Approximately 5% of the hypertensive population have renovascular diseases that can be corrected surgically. Most renovascular hypertension is due to renal-artery stenosis or fibromuscular hyperplasia (*2*). Intrarenal arteriovenous fistulae are a rare cause of hypertension, and of the two types, acquired and congenital, the former is more common. These are usually due to trauma, renal surgery, postpercutaneous or open renal biopsy, infection, rupture of aneurysm, neoplastic erosion of blood vessel, polycystic kidney disease, fibromuscular hyperplasia, and severe arteriosclerosis (*5,6*). A review of the literature uncovers only two cases of the acquired type of arteriovenous fistula that were detected by radionuclide studies.

In the present patient an intrarenal vascular fistula was suspected on the basis of abnormally early increased radioactivity in the lower pole of the left kidney in the arterial phase of a renal perfusion study. Vascular tumor such as hypernephroma was considered an unlikely diagnosis based on the normal [^{131}I] hippuran renogram, i.v. pyelogram, and nephrotomogram. Although i.v. pyelography is sensitive to abnormal renal anatomy, vascular abnormalities are better delineated by radiotracer techniques, as illustrated by this case. Definitive diagnosis, however, can be made only by contrast arteriography and/or surgery.

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Toward Shorter-lived Radiopharmaceuticals for Perfusion Lung Scans

For 15 years the perfusion lung scan has greatly facilitated the diagnosis of pulmonary embolism. When a lung scan is normal, pulmonary embolism is virtually ruled out as the cause of acute chest pain or shortness of breath. Although there has been no estimate of the savings to these patients through avoidance of pulmonary angiography, they must be large in both dollars and morbidity. However, considerable difficulty is encountered in the interpretation of lung scans of patients with similar symptoms in the presence of obstructive lung disease or congestive heart failure. A normal chest roentgenogram and characteristic perfusion abnormality can be useful but may not be sufficient to make the definitive diagnosis. This diagnostic enigma is resolved to a large extent by an additional ventilation lung scan with radioactive inert gas or aerosol. An abnormal perfusion lung scan in the presence of a normal ventilation study is virtually diagnostic of pulmonary embolism, whereas in the presence of an abnormal matching ventilation scan, the diagnosis is very unlikely.

Until radioactive inert gases or aerosols with better physical characteristics than Xe-133 (*1*) are widely available, considerable operational problems remain. Should one perform a ventilation study routinely before the perfusion lung scan, at greater cost for the former procedure, or wait several hours until the injected perfusion agent has decayed sufficiently, at the loss of the benefit of a speedy diagnosis? Alternatively, a large dose of Xe-133 (20–30 mCi) may be used for a ventilation study immediately after the perfusion scan to maximize the signal-to-noise ratio between Xe-133 and the usual Tc-99m radionuclide. Another option should receive serious consideration: the use of a perfusion radiopharmaceutical with shorter half-life, so that a smaller dose of Xe-133 may be used for ventilation immediately after a perfusion lung scan. This approach not only maintains a good signal-to-noise ratio in the immediate ventilation study but may also effect savings in cost and radiation dose. In fact, the optimal half-time for a radiopharmaceutical was shown long ago to be equal to the natural logarithm of 2 times the duration of the measurement (*2*). To apply this principle to the current instrumentation, the half-time of the perfusion radiopharmaceutical should be in the range of 0.5–1 hr. The preparation of such perfusion tracers is technically feasible. Indeed, at least one commercially available kit preparation yields a Tc-99m-labeled MAA with the desired biologic half-time.

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Enigma of the "Hyperfunctioning" Thyroid Carcinoma Resolved?

It is generally agreed that the presence of a nodule showing greater concentration than surrounding thyroid tissue (hyperfunctioning) on radioiodine scintiscan virtually eliminates concern about possible thyroid carcinoma. In a series of 2,736 patients with solitary nodules, Psarras et al. (*1*) found no carcinoma in hot nodules. Nevertheless, scattered reports of carcinoma in hyperfunctioning thyroid nodules appear in the medical literature. Most such reports actually describe association of thyroid carcinoma with benign adenoma, with the carcinoma shown to be in a hypofunctioning area with two nodules palpable, or in an area of low concentration within an otherwise hyperfunctioning nodule, or

as an incidental finding by the pathologist (*2–6*). No report has conclusively shown the carcinoma to be identical to the hyperfunctioning area on scan (*6–9*). Attie (*8*), reporting on 17 cases of hyperfunctioning nodules, three reportedly malignant, suggested that the carcinoma may have great avidity for iodine, or it may merely be adjacent to or surrounded by benign hyperfunctioning tissue. Becker et al. (*5*) reported two cases of carcinoma in hyperfunctioning nodules, but autoradiograms in both showed "no activity over the tumor cells."

Guinet et al. (*2*) described a thyrotoxic patient with bilateral thyroid nodules. The initial scan showed a typical toxic adenoma on the right, with total suppression of function on the left, but a scan repeated after injection of TSH showed the left-lobe nodule to remain hypofunctioning. The case to be described is more like a previous patient in my experience (for whom the pretreatment workup was less complete), who responded well to radioiodine therapy for a solitary toxic adenoma, but 2 yr later was proven to have Hürthle-cell carcinoma, originating in a solitary hypofunctioning nodule initially thought to be the treated adenoma.

The patient to be described presented a common diagnostic problem. A 41-year-old white woman in excellent health was referred for evaluation of a nodule that she had first noted 4 wk previously. She was clinically euthyroid. T-3 resin uptake, T-4 RIA, and T-3 RIA were all in the normal range. Examination of her neck revealed a hard nodule, about 2 cm in diameter, located in the lower portion of the right thyroid lobe, with irregular, equally hard tissue extending superiorly along the lateral margin of the right lobe. The left lobe was not palpable.

The 24-hr I-131 thyroid uptake was 9%, at the low limit of normal. A thyroid scan with I-125 (Fig. 1A) showed all tracer limited to a well-circumscribed area in the right lobe, about 1 cm in diameter, with no concentration elsewhere in the gland. After palpation under the scanner, location of the nodule appeared not to coincide with the area of function, but rather to be immediately adjacent (Fig. 1A, right). She was given an intramuscular injection of 10 units TSH and an oral scanning dose of I-131, and was rescanned the following day (Fig. 1B). The left thyroid lobe was shown to function after TSH, with uniform tracer distribution, but the areas of the right lobe abnormal on palpation remained hypoactive. A total thyroidectomy was performed. Final pathologic diagnosis was: "Papillary and follicular carcinoma, thyroid, multicentric," and "colloid nodules," the largest measuring 1.2 cm. Careful review of the pathologic material, including autoradiograms, showed the area to be the largest "colloid nodule" with hyperplastic epithelium consistent with a hyperfunctioning adenoma. Carcinoma was associated with a 1.7-cm nodule at the right lower pole, and there were microfoci in the left lobe.

The findings in this case certainly cannot be extrapolated to explain all cases of thyroid carcinoma appearing as hyperfunctioning nodules on scintiscan, but it must be emphasized that no reported case has conclusively shown an area of increased radioactivity on scan to represent carcinoma. All reported cases with thorough evaluation have shown the area of carcinoma to be hypofunctioning, some within an otherwise hyperfunctioning nodule. As in this case, the thyroid gland commonly is multinodular when only a single nodule is clinically apparent. When portions of the thyroid gland initially appear to be suppressed, great care must be exercised—including precise palpation in correlation with scan, and followup imaging after TSH injection—before concluding that only a functioning nodule is present with the gland otherwise normal. Any hypofunctioning areas in the scan following TSH must be suspect for carcinoma.

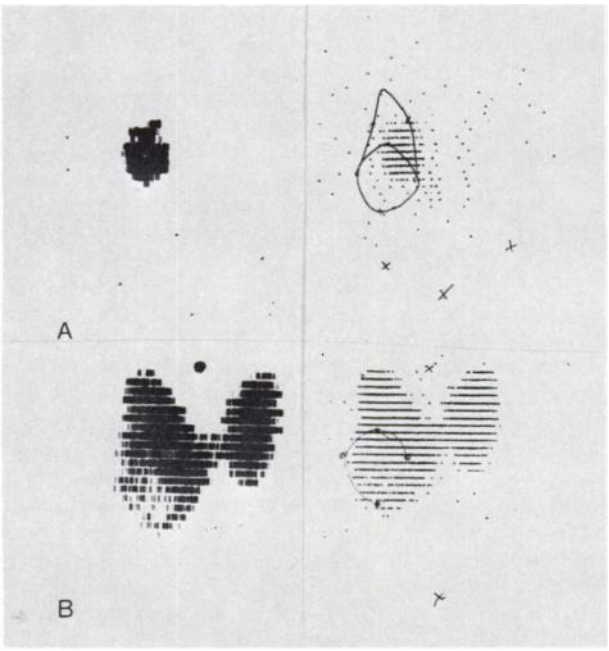

FIG. 1. Thyroid scans (A) with I-125, before TSH stimulation, and (B) with I-131, after TSH. At left, color scans shown in grey-scale copy; at right, dot scans with region of nodule (palpated at time of scan) marked in. Uptake is more general after TSH, but with minimal concentration in palpable nodule.

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