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Contribution of Different Scintigraphic Techniques to the Management of Medullary Thyroid Carcinoma

Dirk Sandrock,* Hans-Christian Blosssey,* Martina Steinroeder,* and Dieter L. Munz*

We compared three different scintigraphic techniques for the localization of neck recurrences and metastases in seven patients with medullary thyroid carcinoma one month to eight years after the first surgical intervention. Three successive scintigraphic studies were performed in five patients (6 × 3 studies) within two weeks using ²⁰¹Tl chloride, ¹¹¹In-labeled F(ab')₂ fragments of the anti-carcinoembryonic antigen (anti-CEA) monoclonal antibody (MoAb) BW 431/31, and ¹³¹I meta-iodo-benzylguanidine (MIBG). Additionally, 11 studies were performed with the ¹¹¹In-labeled MoAb fragment BW 431/31 (seven studies) or the ^{99m}Tc-labeled intact anti-CEA MoAb BW 431/26 (four studies). The gold standards for classifying scintigraphic results were biopsy, histology, surgery, and cytology. Six regions were classified as positive or negative in each study: thyroid region, four quadrants (lymph node regions) around the thyroid, and the region of the upper mediastinum. Of 36 sites, ²⁰¹Tl was true positive (TP) in seven sites, false-positive (FP) in one site, true negative (TN) in 22 sites, and false-negative (FN) in six sites, resulting in a sensitivity of 54% and a specificity of 96%. ¹³¹I MIBG was TP in four sites, FP in none of the sites, TN in 23 sites, and FN in nine sites, with a sensitivity of 31% and a specificity of 100%. Immunoscintigraphy (102 sites overall) was TP in 16 sites, FP in five sites, TN in 77 sites, and FN in four sites, resulting in a sensitivity of 80% and a specificity of 94%. Immunoscintigraphy with ¹¹¹In/^{99m}Tc anti-CEA F(ab')₂ fragment/intact antibody is superior to scintigraphy with ²⁰¹Tl and ¹³¹I MIBG. (Henry Ford Hosp Med J 1989;37:173-4)

Several approaches with different radiotracers have been reported for the localization and treatment of medullary thyroid carcinoma (MTC) (1-6) in addition to serum levels of calcitonin (CT) and carcinoembryonic antigen (CEA) as tumor markers.

We compared different scintigraphic methods (²⁰¹Tl, ¹³¹I meta-iodo-benzylguanidine [MIBG], and immunoscintigraphy) for the localization of neck recurrences and metastases in patients with MTC and for the assessment of the value of immunoscintigraphy for the follow-up of these patients.

Methods

Seven patients with MTC were studied one month to eight years after first surgical intervention (usually total thyroidectomy and/or neck dissection). Patients included three men and four women, aged 22 to 65 at the time of first scintigraphy. Six had a sporadic MTC and one also had a pheochromocytoma.

Overall, 29 scintigraphic studies were performed: in five patients, six intraindividual comparisons were performed within two weeks with all three tracers (6 × 3 = 18 studies). Additionally, 11 studies were performed using immunoscintigraphy alone.

For ²⁰¹Tl studies, 74 MBq ²⁰¹Tl chloride was given intravenously and scintigraphic images obtained 10 to 90 minutes

postinjection. Twenty-six MBq ¹³¹I MIBG were injected intravenously, and scintigraphy was performed one, two, and, if necessary, five days postinjection. For immunoscintigraphy, we used 185 MBq ¹¹¹In-labeled F(ab')₂ fragments of the anti-CEA monoclonal antibody BW 431/31 intravenously with scintigraphy one and two days postinjection (13 studies) or 740 MBq ^{99m}Tc-labeled intact anti-CEA monoclonal antibody BW 431/26 with scintigraphy 4.5 and 24 hours postinjection (four studies). Studies using emission computed tomography were also done if appropriate.

In each study, six regions were classified as positive or negative: thyroid region, four lymph node quadrants around the thyroid, and the upper mediastinal region. The gold standards for classification as true or false positive/negative were biopsy, surgery, histology, or cytology. Computed tomography or ultrasonography demonstrated partly normal, partly equivocal findings.

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Table
Results of Scintigraphy in Medullary Thyroid Carcinoma

Tracer	Sites	TP	FP	TN	FN	Sensitivity	Specificity
²⁰¹ Tl chloride	36	7	1	22	6	54%	96%
¹³¹ I MIBG	36	4	0	23	9	31%	100%
¹¹¹ In/ ^{99m} Tc MoAb	102	16	5	77	4	80%	94%

TP = true positive, FP = false-positive, TN = true negative, and FN = false-negative.

Results

Overall, 13 of 36 regions (²⁰¹Tl, MIBG studies) were positive with tumor recurrence or lymph node metastases as proven by histology or cytology. In the larger group with immunoscintigraphic studies, 20 of 102 regions were tumor positive: eight local recurrences in the thyroid area, four lymph node metastases in the upper quadrant (cervical), six lymph node metastases in the lower quadrant (lower jugular vein and supraclavicular), and two lymph node metastases in the upper mediastinum. The size of the tumor deposits detected by scintigraphy ranged from 1.5 to 4 cm in diameter. At time of first study, serum CEA was elevated in four patients, normal in two patients, and not available in one patient. CT was positive in three patients, negative in three patients, and not available in one patient.

Immunoscintigraphy detected 16 sites correctly (true positive) and missed four sites (false-negative). A total of 77 sites were classified as true negative, and five false-positive spots were seen. In all patients with false-negative or false-positive spots, at least one true positive site was detected.

With ²⁰¹Tl chloride, seven sites were true positive and six were false-negative. Twenty-two regions were true negative and one spot was false-positive. Using ¹³¹I MIBG, only four sites were true positive while nine sites were missed (false-negative). All 23 sites were true negative (no false-positive). The Table gives the appropriate numbers and the sensitivity and specificity values.

Immunoscintigraphy with ¹¹¹In-labeled anti-CEA F(ab')₂ fragments or ^{99m}Tc-labeled intact anti-CEA monoclonal antibody is superior to scintigraphy with ²⁰¹Tl chloride and ¹³¹I MIBG.

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