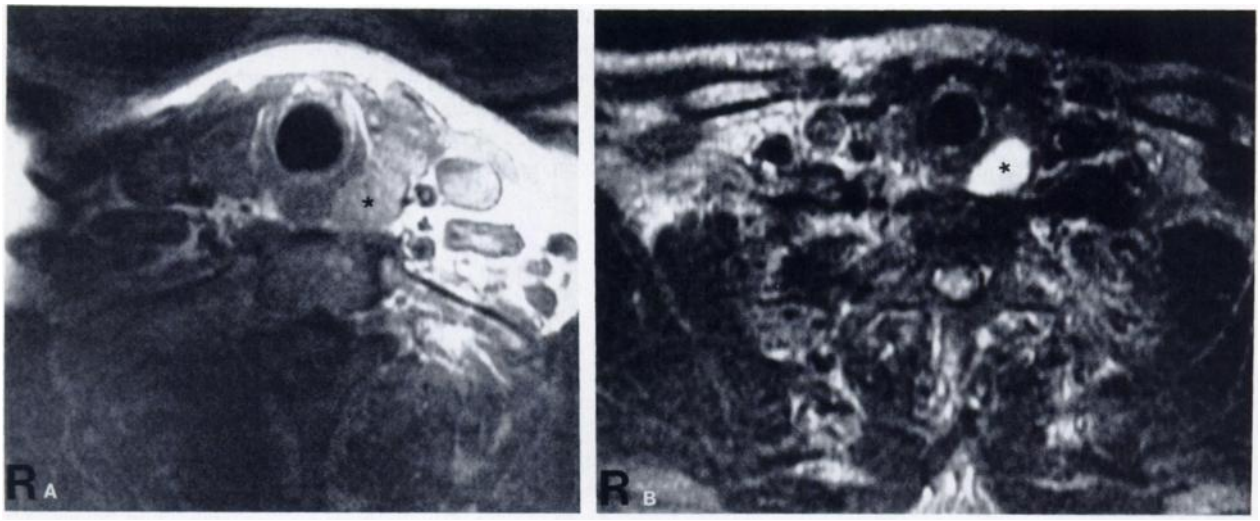

FIGURE 2
MRI examination. A: T1 weighted image shows a mass (asterisk) with signal intensity slightly greater than that of adjacent normal thyroid tissue. B: T2 weighted image shows mass to better advantage (asterisk) with much greater signal intensity than surrounding soft tissues

the adjacent thyroid (Fig. 2A). On T2 weighted images (TR = 2000, TE = 60) the mass is well visualized with a markedly higher signal intensity than the surrounding soft tissues (Fig. 2B).

A smooth, lobulated mass measuring 4.0 × 2.0 × 1.5 and weighing 4.1 gm was removed from the tracheo-esophageal groove. The lesion was well encapsulated with no evidence of adherence to adjacent tissue or adenopathy. A high mitotic rate was demonstrated in the cellular areas of the tumor consistent with carcinoma. The tumor was surrounded by a fibrous capsule with no evidence of vascular invasion despite use of elastin stains. Serum calcium and parathormone levels returned to normal postoperatively.

Thallium does not demonstrate tissue specificity. Its accumulation is related to regional blood flow and to a biologic distribution analogous to potassium. These properties probably account for thallium uptake in parathyroid lesions which are typically hypervascular with a high cellular density (*2*). It is uncertain why this particular neoplasm was not visualized on the nuclear scan. In Ferlin's initial series using double-tracer scanning five parathyroid carcinomas were correctly localized (*3*).

The parathyroid carcinoma in this case behaved as a hypovascular or possibly cystic lesion with no significant uptake of thallium or contrast enhancement. However, microscopically the lesion proved to be neither hypovascular or cystic. Nonvisualization of a lesion of this size has not been previously reported. The inability to resolve small parathyroid lesions has been the principle cause of false negative results with dual radionuclide imaging as well as with CT and high resolution ultrasound (*1,4*). MRI may be able to detect lesions presently below the resolution of these modalities (*5*).

This case suggests that the nonspecific nature of thallium accumulation in parathyroid lesions is not entirely predictable resulting in nonvisualization of tumors normally within the limits of resolution of ^{201}T1/^{99m}Tc pertechnetate subtraction scintigraphy.

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Bone Scintigraphy in Osteomyelitis

TO THE EDITOR: The paper by Alazraki et al. in the *JNM* (*1*) presents useful data, but approaches the evaluation of diagnostic procedures in an inappropriate manner. The authors state that the four-phase bone scintigraphy is preferable, because it has an accuracy of 85%, compared with an accuracy of 80% for the three-phase method.

The data are derived from two populations, which are overlapping, but not identical. In the first, to which the three-phase method is applied, the prevalence is 5/20 (0.20); in the second, subjected to the four-phase method, the prevalence is 5/18 (0.28). The sensitivity and specificity are, respectively, 1.00 and 0.73 for the three-phase method and 0.80 and 0.87 for the four-phase method.

The authors do not seem to consider that the positive predictive value (PPV) and the negative predictive value (NPV), [and, hence, the accuracy (ACC)] are a function of the prevalence (PREV). Indeed, if we use the sensitivity and specificity values reported in their paper on populations with prevalences of 0.25, 0.28, and 0.50, we can derive the following values from Bayes' theorem:

	Three-phase			Four-phase		
PREV	PPV	NPV	ACC	PPV	NPV	ACC
0.25	0.55	1.00	0.80	0.67	0.93	0.85
0.28	0.58	1.00	0.80	0.70	0.92	0.85
0.50	0.78	0.99	0.88	0.86	0.82	0.84

It appears, therefore, that in a population with a 50% prevalence, the three-phase method would have yielded the higher accuracy.

In fact, the authors can be faulted on two levels: first, even in low prevalence populations one would prefer a negative three phase study, yielding a 1.00 NPV, or a positive four phase study yielding a PPV of 0.67 or 0.70. The relative value of each study is therefore a function of the outcome (positive or negative) rather than of the accuracy. This applies particularly in a case where one procedure is part of another (every four-phase includes a three phase).

Second, accuracy is, as demonstrated here, a function of the population, and poorly reflects the value of the test. Indeed, a test which would *never* be positive, would, in a population with a prevalence of 0.05 yield an accuracy of 95%, but would it be the better test?

References

1. Alazraki N, Dries D, Datz F, et al: Value of a 24-hour image (four-phase bone scan) in assessing osteomyelitis in patients with peripheral vascular disease. *J Nucl Med* 26:711–717, 1985

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REPLY: We thank Dr. Goris for his interesting remarks on our report, "Value of a 24-Hour Image (Four-Phase Bone Scan) in Assessing Osteomyelitis in Patients with Peripheral Vascular Disease," published in the July, 1985 issue of the Journal. It is encouraging and stimulating to know that articles are being read with attention to detail and thought about what is not included in the article, as well as what is included.

The study presents data comparing three-phase and four-phase bone scans performed in 21 studies on 17 patients. All data for three- and four-phase studies are derived from the same population. Thus, Dr. Goris' statement in Paragraph 2 of his letter that there were two populations which were not identical is incorrect.

The paper did not address positive predictive value and negative predictive value. In the hypothetical situation of a 50% prevalence of osteomyelitis, Dr. Goris points out that the three-phase method would have yielded higher accuracy. The population studied was actually a population in which the risk for osteomyelitis is probably as high as imaginable in any population. These were adult patients with lower extremity ulcers, underlying diabetes mellitus, and/or peripheral vascular disease, who were referred for bone scans because of suspected osteomyelitis. The prevalence of osteomyelitis was 5/20 scans (one scan was not included in calculations of sensitivity, specificity, or accuracy, because clinical pathology, as well as three- and four-phase results were indeterminate). While the accuracy for three-phase calculates to 80% and the accuracy for four-phase to 85%, sensitivity, as reported in this paper, is higher for three-phase studies, while specificity, is higher for four-phase studies. Since the most difficult interpretation of the three- or four-phase bone scan occurs in patients who have degenerative bone disease (degenerative disease is a cause of false-positive three- or four-phase bone imaging for osteomyelitis), the increased specificity in adult populations at risk for osteomyelitis who are likely also to have degenerative disease, makes the increase in specificity of four-phase imaging extremely important. Thus, although we must agree with Dr. Goris' statement that the value of the test is a function of the population to be studied, we would take issue with his statement that the accuracy poorly reflects the value of the test. Dr. Goris uses the hypothetical situation where a test would never be positive to support his statement that accuracy does not reflect the value of the test. In real life, as described in the study which we did to address assessment of osteomyelitis in patients with peripheral vascular disease, we feel that the more favorable specificity of the four-phase bone scan is an important advantage in assessing osteomyelitis, particularly in patients likely to have degenerative disease.

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Estimation of Bladder Wall Absorbed Dose

TO THE EDITOR: To assess the radiation risk to both volunteers and patients, correct dosimetry calculations are necessary. The bladder remains one organ where errors are often encountered in absorbed dose estimations.

The recent article by Harvey et al. (*1*) concluded that the human bladder wall received the highest absorbed dose, by a factor of ten over any other organ, after an i.v. administration of 6-[^{18}F]fluoro-L-dopa. Others have taken the same general approach to calculate radiation dose to the bladder. We suggest an alternative approach.

In general, the mean absorbed dose to a target organ from a source of radiation in another organ is determined by the product of the cumulated activity in the source organ, the inverse of the mass of the target organ and an S factor (*2*). The S factor, which is unique for a given radionuclide, contains information about the fraction of each emitted particle's energy, that is deposited, on the average, in the target organ. The numerical value of S is dependent upon the amount and composition of the absorbing medium between the source of