Indium-111 octreotide scintigraphy in neurofibromatosis

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Abstract. Scintigraphy with the radiolabelled somatostatin analogue indium-111-DTPA-D-Phe-1-octreotide has recently been proposed for the imaging of CNS neoplasms expressing somatostatin receptors. While meningiomas are imaged with high sensitivity, neurinomas do not take up octreotide owing to the lack of somatostatin receptors. Neurofibromatosis is a relatively uncommon disorder in which meningiomas and neurinomas often occur in the same patient. Differential diagnosis between these two tumours by computed tomography and magnetic resonance imaging can be difficult. This study reports on ¹¹¹In-octreotide scintigraphy in four patients with neurofibromatosis. ¹¹¹In-octreotide scintigraphy was shown to be very helpful in the in vivo differential diagnosis: all four meningiomas showed intense tracer uptake, while all 15 neurinomas were negative (P<0.001 by Fisher’s exact test). It may be concluded that scintigraphy with ¹¹¹In-octreotide is a useful diagnostic procedure in neurofibromatosis, complementing standard neuroradiological imaging procedures.

Key words: Indium-111 octreotide scintigraphy – Neurofibromatosis – Somatostatin receptors


Introduction

Scintigraphy with the radiolabelled somatostatin analogue indium-111-DTPA-D-Phe-1-octreotide has recently been proposed for the imaging of CNS neoplasms expressing somatostatin receptors [1–3]. While there is controversy over the use of somatostatin receptor scintigraphy for the imaging of gliomas, where the role of blood-brain barrier permeability is still incompletely characterized [2, 4, 5], there is general agreement that all meningiomas can be successfully imaged by this means [2–5]. Neurinomas do not show ¹¹¹In-octreotide uptake [2, 3] and this finding is concordant with the known absence of somatostatin receptors in these tumours [3, 6].

Neurofibromatosis (NF), also known as von Recklinghausen’s disease, is a relatively uncommon disorder. In approximately 50% of cases it presents with a familial history consistent with an autosomal dominant transmission with variable expression, while the remaining cases represent new mutations [7]. NF can be subdivided into type I or peripheral NF and type II or central NF [7]. Both type II NF and to a lesser extent type I NF are complicated by meningiomas and multiple CNS tumours other than meningiomas, such as gliomas and neurofibromas, these tumours often coexisting in the same patient. Differential diagnosis between meningiomas and neurinomas by conventional neuroradiological imaging procedures such as computed tomography (CT) and magnetic resonance imaging (MRI) can pose problems [8, 9].

This study reports on ¹¹¹In-octreotide scintigraphy for the differential diagnosis of CNS tumours in a small series of patients with NF.

Materials and methods

Patients. The study included four patients referred to the Neurosurgery Department of the "Regina Elena" National Cancer Institute in Rome between December 1992 and April 1994 and diagnosed as having type I NF (one patient) or type II NF (three patients). Informed consent was obtained from patients or their parents.

Radiotherapeutics. The somatostatin analogue DTPA-D-Phe-1-octreotide and ultra-pure ¹¹¹In-chloride were obtained from Byk-Gulden (Milan, Italy) in a single kit (Octreoscan). ¹¹¹In-chloride contained ¹¹⁴mIn to a limited extent (0.5 kBq ¹¹⁴mIn/MBq ¹¹¹In at calibration time). Single-step radiolabelling of 10 µg of DTPA-D-Phe-1-octreotide with 111–185 MBq of ¹¹¹In was performed. Quality control as per the manufacturer’s instructions was carried out prior to administration of the radiopharmaceutical. ¹¹¹In-DTPA-D-Phe-1-octreotide was given as a bolus intravenous injection.

Scintigraphic imaging. Whole-body and planar images of the brain and of the spinal cord were recorded with a rectangular gamma camera (Toshiba 90/B) equipped with a medium-energy,
parallel-hole collimator using a hardware zoom of x2. The pulse-
height analyser windows were centered over both $^{111}$In photon
peaks (172 and 245 keV) with window widths of 20% and 15%
respectively. Planar images were performed at 2–4 and 24 h with a
pre-set time of 20 min and/or a minimum of 800 kcounts and a
matrix of 256x256 or 512x512. Whole-body acquisition was per-
formed at 2–4 and 24 h with a scan speed of 10 m/s and a matrix
of 128x128.

**Magnetic resonance imaging.** MRI was performed with a super-
conductive magnet operating at 1.5 T (Magnetom-Siemens) using
a body coil and a matrix of 256x256. Images were obtained with
spin-echo techniques including T1-weighted (TR 560 ms, TE 15
ms) and T2-weighted (TR 2500 ms, TE 15/90 ms) sequences with
a 6–8 mm slice thickness. Paramagnetic contrast medium, gado-
linium-diethylene triamine penta-acetic acid (Gd-DTPA, Shering-
AG, Berlin), was administered at a dosage of 0.1 mmol/kg body
weight i.v.

**Results**

**Patient no. 1**

Patient no. 1 was a 12-year-old male who in 1984 under-
went surgery for a large, right frontoparietal meningio-
ma. Two years later he developed a slowly progressive
reduction in visual acuity of the left eye. On admission
in October 1992 he presented with amaurosis and verti-
cal and external ophthalmoplegia of the left eye. Left ex-
ophthalmos was present. MRI showed an hourglass-
shaped tumour consisting of an intraorbital 25-mm-large
round mass surrounding the left optic nerve which ex-
tended through the optic foramen to the middle cranial
fossa as far as the cavum trigeminale (Fig. 1a). The me-
sial aspect of the left temporal lobe was compressed by
the tumour. Two 4- to 5-mm-large enhancing tumours
were also present bilaterally in the internal acoustic me-
atus (Fig. 1b). A malacic area representing a sequela of
the previous operation was appreciable in the right parietal
lobe, with no sign of tumour recurrence. MRI exam-
ination of the spine revealed two intrathecal enhancing
tumours anteriorly located at the C2 and C6 levels and
causing spinal cord compression (Fig. 1c). Other lesions
were present in an intra- or extradural location in the dis-
tal part of the cervical spine, the largest being at the C7
level on the left. The MRI pattern (isointense signal on
T1-weighted images, high signal intensity on T2-weight-
ed images, marked Gd-DTPA enhancement) of the les-
ions suggested the diagnosis of multiple neurinomas.
The absence of skin lesions allowed for a diagnosis of
probable type II NF. $^{111}$In-octreotide scintigraphy
showed intense tracer uptake only in the left orbit (Fig.
1d). The orbital lesion was then partially removed and