

## RADIONUCLIDE EVALUATION OF A CAROTID BODY TUMOR

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The preoperative evaluation of neck masses with radiopharmaceuticals has proven to be of great value (1-4). Furthermore, scintiangiography has been shown to be of value in the evaluation of disease in the carotid vessels (5). A carotid body tumor is rare and radioisotopic studies performed in the evaluation of this lesion will be discussed. The safety, rapidity, and striking positivity of the dynamic  $^{99m}\text{Tc}$  scintiangiography suggests that this procedure be employed as a routine screening method for carotid body tumors, both in patients suspected of having the tumor and in family members in whom the incidence of having similar tumors is increased. In addition, scintiangiography serves as a useful method in the followup of patients following therapy.

### CASE HISTORY

EB, a 70-year-old white male, was admitted to the Division of Nuclear Medicine at Jackson Memorial Hospital with a 3-year history of progressive swelling

of the left side of the neck. The mass was painless and the patient had no other associated complaints. A "nonmalignant" mass had been removed from the same side of the neck 5 years previously. The histologic nature of the lesion was unknown.

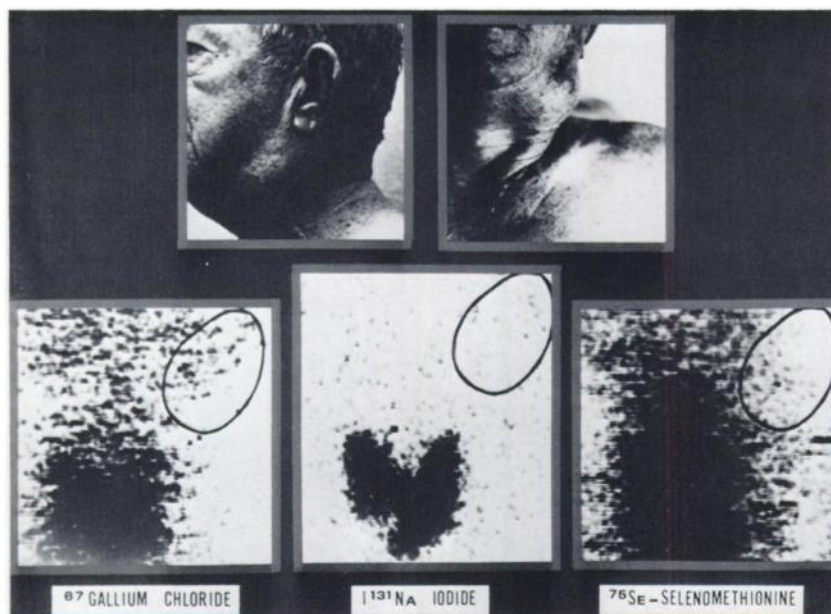
On physical examination a mass  $5 \times 6$  cm was seen in the left side of the neck (Fig. 1). It was firm, freely movable laterally, but fixed vertically. An overlying bruit was noted. The tongue deviated to the left, and there was wasting of the papilla over the left side of the tongue. The thyroid gland was not palpable, nor were there other masses in the neck.

The  $^{131}\text{I}$  thyroid scintigram revealed a normal size gland with a filling defect in the right lower pole (Fig. 1).

Transfemoral catheterization of the thoracic aorta

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**FIG. 1.** Above, left lateral and anterior view of neck mass. Below, no increased concentration of  $^{67}\text{Ga}$ -chloride,  $^{131}\text{I}$ -NaI, or  $^{76}\text{Se}$ -selenomethionine is visualized within tumor (encircled).



**FIG. 2.** Splaying of the bifurcation of carotids and dense tumor vasculature is visualized.

with selective catheterization of the left carotid revealed a marked splaying of the bifurcation of the common carotid. In this area there was an extensive tumor vasculature supplied by the branches of the external carotid. The tumor blush measured  $8 \times 6$  cm. No early draining veins could be identified. The findings were felt to be consistent with a left carotid body tumor (Fig. 2).

The patient underwent a dynamic intravenous radionuclide carotid angiographic study to further evaluate the mass and the opposite carotid. The study showed early uptake of radionuclide in the tumor mass within seconds after injection of a bolus of  $^{99m}\text{Tc}$ -sodium-pertechnetate (Fig. 3). No other abnormalities were noted. The carotid-thyroid trapping time of pertechnetate was within the normal range. The thyroid gland and salivary glands were well visualized. Once again the filling defect in the right lower pole of the thyroid was seen.

Gallium-67-chloride was administered as a 2-mCi intravenous bolus. There was no increased uptake of this radionuclide in the lesion. Selenium-75-selenomethionine also failed to localize in the tumor mass (Fig. 1).

Due to the patient's age and the size of the lesion, radiotherapy was felt to be the treatment of choice. Fifty-five hundred rads were administered in 26 treatments using  $^{60}\text{Co}$ . Repeat carotid scintiangio-

gram dose 2 months after completion of therapy showed no change in the size of the tumor.

In addition two family members, YB, 39-year-old daughter, and BB, 50-year-old son, were scanned. Clinically, and on screening with  $^{99m}\text{TcO}_4^-$  carotid angiogram, no abnormality was detected (Fig. 3).

#### DISCUSSION

The carotid body was first described in 1743 as a flattened, pinkish tan mass,  $2 \times 5$  mm in diameter, located in the posterior aspect of the common carotid at the site of bifurcation (6-8). Tumors of the carotid body account for only a small percentage of cervical masses. They are histologically benign, slow growing tumors which may exhibit malignant clinical features (9-12). Unfortunately, the histologic criteria of malignancy are ill-defined, and no significant histological difference has been noted between tumors that metastasize and those which do not. A local recurrence rate of 12% and a distant metastasis of 5% has been reported (13). Clinically, the tumors may be asymptomatic and present as slowly growing masses. Occasionally they are associated with cough, dysphagia, pain, hoarseness, and the carotid sinus syndrome. The tumor occurs most commonly in the third or fourth decade (12). Occasionally the tumors are bilateral and they may occur simultaneously with other chemoreceptor tumors. There is a significant hereditary tendency (13-16). Twenty-six percent of patients with a positive family history have bilateral disease compared with 2.8% bilateral disease in non-familial tumors.

Because of the intrinsic vascular nature of these tumors, biopsy remains a hazardous procedure, and as such, many authors recommend angiography as a means of preoperative diagnosis (17). Carotid arteriography will reveal a vast network of small vessels in a mass at, or near the bifurcation of, the common carotid artery. The internal and external carotid artery may be widely separated. An assessment of the contralateral carotids should be included in the study as well as an evaluation of the contralateral vessels of the brain. This is necessary in the event that the internal carotid artery is sacrificed during the surgical procedure (17-20).

Chambers et al (21) take exception to the statement that carotid angiography is necessary to substantiate the diagnosis which they feel is mainly a clinical one. They take this stand due to their concern over the morbidity associated with carotid arteriography (22). The differential diagnosis of a mass in the neck in this region include aneurysm, bronchial cleft cyst, salivary gland tumors, lymphoma, and lymphadenopathy associated with metastatic neoplastic disease.



**FIG. 3.** Sequential scintiphotoscans show early activity within the tumor region overlying left carotid artery in patient EB. Normal radionuclide carotid angiogram in daughter YB.

Thyroid carcinoma of the follicular and papillary type in association with chemodectomas is reported in the literature at a higher incidence than expected for chance combinations (23). The abnormal thyroid scan in this patient is of interest in view of this association.

Radionuclides have an obvious place in the evaluation of any patient presenting with a neck mass. The use of  $^{99m}\text{Tc}$ -sodium-pertechnetate has been previously reported by various researchers for its ability to concentrate within tissues of thyroidal or salivary gland origin. In addition, an evaluation of carotid flow can be made using this isotope. The early uptake seen in the technetium carotid angiographic study reflects the high vascularity of this tumor. Early uptake in the neck region can also be seen in hyperfunctioning thyroid tissue or other vascular tumors, such as angiofibromas, which clinically and angiographically may resemble carotid body tumors (24).

Selenium-75-selenomethionine has been employed as a tumor localizing agent with some success in patients with thyroid carcinoma, lymphoma, parathyroid adenomas, thymomas, and a variety of other neoplastic processes (3,25). The negative selenomethionine scan suggests that the lesion has a minimal requirement for the amino acid methionine and is therefore probably a very slow growing lesion which holds true for this type of tumor.

The value of radionuclides in detecting metastatic carotid body lesions awaits investigation. The metastatic lesions have been known to be highly vascular and are capable of producing AV shunting of such a degree as to cause congestive heart failure. The bone lesions may be osteolytic or osteoblastic (26), and as such, bone scanning with fluorine or strontium may play a role in the further evaluation of these patients.

At present,  $^{67}\text{Ga}$  is an experimental radionuclide with a high avidity for various neoplastic diseases.

The mechanism by which  $^{67}\text{Ga}$  concentrates is unknown; however, some tumors are seen not to concentrate the radionuclide (27,28). The carotid body tumor presented appears to belong to the latter group. Because of the associated family incidence, especially in bilateral tumors, all family members should be scanned.

The intravenous radionuclide carotid study in carotid body tumors should be considered complementary to the angiogram which is more specific. Once the diagnosis has been made, it offers the advantage of being a safe and rapid method for the evaluation of family members and for post-treatment followup. In addition, it plays a role in the evaluation of other neck masses and may aid the clinician in differential diagnosis.

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