dr. Tonino[1] advocates using ultrasonography to screen for osteoporosis. I agree that ultrasonography shows promise for assessing fracture risk in a portable, economic manner. However, enthusiasm should be tempered with caution, and before the medical community wholeheartedly embraces this technology, several questions need to be answered.

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What exactly does ultrasound measure?

Gluer et al[2] reported that the orientation of trabeculae affects the key ultrasound measurement, broadband ultrasound attenuation. If this finding is correct, how do ambulatory status and lesions such as bone islands, cysts, lipomas, enthesopathies with endosteal thickening, stress fractures, and previous trauma affect the scan? More importantly, how can ultrasonography detect these lesions, when it produces no image?

Is ultrasonography as accurate as dual-energy x-ray absorptiometry (DEXA)?

In fact, ultrasonography is not as accurate as DEXA. For example, Bauer et al[3] found that the risk of femoral neck fractures correlated significantly with low bone mineral density on DEXA, but not on ultrasound. (However, the risk of intertrochanteric fractures was strongly associated with low ultrasound measurements.)

Greenspan et al[4] compared four ultrasound heel scanners and found they all had larger coefficients of variation (ie, their readings were scattered more widely about the mean) than did DEXA, although the two currently approved scanners (Hologic, Waltham, MA and Lunar, Madison, WI) varied the least.

This finding may in part be related to Gluer's observation that trabecular orientation affects the ultrasound measurement. Will a calcaneal x-ray be required to overcome these problems?

Another area to consider is the relationship between right and left calcaneal densities. Does it make a difference which heel is used?

How does the environment affect the accuracy of the scan?

The scanners are portable, and at least one scanner (Hologic) has temperature tolerances in its operator manual. What is the effect on scanner performance if the scanner is frequently moved to different environments?

What do the numbers mean?

The two approved scanners use different scales for reporting the results in terms of fracture risk. For example, the Hologic Sahara gives its results in standard deviations below the mean for a value that is somehow related to bone mineral density measured by DEXA, with abnormal risk that increases as values decrease from 0 to –1 SD. A value of –1 has the same fracture risk as the World Health Organization classification of –2.5 SD. The Lunar Achilles uses a scale that appears to be the same as the World Health Organization criteria for DEXA diagnosis of osteoporosis, but is actually a stiffness index scale.

Several questions need to be answered before we embrace this technology

*The author has acted as a consultant and is involved in research paid for by manufacturers of devices discussed in this article (the Hologic and Lunar corporations).

Greenspan et al[4] also questioned whether the database mean values of bone density, which are often based on that of white women, are appropriate for non-Caucasians and men.

Confused? You should be. It is important to understand what the report from each piece of equipment means. Further, what is the false-negative rate and false-positive rate?

Do the operators understand the principles involved?

I agree with Dr. Tonino that ultrasonography can have a major impact for identifying patients at risk for fracture and with low bone mass—if the operator and evaluator understand its limitations. In theory, DEXA operators are trained to understand basic anatomy, analysis, and troubleshooting. But at present, ultrasound units are treated more like a computer bought at a discount store.

Personnel operating this equipment must be adequately trained and understand the nuances of the equipment to interpret the information appropriately for the patient's medical record and referring physician. The International Society for Clinical Densitometry (Washington, DC) recently starting offering instructional courses for quantitative ultrasonography.

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Economic issues

As Dr. Tonino points out, ultrasonography is less expensive than DEXA. However, will ultrasonography merely add another layer of testing, and thereby increase costs? Of note: The Health Care Financing Administration (HCFA) will now pay for a screening ultrasound exam and a diagnostic DEXA exam in the same 18-month period.[5] Our experience is that most insurance companies and many HMOs now pay for osteoporosis assessment.

Is ultrasound useful for monitoring therapy?

Greenspan et al[4] questioned whether the use of calcaneal measurement is appropriate to follow the effectiveness of therapy, since different therapies may affect select skeletal sites differently.

Data on this point are conflicting. For example, Balikian et al[6] and Naessen et al[7] found no correlation between broadband ultrasound attenuation of the heel and DEXA bone mineral density changes of the spine and hip in women treated with estrogen replacement therapy.

On the other hand, Gonnelli et al[8] found the opposite: broadband ultrasound attenuation and speed-of-sound changes in the heel did correlate with DEXA bone mineral density of the spine in women treated with estrogen replacement therapy. Ingle et al[9] performed a study that suggested that ultrasonographic speed-of-sound measurements can be used for monitoring longitudinal changes in subjects. However, the study was performed without comparison to DEXA bone mineral density.

Definitive studies need to be conducted to prove the value of ultrasound technology for follow-up of therapy. In my opinion, quantitative ultrasonography has not been proven to be useful for monitoring therapy in patients at this time.

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