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The role of NM in thyroid and parathyroid diseases

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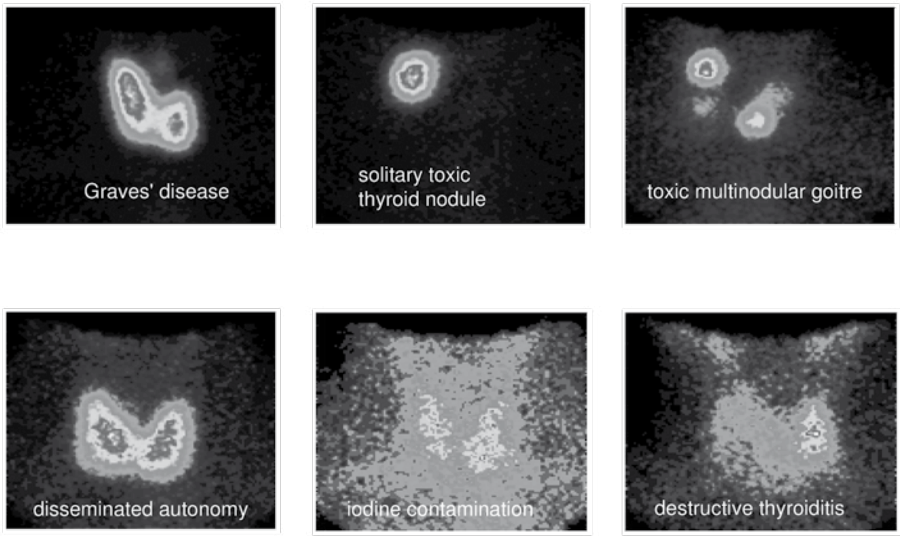
Nuclear medicine procedures were first employed for the diagnosis and therapy of thyroid diseases in the 1950s, and thus represented the first clinical application of nuclear medicine. Today the role of nuclear medicine in this context depends on the conditions within different European countries and the iodine supply of the population. For the assessment of thyroid nodules, ultrasonography and scintigraphy using technetium-99m pertechnetate or iodine-123 are the routine imaging methods in most centers. Technetium-99m pertechnetate (99mTcO4-), the most common tracer for routine thyroid scintigraphy, is transported into the thyroid by the Na+/I- symporter (NIS) because of similarity in the molecular size of 99mTcO4- and iodine, but kinetics differ from iodine isotopes as 99mTcO4- is not organified in the gland. The scintigraphy is performed between 15 and 30 minutes after intravenous application of 37-74 MBq 99mTcO4-. The scintigraphic data are usually acquired using a 20% window centered around the 140 keV peak of technetium-99m, a LEHR collimator and a 128 x 128 computer matrix. If iodine-123 is used, images can be obtained as early as 3–4 hours after ingesting the tracer. The 13.3-hour half-life, the 159-keV principal photon, and the absence of particulate emission allows good imaging with modest radiation exposure. The administered activity usually ranges between 7.5 and 25 MBq Na-I-123 iodide. The strategy of examining thyroid nodules is different in countries with sufficient intake of iodine compared with countries in which iodine intake is insufficient. In the latter scintigraphy of the thyroid is still one basic diagnostic tool. Thyroid nodules are well visualised on sonography permitting definition of the site, size and echo structure. The sonographic findings suggestive of differentiated thyroid cancer are a solid and hypoechoic structure, irregular and ill-defined margins, absence of a halo sign, microcalcification, intranodular vascularisation and local lymphadenopathies (1). The strategy for evaluation of sonographically diagnosed nodules might be: In the case of a hypoechoic nodule smaller than 1.5 cm and euthyroidism, a Tc-99m-pertechnetate scan is of limited value, because most of these small nodules are not hypofunctioning on the scan (2). The next diagnostic step should be an ultrasound-guided fine-needle aspiration biopsy (ugFNAB), which provides the most direct and specific information about a thyroid nodule, in particular there is a high accuracy of ugFNAB in papillary thyroid cancer (3,4). Tc-99m pertechnetate or iodine-123 scintigraphy is also used in proven hyperthyroidism to differentiate between a destructive and productive etiology and to differentiate between Graves' disease and thyroid autonomy. Some different scintigraphic patterns are demonstrated in Fig. 1.

In parathyroid diseases imaging with technetium-99m labelled cationic complexes is the most used scintigraphic method for localizing parathyroid adenomas, being superior to a Tl-201/Tc-99m subtraction scan. In 1989, the use of Tc-99m-sestamibi for parathyroid imaging was reported the first time by Coakley et al. (4). Several authors subsequently presented different techniques and imaging protocols for Tc-99m-sestamibi parathyroid imaging, including subtraction scintigraphy with iodine-123 or Tc-99m-pertechnetate and dual-phase scintigraphy with early and delayed imaging. Later on Tc-99m-tetrofosmin and Tc-99m-furifosmin have been introduced, which show similar but not identical behaviour (5). Today there there is still an inconsistency, which technique or tracer is best for parathyroid imaging. Following factors may play a role in choosing the tracer and technique: Subtraction scintigraphy using either iodine-123 or Tc-99m-pertechnetate as the thyroid tracer shows the highest sensitivity. However, the need for absolute neck immobility to avoid motion artefacts when using sequential dual-nuclide acquisition presents a considerable methodological challenge. Using the dual-phase approach, which has a lower sensitivity than subtraction methods, It is necessary to perform additional SPECT imaging and 3D reconstruction to improve sensitivity. Tc-99m-sestamibi and Tc-99m-tetrofosmin give comparable results, although the uptake mechanism does not seem identical. also economic considerations may play a role in choosing the tracer, as remaining activity from myocardial studies using Tc-99m-sestamibi and Tc-99m-tetrofosmin.

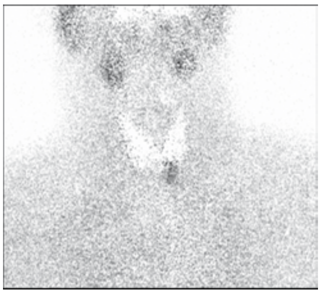
Abstracts

Fig. 1



Different patterns of radionuclide imaging of the thyroid

Fig. 2



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