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### ملاحظات:





# **Role of Ultrasonography and Color Doppler Imaging in Identification of Thyroid Nodules Suspicious of Malignancy for Fine Needle Aspiration**

*Thesis*

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# قَالَ

سَبَّحَانَكَ لَا إِلَهَ إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ  
الْعَلِيمُ الْعَظِيمُ

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# *List of Abbreviations*

Abb.	Full term
ACR .....	American College of Radiology
Ant. Strap m.....	Anterior strap muscle
ATA.....	American Thyroid Association
CCA .....	Common carotid artery
CFD .....	Color flow Doppler
ETE.....	Extrathyroidal extension
FMTC .....	Familial medullary thyroid carcinomas
FNA .....	Fine Needle Aspiration
FTC.....	Follicular Thyroid carcinoma
HCC .....	Hürthle or oncocytic cell cancer
IJV .....	Internal jugular vein
IQR .....	Inter-quartile range
MEN .....	Multiple endocrine neoplasia
MTC.....	Medullary thyroid carcinoma
NPV .....	Negative predictive value
PD .....	Power Doppler
PDTC .....	Poorly differentiated thyroid carcinoma
PI .....	Pulsatility index
PPV.....	Positive predictive value
PRF.....	Pulse repetition frequency
PSV .....	Peak Systolic Velocity
PTC.....	Papillary thyroid carcinoma
RI .....	Resistive index
ROC .....	Receiver operating characteristic curve
SCM .....	Sternocleidomastoid muscle
SPSS .....	Statistical Package for Social Science
TIRADS .....	Thyroid Imaging, Reporting, and Data System
TSH.....	Thyroid-stimulating hormone
US .....	Ultrasonography
WHO.....	World Health Organization

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# INTRODUCTION

Ultrasonography (US) is one of the most widely used imaging technologies in medicine. It is portable, free of radiation risk, and relatively inexpensive when compared with other imaging modalities, such as magnetic resonance and computed tomography the images can be acquired in “real time,” thus providing instantaneous visual guidance for many interventional procedures including those for regional anesthesia and pain management (*Chan & Perlas, 2011*).

Thyroid nodules are exceedingly common, with a reported prevalence of up to 68% in adults on high-resolution US (*Tessler et al., 2017*).

Certain features of thyroid nodules on US are consistently predictive of malignancy and are used as criteria for Fine Needle Aspiration (FNA). These criteria have various sensitivity and specificity, but unfortunately none of them alone is sufficient to discard or detect malignancy efficiently (*Russ et al., 2017*).

FNA of the thyroid is the single most useful diagnostic test for evaluating the patients with thyroid nodules who should undergo surgery (*Renshaw et al., 2020*).

Medical professional societies such as the American Thyroid Association (ATA) and American Association of Clinical Endocrinologists have suggested that the initial

cytological diagnosis can be postponed until growth of a nodule or a change in its US features is observed. Repeated FNA of nodules with an initial benign cytological diagnosis leads to a final diagnosis of cancer in approximately 2% of cases (*Maino et al., 2021*).

The pattern of vascularity and intra-nodular peak systolic velocity can be used as color and spectral Doppler parameters to differentiate benign from malignant thyroid nodules. Intranodular flow is strongest predictor for diagnosing malignancy among color Doppler parameters (*Bhatt et al., 2017*).

Since about 90% of thyroid nodules are benign, it is crucial to correctly stratify the malignancy risk of the nodules to avoid a huge number of unnecessary invasive procedures and/or surgery, as an improper use of FNA has the risk of increasing healthcare expenditures and even of inappropriately referring patients to surgery in case of indeterminate cytology (*Pantano et al., 2018*).

## **AIM OF THE WORK**

The aim of the study is to investigate the performance of US imaging and color flow mapping in identification of thyroid nodules indicated for FNA to predict thyroid cancer to avoid unnecessary interventions.

## **Chapter 1**

# **ANATOMY OF THE THYROID GLAND**

Thyroid gland is the largest endocrine gland. It is situated opposite C5- C7 and T1 vertebra embracing anterolateral part of trachea. The gland is related medially to trachea and esophagus and carotid sheath laterally. The gland is covered anterolaterally by sternocleidomastoid and three ribbon muscles, sternohyoid, sternothyroid and superior belly of omohyoid muscles (*Singh, 2020*).



**Figure (1):** The thyroid gland (*Quoted from Arrangoiz et al., 2018*).

The shape of the thyroid gland varies from an H to a U shape and is formed by two lateral lobes with superior and inferior poles connected by a median isthmus (**Figure 1**), with an average height of 12 to 15 mm, overlying the second to fourth tracheal rings. Each of the lateral thyroid lobes measures an average of 50 to 60 mm (8 to 10 ml in volume), with the