

## The usefulness of cardio-vascular visualization in the localization of mediastinal pheochromocytomas with I-131-MIBG

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A case of malignant mediastinal paraganglioma showing moderate I-131-MetaIodoBenzylGuanidine (MIBG) uptake in the pericardiac region is presented. The patient had already undergone unilateral adrenalectomy with obvious clinical and biochemical findings of pheochromocytoma. The initial thoraco-abdominal CT and adrenal MRI were negative. The MIBG scan prior to the operation showed moderately increased uptake in the left adrenal region. No pheochromocytoma was found in the removed gland and the clinical signs persisted following the operation. The second MIBG scan after surgery showed a moderate left mediastinal uptake site by which it was difficult to rule out intracardiac localization. Without moving the patient, successive images of the tumor, myocardium and main mediastinal vessels were obtained by using the 24 hour activity of the initially injected 37 MBq Iodine-131-MIBG, 74 MBq Thallium-201 and 555 MBq Tc-99m-Human Serum Albumin (HSA), respectively. The superimposed bicolor images clearly showed the extracardiac localization of the tumor. The MRI scan confirmed this finding. Subsequent surgery found a malignant paraganglioma and metastatic mediastinal lymph nodes. We conclude that the visualization of the myocardium and the main mediastinal vessels with specific agents can be very useful in defining the exact location of I-131-MIBG detected mediastinal pheochromocytomas.

**Key words:** iodine-131-MIBG, tumor imaging, pheochromocytoma

### INTRODUCTION

THE CLINICAL DIAGNOSIS of functioning pheochromocytomas (catecholamine secreting tumors of chromaffin cells in the adrenal medulla) and paragangliomas (extra-adrenal pheochromocytomas) is based on sustained or paroxysmal hypertension. The biochemical findings are abnormal levels of plasma or urinary catecholamines or metabolites. Precise localization of the tumor is essential for the planning and evaluation of treatment. Cross-sectional imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI) play a major role in detecting pheochromocytomas located in the adrenal glands. I-131-Metaiodobenzylguanidine (MIBG) scintigraphy provides an additional method for

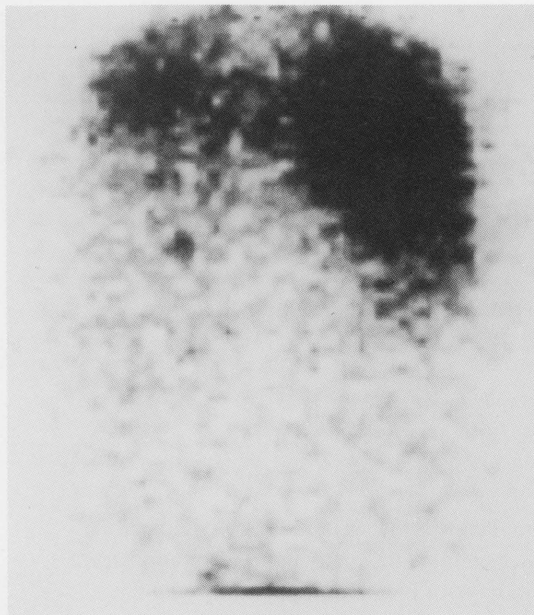
localization.<sup>1</sup> MIBG is an aralkylguanidine which structurally resembles noradrenaline sufficiently to be recognized by the uptake-1 mechanism and to be stored in the catecholamine storage vesicles.<sup>2</sup> Whereas the sensitivity of CT and MRI approaches 100% for adrenal tumors greater than 2 cm in diameter, I-131-MIBG scanning has greater specificity for adrenal disease and has clearly superior sensitivity for smaller tumors and extra-adrenal sites.<sup>1,3</sup> We present a case of mediastinal paraganglioma in which I-131-MIBG scintigraphy and radionuclide cardiovascular imaging were the problem solving methods.

### CASE REPORT

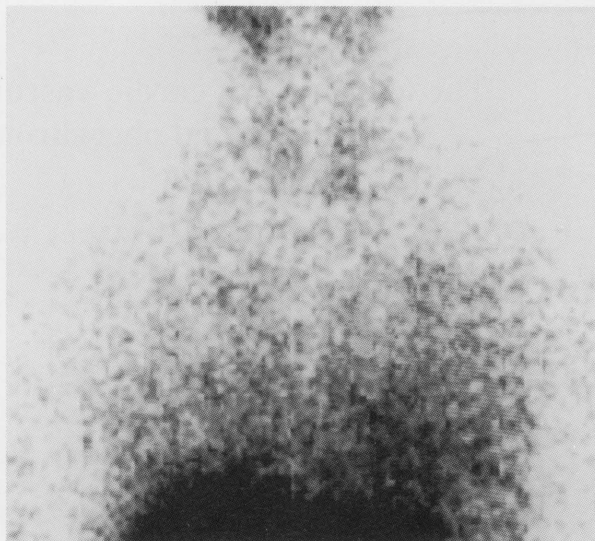
A 35-yr-old man was admitted to the internal medicine department with paroxysmal hypertension (220/110 mm Hg), headache and palpitation. The plasma noradrenaline level as well as 24-hour urinary noradrenaline and normetanephrine levels were increased (*Plasma*: Noradrenaline = 3631, NV = < 800 pg/ml, Adrenaline = 175, NV = < 200 pg/ml; *Urine*: Noradrenaline = 564, NV = 50-

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a



b

**Fig. 1** a. Initial posterior abdominal I-131-MIBG scan with faint uptake of the left adrenal gland.  
b. Initial anterior I-131-MIBG scan of the thorax.

200  $\mu\text{g}/24\text{ h}$ ; Adrenaline = 11, NV =  $< 60\ \mu\text{g}/24\text{ h}$ ; Normetanephrine = 922, NV = 110–420  $\mu\text{g}/24\text{ h}$ ; Metanephrine = 60, NV = 70–380  $\mu\text{g}/24\text{ h}$ ; Vanillylmandelic acid = 5.5, NV = 2–7  $\text{g}/24\text{ h}$ ). The initial thoraco-abdominal CT scan was normal. The clonidine test was positive. MRI scan of the adrenals was normal. The I-131-MIBG scintigraphy, realized one week later, showed no anomaly in the thoracic region but moderately increased uptake in the left adrenal region (Fig. 1a, b). Despite all signs of a catecholamine secreting tumor, this was not definitely located. The patient was treated medically and a control CT-scan in several months was planned. The latter was performed 2 months later and there was suspicion of a small (5 mm diameter) left-adrenal tumor. This was also observed by ultrasonography during a Doppler examination of the renal arteries. The urinary noradrenaline and normetanephrine levels were still increased. Slightly high values of adrenaline were found in the left adrenal venous blood, but the final decision on adrenalectomy could be made after a medical treatment period of five months. The peroperative pathological examination of the removed gland showed surprisingly normal adrenal tissue. The exploration of the right adrenal gland, abdominal and retroperitoneal cavity was unremarkable. All symptoms persisted after the operation and almost all urinary catecholamines as well as their metabolites were increased (Noradrenaline = 2740  $\mu\text{g}/24\text{ h}$ ; Adrenaline = 110  $\mu\text{g}/24\text{ h}$ ; Normetanephrine = 9033  $\mu\text{g}/24\text{ h}$ ; Metanephrine = 347  $\mu\text{g}/24\text{ h}$ ; Vanillylmandelic acid = 12.5  $\text{g}/24\text{ h}$ ). The medical treatment had to be continued. As part of the thoracic exploration, the aortography was normal. The following coronarography showed no mor-

phological anomaly but the catecholamine levels in the arterial blood were more elevated than in the venous blood. A second I-131-MIBG scan was planned and could be performed nine weeks later. Following the blockage of thyroid iodine uptake with Lugol's solution (200 mg per day orally starting 2 days before tracer administration and continuing for 7 days). 37 MBq of I-131-MIBG was administered intravenously. Because of the patient's personal reasons only the 24 hour images could be obtained with a large field of view gamma camera (Sopha Medical, DSX) equipped with a high energy collimator and a 20% window centered at 364 KeV. The spot images showed moderate tracer uptake in the left mid-mediastinal region. Although the typical myocardial uptake of I-131-MIBG was absent, it was difficult to affirm with certainty the presence of an extracardiac mediastinal tumor. To more clearly pinpoint this uptake site, 74 MBq of Tl-201 was injected intravenously for the myocardial visualization and without moving the patient static thorax images were obtained 15 min after the injection. Still without moving the patient 555 MBq of Tc-99m-Human Serum Albumin (HSA) was administered intravenously to visualize the cardiac cavities and the main mediastinal vessels. Anterior superimposed bicolor images of I-131-MIBG (red) and Tc-99m-HSA (green) (Fig. 2) and left lateral superimposed bicolor images of I-131-MIBG (red) and Tl-201 (green) (Figs. 3, 4, and 5) clearly showed the extra cardiac localization of the uptake site beneath the pulmonary artery.

The MRI scan (Fig. 6), focused on this region, detected a 2.2 cm mass behind the main pulmonary artery. Subsequent thoracotomy, performed during the same hospital



Fig. 2

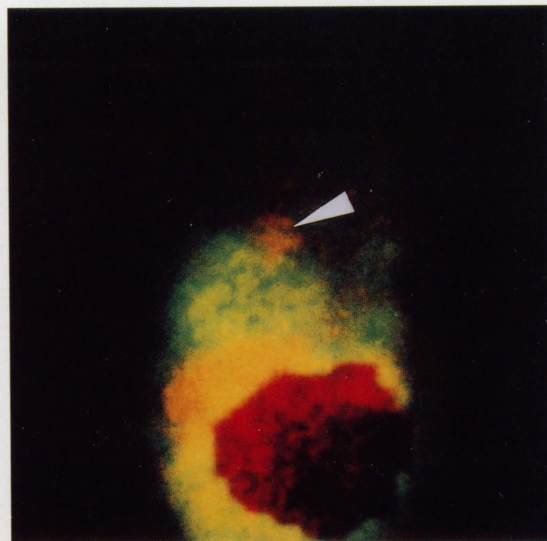


Fig. 5



Fig. 3

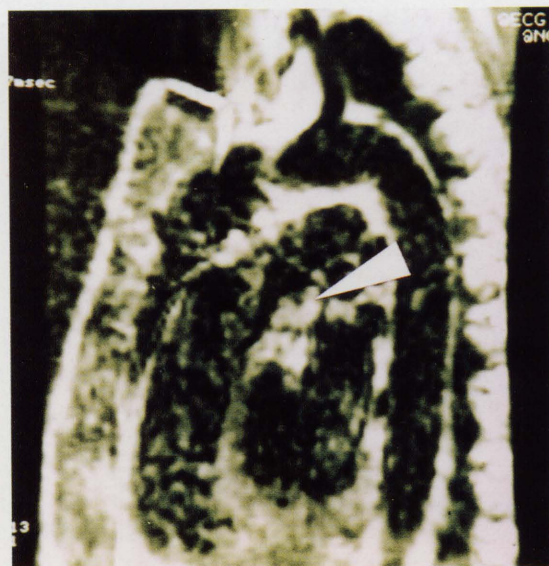


Fig. 6

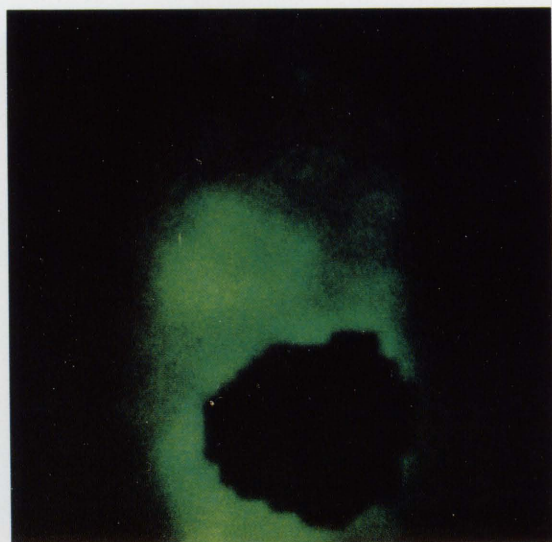


Fig. 4

Fig. 2 Anterior thoraco-abdominal superimposed I-131-MIBG (red) and Tc-99m-HSA (green) scans (arrow pointed at tumor).  
 Fig. 3 Left lateral thoraco-abdominal I-131-MIBG scan.  
 Fig. 4 Left lateral thoraco-abdominal Tl-201 scan.  
 Fig. 5 Left lateral thoraco-abdominal superimposed I-131-MIBG (red) and Tl-201 (green) scans (arrow pointed at tumor).  
 Fig. 6 Mid-mediastinal sagittal MRI image (arrow pointed at tumor).

admission, revealed an adherent and richly vascularized tumor behind the pulmonary artery in contact with the left coronary artery. The pathological examination of the removed mass showed lymph node metastasis in the peritumoral adipose tissue resulting in the diagnosis of a malignant paraganglioma. In the days following the operation, the patient underwent adjuvant chemotherapy. All clinical symptoms and biochemical findings of the catecholamine secreting tumor rapidly disappeared.

## DISCUSSION

I-131-MIBG is normally taken up by liver, spleen, salivary glands and the myocardium. Faint uptake in the normal adrenal glands is seen in up to 16% of cases. The degree of myocardial uptake is inversely related to circulating noradrenaline levels, so that cardiac uptake is frequently reduced or even absent in patients with pheochromocytomas.<sup>4,5</sup> In this patient, the tumor uptake in the initial I-131-MIBG study was probably so faint that it was not seen beneath the moderate myocardial uptake. In the second study, the small mediastinal uptake site could be hardly distinguished from a partial myocardial uptake of I-131-MIBG. A cardiac tumor location could therefore not be easily ruled out. It must be mentioned that Tl-201 uptake in an adrenal pheochromocytoma has been demonstrated by Nakajo et al.<sup>6</sup> The images obtained by this superimposition technique with Tl-201 alone should therefore be carefully interpreted. In the case of overlapping I-131 deposits and myocardial Tl-201 uptake, it can be impossible to exclude the cardiac origin of the tumor. In our patient there was no such problem. After a negative thoracic CT and exploratory thoracotomy, demonstration of a left atrial pheochromocytoma by means of a similar superimposition technique with I-131-MIBG and Tc-99m labeled red blood cells, has been reported by Shapiro et al.<sup>7</sup> We conclude that in the case of suspected pheochromocytomas and mediastinal uptake of I-131-MIBG, the

visualization of the myocardium, cardiac cavities and mediastinal blood vessels with specific tracers can significantly improve the localization of these tumors.

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