Radionuclide Angiography as the Primary Investigation in Chemodectoma: Concise Communication

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A technique is described for investigating tumors of the carotid body and glomus jugulare. The examination comprises an easily performed radionuclide angiogram, and has been used to investigate 30 patients. This technique demonstrated seven carotid-body tumours, including two unsuspected clinically, and one tumor of the glomus jugulare. There was also one patient with a false-positive test for bilateral carotid-body tumors. Angiographic and/or surgical confirmation was obtained in all cases but one. A significant incidence of complication during contrast angiography was noted (two cases of transient hemiparesis). The radionuclide angiogram proved safer than contrast angiography and more reliable than clinical examination; it therefore appears to be the method of choice as the primary screening test in patients with suspected carotid-body and glomus-jugulare tumors.

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Chemodectomas are rare tumors of the chemoreceptor system, occurring in various parts of the body but most frequently in the head and neck. The most common type is the carotid-body tumor (CBT), occurring at the carotid bifurcation. These are slowly-growing, and cause pressure changes in surrounding structures, including the hypoglossal and vagus nerves and the sympathetic chain (*1*,*2*). Common symptoms are hoarseness, cough, and dysphagia. The tumors are very vascular and it has been suggested that about 5% become malignant (*3*,*4*). Similar tumors occur in the glomus jugulare and in the aortic body. Bilateral CBTs are known to have a high familial incidence (*5*,*6*).

Investigation of CBTs normally starts with the discovery of a mass fixed to the carotid bifurcation. Arteriography is required to confirm the diagnosis (*7*). There have been several reports of the use of radionuclide angiography in the diagnosis of these tumors (*8–10*).

MATERIALS & METHODS

Patients. A 63-yr-old male (patient no. 1) who had had a right-sided CBT removed 5 yr previously, was referred for investigation of a mass in the left side of the neck. The radionuclide angiogram was strongly suggestive of a L-sided lesion, and contrast radiography was undertaken. This demonstrated the presence of a tumor of the carotid body, which was surgically removed and confirmed by pathology. Because of the known familial incidence of bilateral tumors, and in view of the hazards of contrast angiography, it was decided to screen the patients' three siblings and their children—23 persons in all—by clinical examination and radionuclide angiography. It was also decided that either the presence of a palpable mass in the region of the carotid bifurcation or a positive radionuclide angiogram would be an indication for contrast angiography.

Five other patients (unrelated to each other or to the first group), presenting with palpable masses in the neck, were considered on clinical grounds to have CBTs; they were investigated by radionuclide and contrast angiography.

A further two patients were investigated for possible glomus jugulare tumors. (One was further studied by contrast angiography and the other by CT and biopsy).

Imaging studies. The protocol that we have used calls for the imaging of the first passage of a bolus of Tc-99m gluconate through the carotid and jugular vessels. The

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patient was positioned supine under a large-field gamma camera, with a pillow below the shoulders to produce hyperextension of the neck. The camera was fitted with a low-energy converging collimator and peaked to 140 keV with a 20% window. Data acquisition was performed using a computerized acquisition and analysis system.

As with all dynamic studies, a good bolus technique is essential, and the delivery system is therefore important. A 19-gauge, scalp-vein needle was placed into an antecubital vein (basilic vein if possible), and the 20-mCi radioactive bolus introduced, via a three-way tap, into a connecting tube attached to the scalp-vein set. The bolus was then propelled into the vein by a rapid saline flush. Data acquisition was commenced simultaneously with the injection of the radiopharmaceutical, at a rate of 1 frame per second for 30 sec, using a 64 × 64 matrix.

Once the data had been acquired, the initial passage of the bolus through the carotid system was studied, using the computer to display and process the individual frames of the study. Facilities to aggregate frames and to perform background subtraction and image smoothing were available on the computer, and were routinely used in the analysis of the data.

RESULTS

Investigation of the 23 members of patient no. 1's family group revealed a total of 19 radionuclide studies that were interpreted as normal.

Four studies from this group were interpreted as abnormal, and the findings in these cases are summarized in Table 1. Two patients (no. 1 and 2) had angiographic, surgical, and pathological confirmation of positive radionuclide studies. A third patient, (no. 3) had palpable, bilateral, masses at the carotid bifurcation, and strongly positive radionuclide angiography. This patient refused further investigation, but was accepted as having bilateral tumors. An interesting feature is that one of these

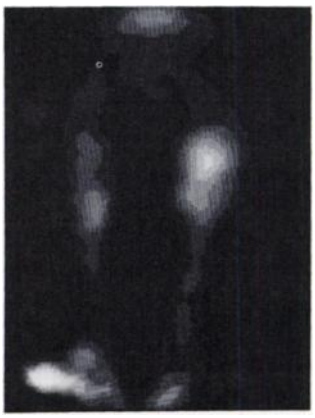

FIG. 1. This demonstrates a large, left carotid body tumor and a smaller, right one (patient no. 1). These were not felt on clinical examination.

patients (no. 2), in whom the radioangiogram was positive, was normal by clinical examination (Fig. 1). Investigation of this family also produced one false-positive radionuclide study (Fig. 2) in a patient, (no. 4), without positive clinical findings, and in whom contrast angiography showed only slightly prominent origins of the internal carotid arteries without evidence of CBTs.

Of the five unrelated patients also investigated following discovery of masses in the neck, two (patients no. 5 and 6), were considered to have positive radionuclide angiograms. The radionuclide and contrast angiograms of patient no. 5 are shown in Fig. 3. In both cases, the presence of CBT was confirmed by contrast angiography; and in one case, (no. 5), surgical and pathological confirmation was obtained. One of these patients (no. 6) previously had a L-sided CBT. The findings in these two cases are also summarized in Table 1.

In the search for glomus jugulare tumors, we investigated two patients, one of whom (patient no. 7), was found to be strongly positive on the basis of the radionuclide study (Fig. 4). This examination also suggested increased blood flow in the L. carotid system supplying

TABLE 1. PATIENTS INVESTIGATED FOR CAROTID BODY TUMORS (CBT) & GLOMUS JUGULARE TUMORS, HAVING ABNORMAL RADIONUCLIDE ANGIOGRAMS

Patient	Clinical impression	Radionuclide angiogram	Contrast angiogram	Pathological confirmation
1	L-sided CBT	+ve on L.	+ve on L.	Yes
* 2	Normal	+ve L. & R.	+ve L. & R.	Yes
* 3	Bilat. CBTs	+ve L. & R.	Refused further investigation	
* 4	Normal	+ve L. & R.	Normal	—
5	L-sided CBT	+ve on L.	+ve on L.	Yes
6	R-sided CBT	+ve on R.	+ve on R.	Awaiting surgery
7	L-sided glomus jugulare tumor	+ve on L.	+ve on L.	Yes

* Relative of patient no. 1.

FIG. 2. False-positive study, suggesting that bilateral carotid body tumors are present (patient No. 4). Angiography and clinical examination did not reveal any abnormality.

the tumor, and decreased flow in the L. internal jugular vein due to pressure from the mass. This glomus jugulare tumor was biopsied and confirmed histologically.

A striking feature of the investigation of these patients was the high incidence of complications of contrast angiography. Of the 10 patients who had contrast angiograms for the investigation of chemodectomata, two developed hemiparesis; each lasted for approximately one month and resolved completely.

DISCUSSION

Radionuclide angiography correctly identified all tumors suspected on clinical examination. However, it also detected some that were not associated with palpable masses in the neck. This suggests that the technique is more sensitive than clinical examination.

Because of the method of patient selection, and also because not all of our patients had contrast angiography, assessment of the specificity of the test for CBT can only be conjectural. However, of the other mass lesions usually occurring in the lateral part of the neck (*12*) (thyroid lesions, parathyroid tumors, cystic hygroma, bronchogenic cysts, neural tumors, sarcoma, thymic cysts, and lymph nodes) none generally shows the very marked

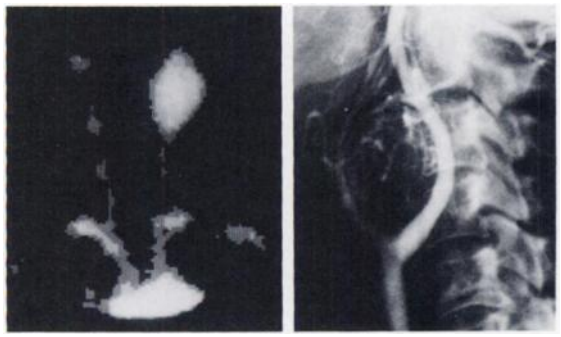

FIG. 3. Large, left carotid-body tumor is shown on radionuclide angiography (left, patient no. 5). Arteriogram shows left carotid-body tumor (right).

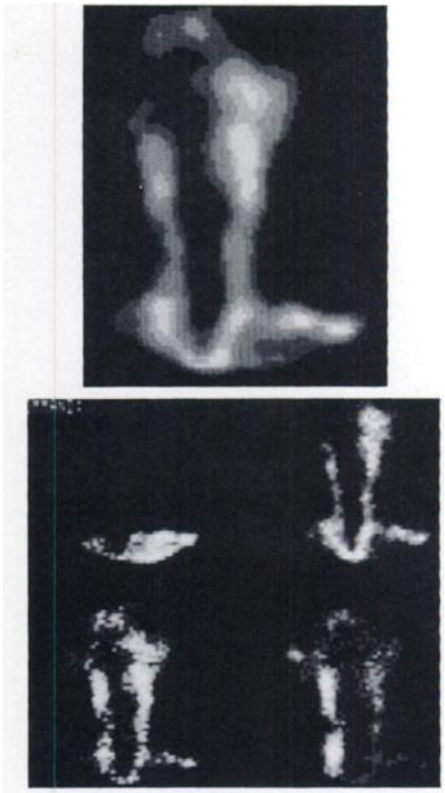

FIG. 4. Radionuclide angiogram of a large, left glomus jugulare tumor (upper, patient No. 7). Note increased left carotid flow (frame 2), the tumor (frame 3), and diminished left jugular flow (frame 4).

vascularity of CBTs. It appears, therefore, that the only other lesion likely to be confused with a CBT is an aneurysmal dilatation of the carotid artery near the bifurcation.

We note that among those patients in our series who had contrast angiography, an unexpectedly high incidence of complication was found (two cases of transient hemiparesis in 10 studies). An extensive review of complications of angiography in 514 American hospitals, conducted by Hessel et al. (*11*), showed a very low incidence of transient hemiparesis (0.03%) following transfemoral catheterization. This, taken with our own experience, suggests that increased risk factors may operate during contrast angiography of tumor chemoreceptor tissue. On the available evidence, therefore, it appears that radionuclide angiography should be the first line of investigation following clinical assessment of patients in whom the diagnosis of CB or glomus jugulare tumor is being considered.

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