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THE ROLE OF COMPLEX ULTRASOUND IN FOCAL CHANGES OF THE THYROID GLAND

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Summary: This prospective observational study was conducted in the Department of Radio-Diagnosis at Government Medical College, Srinagar, to evaluate various thyroid gland disorders using ultrasound and confirm findings through fine needle aspiration cytology (FNAC). The study included all patients referred for thyroid scans using convenience sampling. Ultrasound, performed with a 12 MHz linear transducer, was the primary diagnostic tool due to its ability to detect both focal and diffuse thyroid pathologies.

Most patients (84%) presented with thyroid swelling, while others had symptoms like pain, pressure effects (e.g., dysphagia, dyspnoea), or signs of hyperthyroidism. Females were more affected than males (ratio 2.3:1), and the right lobe showed more involvement than the left. Hypoechoic lesions were most common (34%), followed by isoechoic and heterogeneous textures. Among malignancies, papillary carcinoma was the predominant type (83.34%), with one case of anaplastic carcinoma.
Key words. Thyroid, USG, FNAC, Papillary carcinoma, Hashimoto's thyroiditis.

Introduction. The thyroid gland is composed of two symmetrical lobes joined by an isthmus located in front of the second to fourth tracheal rings. Each lobe is roughly pear-shaped, with the upper pole narrower than the lower, and appears triangular in cross-section with lateral, medial, and posterior surfaces. The gland is surrounded by its own capsule and enclosed within the pretracheal fascia.

Ultrasound is the most widely used and initial imaging modality for evaluating the thyroid gland. Due to its high iodine content, the gland shows slightly increased echogenicity compared to surrounding tissues and presents a uniform "ground-glass" appearance. This feature makes it easier to detect hypoechoic or cystic lesions within the gland.

Before high-resolution ultrasound became available, radionuclide scintigraphy was the main tool for both functional and structural assessment of the thyroid. However, studies have shown that only 4% of "hot" nodules and 16% of "cold" nodules identified by this method are cancerous, indicating its limited reliability in diagnosing malignancy.

Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) have a limited role in the initial evaluation of thyroid nodules. In contrast, modern high-resolution ultrasound combined with color Doppler flow imaging can provide detailed insights into both the structure and blood flow characteristics of thyroid lesions. This combination enhances diagnostic accuracy, especially in identifying malignant nodules.

Thyroid disorders are more prevalent in females than males. The most frequent cause of thyroid gland enlargement is nodular thyroid disease. Thyroid conditions are generally categorized as: (1) benign masses, (2) malignant tumors, and (3) diffuse thyroid enlargements.

Nodularity in the thyroid is considered common and increases with age, often seen as a normal aging process. Ultrasound studies report the prevalence of thyroid nodules to be between 50% and 70%.

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US features that may suggest malignancy include: microcalcifications smaller than 2 mm, irregular margins, solid internal composition, marked hypoechogenicity, lack of a peripheral hypoechoic halo, size greater than 1 cm, taller-than-wide shape, and increased internal vascularity. Ultrasound is also useful for identifying and monitoring conditions like subacute granulomatous thyroiditis, which typically presents as poorly defined hypoechoic areas without vascularity and lacking a rounded or oval mass appearance.

The purpose of this study. The aim is to determine the informational significance of ultrasound examination criteria for the development of a differential diagnostic algorithm for the detection of focal thyroid formations.

Materials and methods of research. 134 patients were examined to determine the diagnostic significance and validity of the proposed algorithm for complex ultrasound diagnosis of thyroid diseases. Ultrasound examination in the gray scale mode in combination with color Doppler mapping (CDM) and shear wave sonoelastography was included in the comprehensive examination for all patients. The study was conducted on an ultrasound device "Aixplorer" from the company "Super Sonic imagine" (France) with a frequency range of 6-12 MHz linear sensor. The final diagnosis of the examined patients was confirmed by histological examination of the surgical material. At the final stage, ultrasound in shear elastography (SEG) mode was performed as part of a comprehensive study of the thyroid gland. Depending on the degree of stiffness and elasticity of the most suspicious area of the focal formation of the thyroid gland, elastographic images were classified into 3 types of color staining and the corresponding range of values of the Young's modulus as follows: Type 1 is uniform blue staining (low values of Young's modulus), typical for unchanged thyroid parenchyma and surrounding tissues. Type 2 is a mosaic structure with a predominance of blue areas and several denser green areas (average values of the module The cabin boy). Type 3 is a mosaic structure with red sections (high values of Young's modulus). Quantitative elastometry was performed using one of the Young's modulus (MU) equations (e=3c2, where c is the shear wave velocity).

Results. This prospective study was conducted in the Department of Radiodiagnosis and Imaging at Government Medical College and Associated Hospitals. A total of 50 patients with suspected thyroid disease were included, referred from outpatient departments (OPD), inpatient wards (IPD), and the emergency department.

Patients ranged in age from 12 to 70 years, with the highest number of cases (42%) in the 31–40-year age group, followed by those aged 41–50. Female patients made up the majority, accounting for 70% (35 out of 50), while males constituted 30% (15 out of 50), indicating a female-to-male ratio of approximately 2.3:1. Most patients (84%) presented with noticeable thyroid swelling. Other common complaints included neck pain (14%), pressure symptoms such as difficulty swallowing, breathing problems, and hoarseness (12%), and signs of hyperthyroidism like tremors and weight loss (6%).

On physical examination, thyroid swellings were bilateral in 36% of cases, midline or right-sided in 20% of cases, and left-sided in only 8%. Overall, 84% of patients had palpable swellings, while 16% had none.

The thyroid gland is the earliest endocrine organ to develop, forming around the 24th day of gestation. It arises from the primitive pharynx (median thyroid) and neural crest (lateral thyroid), with endodermal epithelial cell proliferation forming the main structure of the gland.

Detailed ultrasonographic examinations were conducted for all 50 patients. Most were between their third and fifth decades of life (66%), with females outnumbering males. Twenty-eight patients had a solitary thyroid nodule on clinical assessment, and eighteen had multinodular goiter. Ultrasound, however, revealed that 12 patients initially diagnosed with solitary nodules actually had

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multiple nodules. This highlights the superior sensitivity of ultrasound over clinical examination, in line with previous research.

Five patients were diagnosed with multinodular goiter. Sonographically, nodules were wider than tall with well-defined margins. Four (80%) had a peripheral halo, three were solid, one predominantly solid, and one cystic. These characteristics align with findings from earlier studies.

Three cases showed diffuse hypoechogenicity and a "thyroid inferno" vascular pattern, suggestive of Grave's disease. FNAC confirmed Grave's disease in two cases, while one was diagnosed as Hashimoto's thyroiditis. These observations are consistent with previous studies where Grave's disease was the predominant cause of hyperthyroidism.

Seven patients had malignant thyroid lesions. Of these, five (71.4%) were diagnosed with papillary carcinoma and one with anaplastic carcinoma. Most malignant nodules (80%) were markedly hypoechoic, with one case showing heterogeneous echotexture. Microcalcifications were present in 60% of the malignant cases, and macrocalcifications in 40%. Ill-defined margins were seen in 80%, and 60% of lesions were solid. Most nodules were taller-than-wide and lacked a peripheral halo. Cervical lymphadenopathy with necrosis and microcalcifications was also common. These sonographic features are consistent with known patterns of thyroid malignancy as noted in prior studies.

Out of 50 patients, 44 (88%) showed features suggestive of benign thyroid disease on ultrasound, while 6 (12%) were suspected to have malignancy. FNAC confirmed five cases as papillary carcinoma and one as anaplastic carcinoma. Additionally, one lesion initially diagnosed as follicular adenoma was later confirmed to be follicular carcinoma upon histopathology, underscoring the need for cytological verification.

The findings correspond with recommendations by the Society of Radiologists in Ultrasound, which advocate FNAC for nodules ≥1 cm with microcalcifications or nodules ≥1.5 cm with solid components or coarse calcifications.

Conclusion. This study emphasizes the importance of using high-resolution ultrasound in all patients presenting with thyroid swellings or symptoms suggestive of thyroid disorders. Ultrasound proves to be the most effective imaging technique for identifying and evaluating thyroid nodules. It offers superior ability to distinguish between benign and malignant lesions, as well as between focal and diffuse thyroid diseases.

A structured approach can be developed where nodules with benign features on ultrasound are monitored through regular follow-ups, while fine needle aspiration cytology (FNAC) or biopsy (FNAB) is reserved for those with suspicious or indeterminate ultrasound characteristics.

Implementing this strategy can significantly enhance patient care by reducing unnecessary surgical interventions, lowering patient morbidity, and minimizing overall healthcare costs.

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