Complementary Role of Thyroid Scintigraphy, Neck Ultrasonography and Biochemical Assay to Delineate Thyroid Disease Pattern in Southern Part of Dhaka

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ABSTRACT

Thyroid disorders are among the most common endocrinopathies, and a wide array of patients are referred to Nuclear Medicine (NM) institutes for different thyroid-related investigations. In this study, we analyzed the findings of thyroid scintigraphy, high-resolution thyroid gland ultrasound, and thyroid hormone assays of 279 referred patients in the thyroid division of the Institute of Nuclear Medicine and Allied Sciences (INMAS), Mitford. The complementary role of the aforementioned investigations not only helped portray the pattern of thyroid disease in the historic southern part of Dhaka but also once again emphasized the importance of multidisciplinary diagnostic tools in disease management.

Keywords: Thyroid scan, thyroid ultrasound, thyroid hormone assay.

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INTRODUCTION

Thyroid diseases are among the most common endocrine disorders worldwide, including in Bangladesh. Early diagnosis and treatment are the cornerstones of management, and so wide arrays of patients are referred to NM institutes for different types of thyroid-related investigations. Radionuclide imaging or thyroid scintigraphy plays a pivotal role in the evaluation of thyroid disease as it provides excellent functional information; hence, it has been a part of the thyroid evaluation for many years. High-resolution ultrasound (HRUS) imaging is another important tool and the most sensitive modality for understanding the morphological change and detecting intra-thyroidal lesions. Last but not least is the detection of thyroid hormone levels by different methods. In this study, we have tried to explore and share our experiences by analyzing the correlation between the findings in thyroid hormone assays, neck ultrasounds, and thyroid scintigraphy done in our institute.

PATIENTS AND METHODS

The prospective observational study, which took place at the Institute of Nuclear Medicine and Allied Sciences Mitford in Dhaka, lasted two years, from January 2020 to December 2021.The study population consisted of 279 patients referred to the thyroid division for thyroid scintigraphy from different local hospitals and clinics in the southern part of Dhaka city. Each patient underwent a thyroid scan with a Dual Head Siemens Gamma Camera 20 minutes after intravenous administration of ^{99m}Tc pertechnetate. Each of them also had thyroid hormone assays by the RIA and IRMA methods and an ultrasound of the neck with a Medison Accuvix A30 machine using a high-resolution linear transducer of 5–13 MHz frequency.

All patients were grouped into three categories, euthyroid, hyperthyroid, and hypothyroid, according to their biochemical profiles. Findings from HRUS and thyroid scintigraphy were documented under the subheadings of these three groups. For simplification, ultrasound findings were divided into six categories, namely no thyroid tissue, normal thyroid gland, non-homogeneous normal-sized thyroid gland, non-homogeneous thyromegaly, and single or multiple nodular goiters. Similarly, thyroid scan findings were categorized into absent, normal, reduced, or increased radiotracer concentration, hot, cold, or poorly outlined thyroid glands.

Statistical analyses were performed using Microsoft Excel and SPSS version 25. Quantitative data were described as mean, standard deviation, and range, and qualitative values were given as numbers and percentages. The chi-square test was used in the evaluation of categorical data. In the analyses, values at the P 0.05 level were considered statistically significant.

RESULTS

The majority of the 279 patients (88.9%) were female, with ages ranging from three to 65 years, with a mean of 41.6 ± 11.6 years. In terms of biochemistry, 113 patients were euthyroid, 126 were hyperthyroid, and 40 were hypothyroid. The most common findings in thyroid scintigraphy were reduced tracer uptake (35.4%) in the euthyroid group, hyperfunctioning gland (50.8%) in the hyperthyroid group, and absent or reduced uptake (40% each) in the hypothyroid group (Figures A, B, and C).

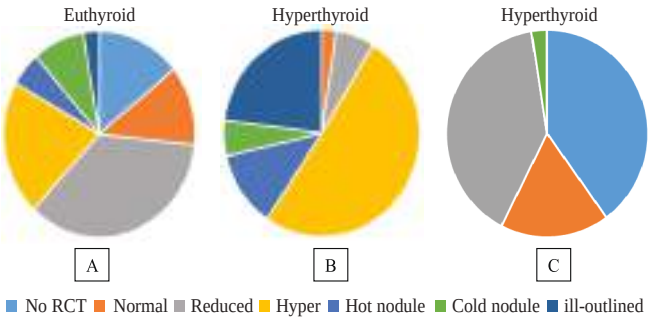

Figure 1: Distribution of thyroid scan findings in euthyroid (A), hyperthyroid (B) and hypothyroid (C) groups.

On the other hand, predominant findings from HRUS were normal thyroid gland (36.3%) in the euthyroid group, multinodular goiter (33.3%) in hyperthyroid group, post-thyroidectomy state (40%) in hypothyroid group (Figure 2 A, B, C).

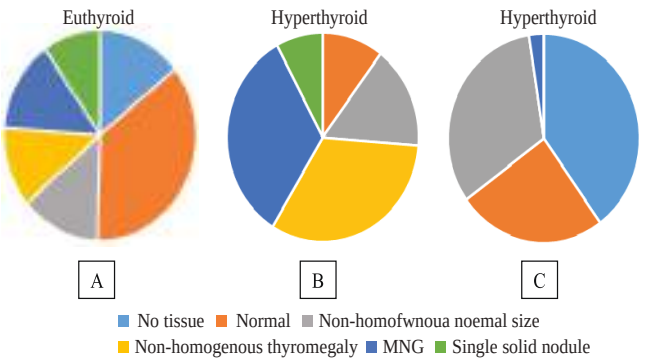

Figure 2: Distribution of thyroid HRUS findings in euthyroid (A), hyperthyroid (B) and hypothyroid (C) groups. MNG- Multinodular goiter.

We also observed the distribution of thyroid HRUS findings in relation to thyroid scintigraphy results (Figure 3). Statistical analyses of the findings revealed high significance (P < 0.001).

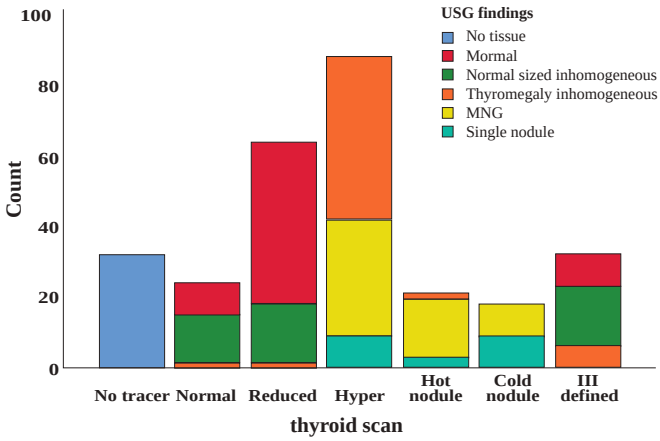

Figure 3: Bar chart showing distribution of thyroid HRUS and scan findings.

DISCUSSION

Abnormalities of the thyroid's function and structure are commonly encountered, and despite recent advances in thyroid imaging, scintigraphy and ultrasound remain the mainstays of the diagnostic work-up. Besides, while a thyroid scan can reveal the functional status of the gland, a hormone assay is ultimately required to assess the actual levels of thyroid hormones in the blood.

Most of the studies observed a correlation between these investigations and the background of diagnosed pathology, e.g., Grave's disease, autoimmune thyroiditis, thyroid malignancy, etc. (1, 2). The data we represent is the cross-sectional picture of a tertiary-level institute in southern Dhaka where multitudes of patients are referred in various stages of disease course with a view to not only confirming the diagnosis but also monitoring treatment response and follow-up. Therefore, the depicted picture may not reveal the thyroid profile of the general population, but rather the prevailing pattern of diagnosed thyroid patients in the adjacent region.

Worldwide, thyroid-related disorders are more common in females, which was also evident in our data (3). The highest number of patients in our study sample were in the hyperthyroid group, with hyperfunctioning scan pictures and non-homogeneous enlarged glands in ultrasound. Alswat et al. also found a similar picture in hyperthyroid subjects but with a normal-sized thyroid gland (1).

We had 32 post-total thyroidectomy cases who showed no remnant of thyroid tissue both in ultrasound and scintigraphy. These cases are usually referred to nuclear medicine centers after surgery for radio-iodine ablation therapy while they are not on thyroxin supplements and also for follow-up while they are taking the prescribed dosage. As a result, the biochemical profiles of our total thyroidectomy study subjects revealed both hypothyroid and euthyroid status.

In a study conducted in 2015, the hormone assay of 303 individuals with normal thyroid ultrasound showed euthyroid status in 77.6% (4). In our study, the percentage of euthyroid patients is slightly lower, at about 64.1% in the normal ultrasound category and 58.3% in the normal thyroid scan category.

Reduced radiotracer concentrations in thyroid scans may indicate a variety of pathological conditions, as well as the impact of diet and medication (5). Among the pathologies, autoimmune and subacute thyroiditis are two commonly encountered disorders, and these may produce hyperthyroidism, subclinical hypothyroidism, or overt hypothyroidism depending on the stage of the disease. Our findings also reveal no definite pattern or preponderance of any pathological trait in the 64 patients with decreased tracer uptake.

Thyrotoxicosis is a frequent reason for referring patients to nuclear medicine centers for radio-iodine therapy, while Grave's disease and toxic nodular goiter are the two most common pathologies causing thyrotoxicosis (1). All of our subjects with a hyperfunctioning thyroid gland had ultrasound findings consistent with either of these two disorders. The majority were also biochemically hyperthyroid; the remainder (27.3%) were euthyroid, which was most likely due to ongoing treatment.

All the patients showing a hot or cold nodule in the thyroid scan also had single or multiple nodular goiters in the ultrasound, except only one case showed non-homogeneous thyromegaly. Toxic nodule patients were also predominantly hyperthyroid, and cold nodule cases revealed a mixed pattern biochemically.

A poorly outlined thyroid bed in scintigraphy with an intact gland in ultrasound having various degrees of echotextural change is typical of thyroiditis, which also produces an initial hyperthyroid state due to the release of pre-formed hormones into the bloodstream. The hyperthyroid phase is usually short-lived (about one to three months), whereas symptoms often last three to six months (2, 6, 7). Our findings showed a very good overall agreement between thyroid scintigraphy, ultrasound findings, and hormone level, as 71.8% of subjects with poorly outlined thyroid glands at scan revealed non-homogeneous thyroid echotexture with or without enlargement. More than 90% of them also had increased thyroid hormone levels.

CONCLUSION

This study indicates that most of the patients from southern Dhaka referred to our institute have thyroid profiles concordant with hyperthyroidism and a female preponderance. It is also evident from the study that nuclear medicine techniques, e.g., scintigraphy and hormone assay, are time-proven methods for evaluation of thyroid gland function that complement each other, whereas neck ultrasound provides the anatomical details. The combination of these diagnostic tools is very beneficial and often essential in the detection and management of different types of thyroid disease.

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