Different concentrations of various radiopharmaceuticals in the two main liver lobes: a preliminary study in clinical patients

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Introduction

Nuclear medicine examinations represent functional imaging, as the uptake mechanisms of radiopharmaceuticals are based on physiological or biochemical properties. In our laboratory, most scintigraphic examinations of the abdomen are made using single photon emission computed tomography (SPECT). We have considerable experience with this examination technique, since the first clinically working SPECT-system was developed at our laboratory.1 This technique enables three-dimensional visualization of the activity distribution within an organ or a tissue by means of sectional (tomographic) images. As many radiopharmaceuticals are eliminated by the liver, this often shows up irrespective of whether the examination is directed to the liver or not. In clinical liver/spleen scintigraphy, using radiolabelled colloids for depiction of the reticuloendothelial system, lower uptake of the left main liver lobe compared to the right main lobe was a consistent occurrence in patients with otherwise unremarkable findings.2 We have made the same observation at clinical examinations using 111In-pentetreotide (OctreoScan; Malinckrodt Medical, Petten, The Netherlands) for tumor detection and 99mTc-dimethyliminodiacetic acid (HIDA).3 Using [123I]-metaiodobenzylguanidine ([123I]-MIBG) for the depiction of neural crest tumors in clinical patients, we noted the opposite; namely, a higher uptake in the left main liver lobe than in the right.4 In contrast to these observations, granulocyte scintigraphy using a monoclonal antibody shows no apparent difference between the two main liver lobes.

Background. At clinical scintigraphic examinations of the abdomen using single photon emission computed tomography (SPECT), we have observed a different distribution between the left and right main liver lobes of various radiopharmaceuticals. This was studied retrospectively in clinical patients.

Methods. Examinations with [123I]-metaiodobenzylguanidine MIBG; (n = 19), a 99mTc-labelled monoclonal antibody against granulocytes (n = 18), and 111In-pentetreotide (n = 26) were assessed. There was no known history of, or risk factor for liver disease, and all lobes showed a uniform activity distribution. Twenty healthy volunteers underwent consecutive examinations with 99mTc-dimethyliminodiacetic acid (HIDA). The activity ratios between the left and right main liver lobes were calculated from the transverse tomographic (SPECT) sections.

Results. The left:right lobar activity ratio for [123I]-MIBG was (mean ± SD) 1.25 ± 0.21 (null hypothesis = 1.00; P < 0.001); for the antibody, acquisition after 3–5 h was 0.98 ± 0.06 (NS) and after 20–24 h, 0.99 ± 0.11 (NS); for 111In-pentetreotide, 0.90 ± 0.09 (P < 0.001); for 99mTc-HIDA, immediate acquisition, 0.68 ± 0.12 (P < 0.001) and acquisition at 7 min, 0.66 ± 0.12 (P < 0.001).

Conclusions. The differences in tracer uptake between the liver lobes cannot be caused only by differences in blood flow. One explanation of the higher uptake of [123I]-MIBG by the left lobe may be a greater presence of catecholamines and a higher sympathetic nerve density in this liver portion. Consequently, there may be a functional difference between the two main liver lobes.

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clinical patients, using $^{[123]}$I-MIBG, $^{111}$In-pentetreotide, and a $^{99m}$Tc-labelled monoclonal antibody directed against human granulocytes (mAb), and in healthy volunteers, using $^{99m}$Tc-HIDA.

**Subjects and methods**

**Subjects**

From all clinical examinations in adults performed during a 5-year period, 19 patients examined with $^{[123]}$I-MIBG, 26 examined with $^{111}$In-pentetreotide, and 18 examined with $^{99m}$Tc-labelled mAb were studied retrospectively (Table 1). Inclusion criteria were: (1) no known history of, or risk factor for liver disease; (2) uniform activity distribution in each liver lobe; (3) a left liver lobe bulky enough to allow a representative evaluation; (4) liver chemistry test done within ±3 months from the examination, showing alkaline phosphatase plus at least one more liver test result within the normal range. Patients having any pathological liver test findings were excluded. All patients were examined with only one of the tracers studied. The indication for $^{[123]}$I-MIBG scintigraphy was suspected pheochromocytoma/paraganglioma. For $^{111}$In-pentetreotide, the indication was suspected carcinoid, insulinoma, or gastrinoma. Indication for examination with the mAb was a suspected focal bacterial infection. In all patient groups, a number of examinations showed pathological uptake outside the liver (Table 1).

Twenty healthy volunteers were examined with $^{99m}$Tc-HIDA. This was approved by the local Ethics and Radiation Safety Committees. Informed consent was always obtained.

**Radiopharmaceuticals**

The subjects received i.v. 120–200 MBq of $^{[123]}$I-MIBG (Mallinckrodt Medical), 120–200 MBq of $^{111}$In-pentetreotide ([$^{111}$In-DTPA-D-Phe$^1$]-octreotide, OctreoScan, Mallinckrodt Medical), 500 MBq of $^{99m}$Tc-labelled monoclonal murine antibody against human granulocytes (mAb; Anti-Granulocyte BW 250/183; CIS MEDIPRO, Geneva, Switzerland), or 120 MBq of $^{99m}$Tc-$N$-(2,6-diethylphenylcarbomoylmethyl)iminodiacetic acid (etifenin; $^{99m}$Tc-HIDA, HIDASOL; Amersham Sorin, Saluggia, Italy). Each batch of the mAb and $^{99m}$Tc-HIDA labelling kits was routinely tested with regard to free pertechnetate by thin-layer chromatography.

**Examination**

SPECT examinations were performed 22 to 26 h after the administration of $^{[123]}$I-MIBG and $^{111}$In-