

et al. were able to detect seven/seven patients bleeding from the stomach/duodenum (7). Miskowiak et al. after studying patients with both upper and lower GI bleeds using with ^{99m}Tc-labeled red blood cells, concluded, "In upper gastrointestinal bleeding, scintigraphy should be considered when endoscopy fails." (11). Gupta et al. in a similar study, concluded that, "In suspected upper GI bleeding, it [Tc-99m RBC's] should be considered if endoscopy is either unsuccessful or contraindicated" (10). However, even if ^{99m}Tc red blood cells were not useful in upper GI bleeds, this would not be of great significance since endoscopy is the primary technique for evaluating these patients (12).

To completely answer the question of [^{99m}Tc]DTPA versus ^{99m}Tc red cells, a large-scale comparison study would need to be performed. Technically, this would be more difficult than comparing sulfur colloid to red cells.

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Bone Density Measurements of Spine and Distal Forearm in Osteoporosis

TO THE EDITOR: Nilas et al. (1) recently reported that there was not preferential spinal osteopenia using dual photon absorptiometry (DPA) in patients with spine "fractures" and that single photon absorptiometry (SPA) of the distal radius provided comparable diagnostic sensitivity. However, most other institutions that have made comparisons of SPA and DPA have found that the lumbar spine provides (a) about twice the diagnostic sensitivity of peripheral measurements for early crush-fracture osteoporosis (2) and (b) even better precision than SPA (3).

In the report by Nilas et al. (1), the 28 women with "spine fracture" actually are similar in characteristics to women with spinal wedging, not crush fractures, reported in another paper by the same group (4). The spine density in this "wedge fracture" group was only 25% below premenopausal women and 7% below postmenopausal women. Typically, crush-fracture osteoporotic patients average 33% below premenopausal women and ~15% below postmenopausal controls. This is in fact what the Glostrup Lab observed in true crush-fracture cases; that is a 35% spine decrement compared with an 18% forearm deficit (4).

Thus, it appears that patient selection and, perhaps, sub-optimal DPA methodology has led to the unusual results in the Nilas report.

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REPLY: Dr Mazess has raised some critical comments on our recently published paper (1). His criticism concentrates on the dual photon methodology (DPA) and the patient selection. The diagnostic sensitivity of a method does not only depend on the difference between two groups, it also depends on the scatter of values. It is well documented and generally accepted that single photon absorptiometry (SPA) has a better precision than DPA in normal subjects (1-4). In osteoporotic patients this difference is even greater. Calculations of spinal BMC thus have a precision of 6.1% in patients with moderate spinal osteoporosis compared with 1.1% in normal subjects (1).

We agree with Dr. Mazess that the more severe the osteoporotic condition, the larger the deficit of bone mass. In other words, patients with several crush fractures have a lower bone mass than those with a single wedge fracture. It is likely that patients who develop spinal crush fractures within the first

postmenopausal year have a relatively larger deficit of trabecular bone. A precise measurement of their spinal bone mass can hardly be achieved with the present DPA technique, and for the diagnosis of crush fracture it is easier to take an x-ray. The interesting question is, however, how to diagnose mild osteoporosis, and this was the aim of our study. As described in detail our 28 unselected patients had mild osteoporosis and in these patients DPA measurement of the lumbar spine had no advantages over SPA measurement of the distal forearm.

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Quantifying Intracranial CSF Volume Using MRI

TO THE EDITOR: Chawluk et al. (1) described a method of correcting for the presence of cerebrospinal fluid (CSF) in positron emission tomography (PET) estimations of cerebral metabolism per unit mass of brain tissue. They did so using a series of x-ray (XCT) computed tomography images with areas of CSF in sulci and ventricles being identified subjectively using a data tablet operating on a high resolution display. This use of XCT images follows the similar approach taken by Herscovitch et al. (2).

We would like to point out that a more accurate correction technique exists that does not involve ionizing radiation. While using magnetic resonance (MR) images, it does not do so in the way suggested by Chawluk et al. (1), namely, simply as a substitute for the XCT slices with CSF spaces again being identified subjectively. Rather, it takes a radically different approach by utilizing the significant differences between the relaxation times of CSF ($T_1 > 3,000$ ms, $T_2 > 2,000$ ms) and those of gray matter (513 ms, 118 ms) and white matter (242 ms, 86 ms) (3). Using an IRCP5000/300/400 ($T_R/T_1/T_E$) image contrasts between a unit volume of CSF and a unit volume of brain tissue of $> 200:1$ are obtained in practice. In other words, images are effectively obtained that show only CSF with the signal from each pixel being proportional to the amount of CSF contained in the corresponding volume element. A reference vial containing a known volume of water that has very similar relaxation times to CSF (4), is used to translate this into absolute volume. Slices can be obtained in any orientation and thickness and thus can be accurately

matched to the actual PET images to be corrected and estimates of absolute CSF volume (ventricular and extra-ventricular) can be obtained. The method is not subject to the beam hardening effects of XCT, does not suffer from significant partial volume effects (3) and does not require either a threshold algorithm (2) or subjective observer choice (1) to define regions of CSF. Its noninvasive nature and lack of ionizing radiation means that it may be used to establish normal values in volunteers as well as being applied serially to patients with greater frequency than would be possible with XCT. The fact that each pixel in the MR image represents the absolute volume of CSF in the corresponding volume element means that it may also be possible to correct the PET images on a voxel by voxel basis as opposed to the present global correction as described by Chawluk et al. (1).

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REPLY: We appreciate the interest demonstrated by Condon and colleagues in the issue of quantifying CSF spaces in vivo. Their method is the most promising we have encountered to date, and provides the potential for greater accuracy and ease of implementation than the more subjective and operator-intensive XCT technique which we have employed for the past several years (1-3).

The method of quantifying intracranial CSF volume described by Condon et al. (4) uses an MR pulse sequence designed to produce a maximal signal from CSF, minimizing the signal from other tissues (gray and white matter). As currently presented, a potential disadvantage of this technique in studies of aging and dementia is the length of time required to obtain a single slice (almost 5 1/2 min with a 64 x 64 matrix). The magnitude of this disadvantage is partially counteracted by the use of thicker slices, permissible given the very high signal contrast between CSF and brain.

Data from phantom studies and reproducibility data using this method are quite good (4). Several factors limit an uncritical implementation of this method, however, including image nonuniformity, unavoidable residual partial volume averaging effects, and motion during scanning (patient motion as well as CSF bulk flow). Another limitation of this "thick-slice" approach is that measurements of regional atrophy are