



NINTH INTERNATIONAL CONFERENCE ON RADIATION IN VARIOUS FIELDS OF RESEARCH

June 14-18, 2021 | Hunguest Hotel Sun Resort | Herceg Novi | Montenegro

Thyroid scintigraphy using Technetium-99m

Florina-Gianina ELFARRA^{1,2}, Radu MUTIHAC¹, Ileana RADULESCU³

¹University of Bucharest, Faculty of Physics - Doctoral School of Physics - Department of Biophysics and Medical Physics, Bucharest, Romania

²St. John's Emergency Clinical Hospital, Bucharest, Romania

³Horia Hulubei National Institute for Physics and Nuclear Engineering - IFIN HH, Department of Radioisotopes and Radiation Metrology (DRMR), 30 Reactorului Street, P.O. Box MG-6, 077125, Magurele, Romania



• INTRODUCTION

The choice of radiopharmaceutical for visualization of the thyroid gland is conditioned by:

- ✓ the degree of its concentration in the thyroid;
- ✓ the need for low irradiation of both the gland and the whole body;
- ✓ the emission of sufficiently high gamma radiation for increased detection efficiency;
- ✓ suspected pathology;
- ✓ procureability and cost, as well as the doctor's preference.

Currently, nuclear medicine uses $Tc-99m$. $Tc-99m$ pertechnetate has the following physical and radiobiological benefits:

- emits 140 keV gamma radiation, allowing to obtain good quality images;
- produces low irradiation of the thyroid (0.3 rad / mCi) and of the whole body (0.011-0.018 rad / mCi);
- even allows the repetition of the scintigraphy after a short period of time, due to $T_{1/2}$ less than 6h;
- makes it possible to visualize the thyroid after about 20 minutes, without undergoing the process of organification in the gland (iodine enters the cell and participates in cell metabolism producing thyroid hormones, while $99m Tc$ only sticks to the cell surface);
- the dose used 1-10 mCi for $Tc-99m$.

SCINTIGRAPHIC DIAGNOSIS



Thyroid scintigraphy allows pathological exploitation, providing data on the size of the thyroid, the homogeneity of the distribution of the radiotracer and the intensity of its uptake, elements that help to establish the diagnosis of diseases of this organ:

- thyroiditis;
- goiter;
- toxic thyroid adenoma;
- thyroid neoplasm

Thyroid nodules are a very common health problem for adults. Their prevalence increases with age and can reach 50% by the age of 65. Thyroid scintigraphy is the only technique that allows the evaluation of the functional characteristics of a nodule.

STUDY CASE



For the clinical study, two different cases of thyroid disorders were preferred. There was one patient with toxic thyroid nodule on the right lobe and another patient with left thyroid lobe agenesis. Our study included a 45-year-old female patient with hyper-functional thyroid adenoma and a 40-year-old patient with left thyroid lobe agenesis.

The aim was to estimate and determine the activity ratio when the source with high activity (the toxic nodule had accumulated much more radioactivity) can make the total suppression of the second lobe with low activity, under the same conditions of thyroid scintigraphy. There is a high uncertainty that the lobe did not form or fade due to the high activity of the toxic nodule.

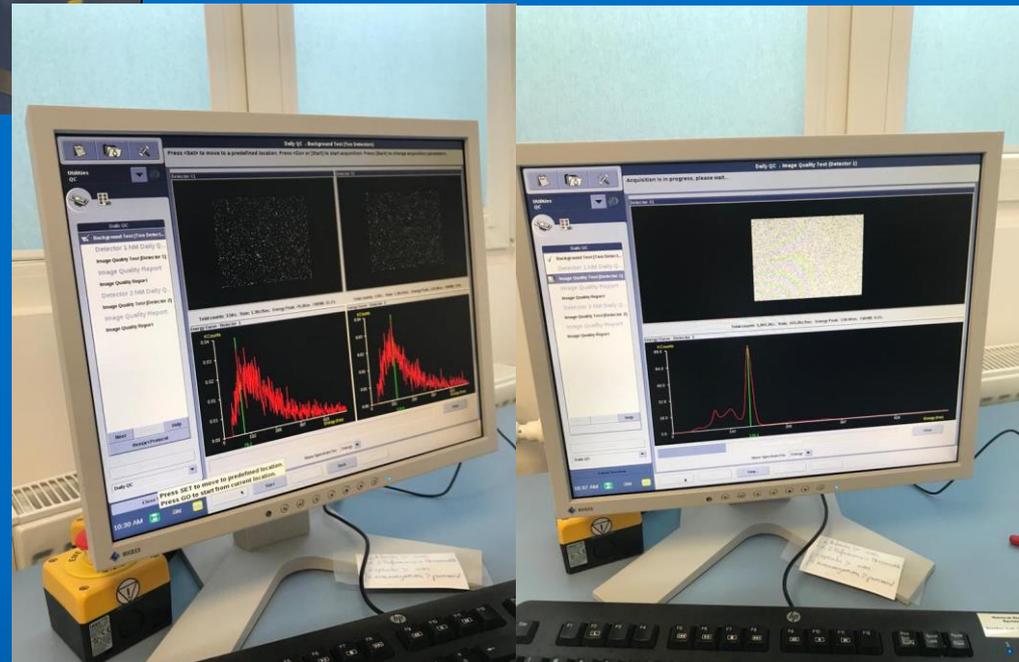
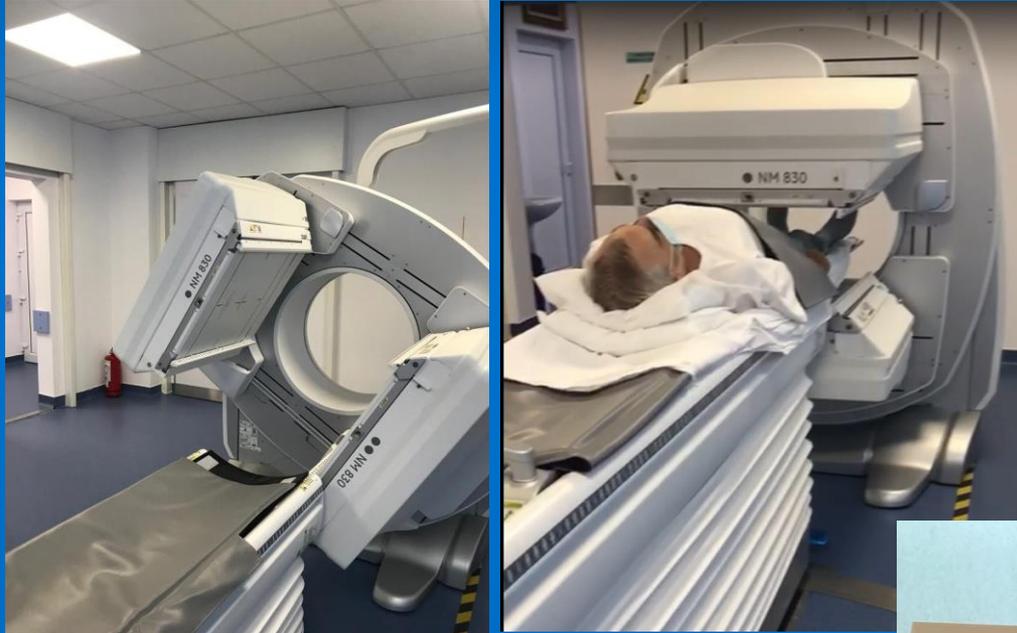
In cases of toxic thyroid adenoma, the anterior projection of the Tc-99m pertechnetate image shows a hot nodule occupying most or the entire thyroid lobe with an almost total suppression of the lobe against the side. In this case, it is very difficult to distinguish the lobe agenesis from the toxic nodule.



- **Materials and methods**

- NM 830's Elite NXT NM detectors were designed to address some of nuclear medicine's most significant challenges. Shorter photomultiplier tube combined with lean front-end electronics reduce analog noise and improve performance. The collimator is optimized to enable high sensitivity, low septal penetration and high resolution.
- In this study, a clinical trial with two different thyroid disorders were preferred.
- The radiopharmaceutical chosen for performing scintigraphy was pertechnetate Tc-99m, and was administered intravenously.
- After waiting for 20 minutes, the patient was placed on the table of the scintigraphy device with his head bent on his back, so that the area of the thyroid lodge is under the detector as central as possible. To assess the position and size of the thyroid on the image from the previous incidence, mark the upper edge of the sternum, the collarbones, the upper edge of the thyroid cartilage and the lateral edges of the neck. When using the scintillation chamber, it is preferable that each image obtained should contain 200,000 pulses.

- Materials and methods



• RESULTS EVALUATION



Thyroid scintigraphy was performed 20 minutes after intravenous administration of 3 mCi of pertechnetate Tc-99m.

The scintigraphy of the thyroid gland showed, in the first case, a toxic nodule in the right thyroid lobe in the 45-years-old patient.

Thyroid scintigraphy examination revealed (Figure 1):

- thyroid with normal position and enlarged dimensions of the lobe;
 - increased and inhomogeneous fixation of the radiotracer at the levels of the entire parenchyma;
 - hypercapture area at the upper 1/3 of the RST (warm nodule)
 - low intensity perithyroid radioactive background
- Conclusions:
hypercaptic goiter (hyperfunctional) with warm RST nodule

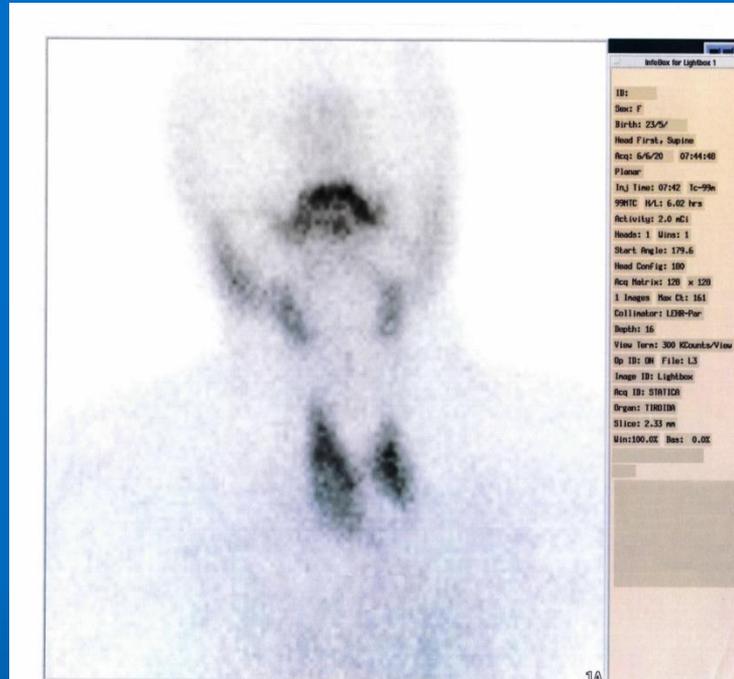


Figure 1: Thyroid scintigraphy, right lobe with enlarge dimensions

• RESULTS EVALUATION



- In the 40-years-old patient with left thyroid lobe agenesis (Figure 2), the experiment was performed identically, the thyroid gland scintigraphy was performed 20 minutes after intravenous administration of 3 mCi of pertechnetate Tc-99m. In this case accumulated radioactivity in the lobe ratio is more 30: 1. Subsequently, the hyper-functional node was covered with lead consisting of lead with thickened walls 4-5 mm and in both images the absence of the left lobe is seen, after previously covering the normal lobe to observe the undeveloped lobe.
- While the absorption for the right lobe was also observed, in the differential diagnosis was considered toxic adenoma.



Figure 2: Thyroid scintigraphy,
left thyroid lobe agenesis

CONCLUSION



- ✓ During the measurements and investigations in this study, it was found that the suppression effect will occur when the accumulated radioactivity in the lobe ratio is more 30: 1. In the case of the thyroid gland, when the thyroid nodule is toxic and hyper-functional, the nodule will absorb more radioactivity.
- ✓ In some cases, the toxic nodule may cause complete suppression of the contralateral lobe of the thyroid gland. In this case, it is necessary for the doctor to make a differentiated diagnosis between the toxic nodule and the agenesis of the thyroid lobe.
- ✓ In conclusion, thyroid scintigraphy allows topographic exploitation, providing data on the size of the thyroid, the homogeneity of the distribution of the radiotracer and the intensity of its uptake, elements that help to establish the diagnosis of diseases of this organ.



Thank you