

# Evaluation of Solitary Thyroid Nodule by Ultrasound Guided FNAC

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**Abstract:** Background: Fine needle aspiration cytology (FNAC) is commonly used in evaluation of thyroid nodule. It provides specific diagnosis rapidly with minimal complications. FNA under ultrasound guided decreases complication and error based on cytology findings surgeon can decide type of operation. Objectives: aim of our research is to find diagnostic accuracy of FNAC under control of ultrasound and compare it with histopathology results. Methods: this prospective study done on 70 patients done in Al-Immamain medical city in one year (November 2015-December 2016) to evaluate of solitary thyroid nodule by FNAC under ultrasound guidance. All patients clinically examined, u/s thyroid and FNAC under u/s, the results have been correlate with postoperative histopathological diagnosis. Result: 70 patients were included in our study (59 female, 11 male) in ratio female to male (5.4:1). u/s guided FNAC done for 3 categories: 76.7% benign, 20% malignant and 3.3% indeterminate. Histopathological reports reveal that those who considered benign 95.8% were true negative and 4.2% were false negative. Malignant cases histopathologically have been found 83.3% true positive and 16.7% false positive. u/s guide FNAC in our study had sensitivity of 83.3%, specificity of 95.8% and accuracy 93.3%. Conclusion: U/S guide FNA has a high accuracy in diagnosis of solitary thyroid nodule with cytological features of malignancy.

**Keywords:** Thyroid nodule, U/S guided FNAC, Thyroid malignancy.

## 1. Introduction

Solitary nodule is a discrete swelling in one lobe with no abnormality elsewhere, while in presence of abnormality it termed dominant nodule in multinodular goiter. Thyroid nodule can be hyperplastic, colloid, cystic, inflammatory and neoplastic [1]. A solitary thyroid nodule is a palpable swelling that has otherwise a normal appearance [2]. Majority of nodules are asymptomatic and only 5% are malignant [3]. FNAC is the single most sensitive, specific and cost effective investigation, but it can't differentiate between follicular adenoma and follicular carcinoma [4,5]. Either palpation or U/S may be used for guidance of FNA, but U/S is the superior one as we can visualize the needle in the lesion even in non-palpable one, even in palpable one U/S is the best as it provides us with adequate material for accurate cytology examination [6]. FNAC reduces number of thyroidectomy by half and the cost by quarter while doubling surgical confirmation of carcinoma [7].

FNAC may need to be repeated in case of: sample inadequacy, nodule enlargement, cyst recurrence or clinical or imaging findings which point to suspicious of malignancy even if cytology negatives [8].

Anaplastic carcinoma, medullary, primary lymphoma has accuracy about 90% [9]. The main problem is in the differentiation between follicular benign and malignancy which gives accuracy about 40% [9], in follicular neoplasms need to see invasion of the capsule which is not possible with FNAC, so many techniques in addition to FNAC have been developed to increase accuracy of FNAC to diagnose follicular carcinoma like immunocytochemistry technique as in thyroid peroxidase immunochemistry with monoclonal antibody termed MoAb 47, large needle biopsy but this can also increase risk of hematoma, tracheal injury, laryngeal nerve injury, or injury to the neck structures and cutaneous implantation of malignant cells, and intraoperative frozen

section, this requires excisional biopsy [9,10]. Application of molecular genetics to fine needle aspiration biopsy give more chance for accuracy and avoid surgery for benign diseases, these molecular marker include BRAF, RAS, PAX8-PRAR, microRNAs and loss of heterozygosity [9].

The operator should be:

- Sure that the nodule is aspirated by direct vision.
- Sure that the nodule is present before aspiration.
- Avoid passing needle into critical structure in the neck.

## 2. Patients and Methods

We did a prospective study in Al-immamain medical city in the department of general surgery from November 2015-December 2016, data have been written include: history of present illness including pain, stridor, dysphonia, dysphagia and increase the size of the thyroid. Previous history of irradiation, past medical history, and family history of pheochromocytoma or hyperparathyroidism. Physical examination include: consistency, fixation to surrounding structure and any enlarged lymph node.

Investigation done include:

Thyroid function test.  
Anti-thyroid antibodies  
CBC, Hb, ESR and serum calcitonin,

- Image study: U/S – show nature of the nodule whether it is cystic, solid, or mixed, any micro calcification, irregular margin and hypoechogenicity.
- Radio iodine scan: done for few patient when it was available.
- CXR: to show any retrosternal goiter and metastases to the lung.
- CT Scanning and MRI: might show extend of thyroid disease for patients with suspicion of retrosternal goiter.

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FNAC under U/S guide advice mostly in:

- 1) Non palpable nodule.
- 2) Insufficient cells /colloid for examination.
- 3) Malignant U/S finding of single nodule.
- 4) Posterior nodule even if palpable.
- 5) Predominantly cystic nodules more than 25%.
- 6) Nodule with prior benign on FNAC that have grown.
- 7) Incidental nodule on U/S, cold nodule on radio isotope scan and in suspicious results in prior FNAC.

Experience staff did the aspiration and the cytological examination. U/S examination done by specialized doctor in the radiology department. Nodule located and a needle ( 22 to 26 gauge) attached to a syringe (5-10 cc), for posterior nodule we used long needle (22 gauge), for anterior and isthmus nodule we used (26 gauge), needle inserted perpendicular to the anterior surface of the neck with assistance of the U/S. Once nodule was entered, a deliberate, vertical motion of the needle, back and forth over 1-2 mm, then material was aspirated by the syringe, after aspiration of the material the needle was detached then reattached with the syringe and after expel of air in the syringe we forced the material into a slide which was immediately smeared and fixed. During that we applied pressure on the puncture site, patient was observed for few minute to be sure that there is no swelling, bleeding or any discomfort.

A satisfactory specimen should contain at least 5 or 6 groups of 10-15 cells. Specimen air dried or fixed for staining, the adequacy of specimen should be determined before the patient leaves.

Finding of the FNAC readings was compared with surgical histopathological results.

Surgery was done to all patient by collar incision under general anesthesia, thyroid was assessed intra operatively for other nodules or any suspicious area, then lobectomy and isthmectomy, subtotal thyroidectomy was done. post-operative antibiotic, air way observation and hemodynamic evaluation was done. We analyzed our result by using statistical data and equation applied to determine sensitivity specificity and accuracy.

### 3. Result

Our study includes 70 patient with thyroid swelling. 59 (84%) were female and 11 (15%) were male. 37 of female (52.9%) and 6 of male (33.9%) were in the 4<sup>th</sup> decade of age, one 1/3 of female 20(33.9%) and 3 male (27.3%) presented in their 3<sup>rd</sup> decade of life, the least age group were those above 50 years in female 8 patients (13.6%) and in male 2 patients (18.2%). The overall mean age was ( 36.7± 7.3%). with age range of (21 – 63) years, the mean age of female was( 36.4 ±7.3%) with age range of (21- 58) years while for male it was 38.1±\_7.6) years with age range of 23-63) years. Female to male ratio of single nodule was (5.4: 1). Table 1 shows the prevalence related to gender.

**Table 1:** Age and gender distribution among patients included in our study, n=70.

Age (years)	Female /no (.%)	Male/ no. (%)	Total No.(%)
21-30	20(33.9)	3(27.3)	23(32.9)
31-49	31(52.5)	6(54.5)	37(52.9)
≥50	8(13.6)	2(18.2)	10(14.3)
Total	59(100)	11 (100)	70(100)
Mean±SD	36.4±7.2	38.1 ±7.6	36.7±7.3
Range	21 -58	31-47	21- 63

P-value = 0.874.

In our study we get that total prevalence of malignancy among solitary thyroid nodule was 5/70 (7.1%), and it was 2/11 (18.3%) in male and 3/59 (5.1%) in female with male to female ratio of( 3.6:1 ) as shown in Table 2.

**Table 2:** Distribution of patients with solitary thyroid nodule according to diagnosis among gender

Gender	Male no.(%)	Female no.(%)	Total no.(%)
Malignant	2(18.2)	3(5.1)	5(7.1)
Benign	9(81.8)	56((94.9)	65 ( 92.9)
Total	11(100)	59(100)	70(100)

Figure.1 illustrates the main clinical data of the patient who included in our study 6 (8.6%) patients presented with dysphagia, 4(5.7%) patients presented with dyspnea, 3 (4.3%) patients presented with dysphonia and one (1.4%) patient presented with neck pain, stridor or bilateral lymph nodes of neck for each condition.

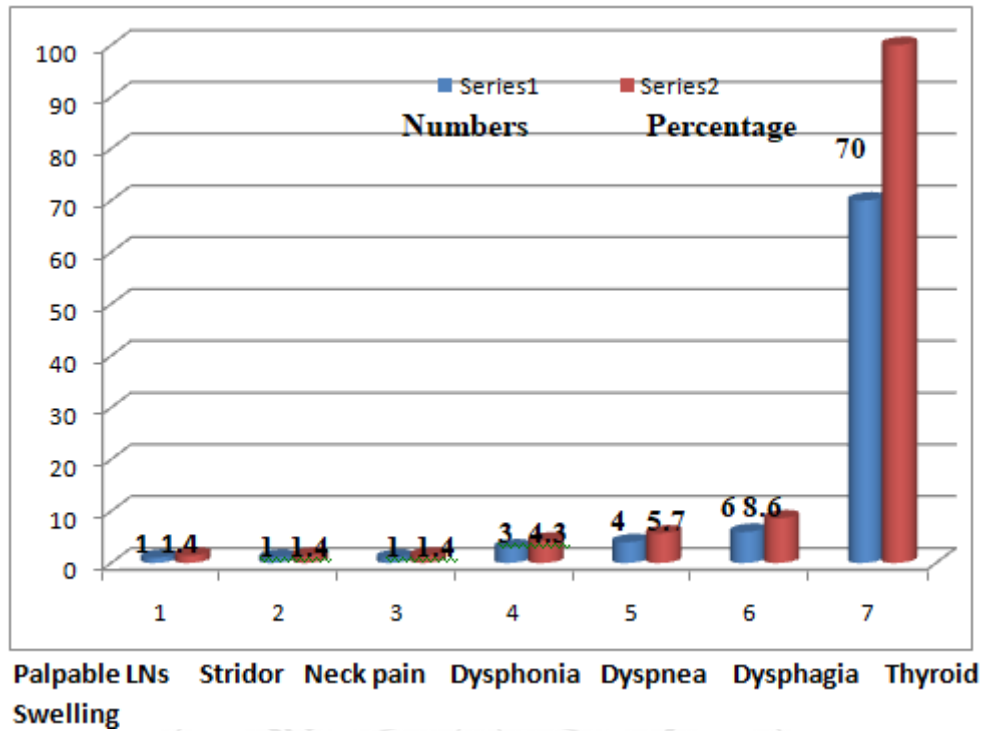


Figure 1: Clinical Data of the included patients, n=70

Regarding the site of the thyroid nodule it was found that one half ( 35 ) patients ( 50% ) its site in the right lobe, 31 ( 44.3% ) patients was in the left lobe and 4 ( 5.7% ) were presented in the isthmus Figure 2.

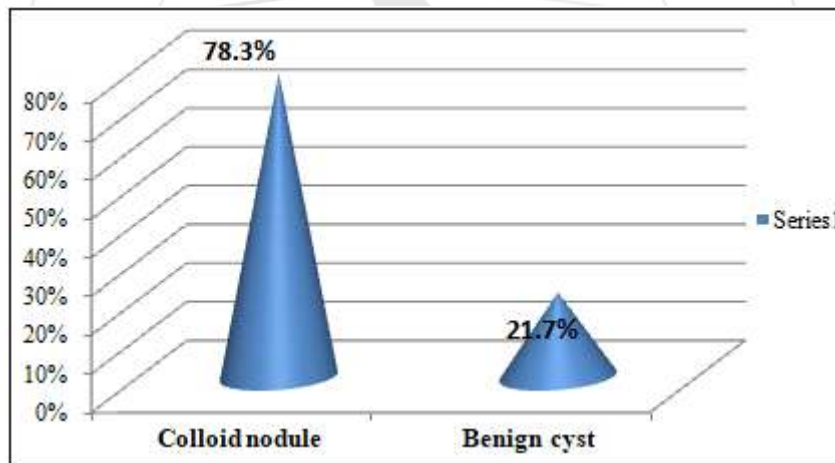


Figure 2: Site of the thyroid nodule, n=70

The results of the thyroid function test for our patients show that 60 patients ( 85.7% ) were euthyroid, and 10 patients ( 14.3% ) were hyperthyroidism. Table 4

Table 4: Results of thyroid function test, n=70.

Thyroid function	No.	%
Euthyroid	60	85.7
Hyperthyroidism	10	14.3
Total	70	100.0

Isotope scanning had been performed for 10 patients because it was unavailable and for that reason it was not incorporated in our discussion, for those 10 patients isotope scan revealed that 6 patients ( 60% ) had cold nodules, 2 patients ( 20% ) had hot nodules and 2 patients ( 20% ) had warm nodules. Table 5.

Table 5: Positive results of isotope scanning of the nodules, n= 10.

Thyroid scan	No.	%
Cold	6	60
Hot	2	20
Warm	2	20
Total	10	100.0

Regarding ultrasound test it was found that 53 patients ( 75.7% ) had cystic nodules, and 11 patients ( 15.7% ) had solid nodule and others 6 patients ( 8.5% ). Table 6.

Table 6: Positive results of ultrasound for the thyroid n =70.

Ultrasound	No.	%
Cystic	53	75.7
Solid	11	15.7
Others ( micro calcification, hypochogenic )	6	8.5
Total	70	100.0

Regarding cytological results, we classified patients into 3 groups; group A:40 patients sent for FNAC of palpable nodules, group B: 6 patients sent for U/S guided FNAC as indicated after prior FNAC either due to insufficient sample, suspicious results or benign nodule which had grown during follow up, group C 24 were sent for U/S guided FNAC for non-palpable nodule or malignant U/S features.

**Table 7:** Result of cytology for group A & B, n 46

FNAC	No.	%
Benign	41	86.9
Malignant	3	6.52
Indeterminate	2	4.34
Total	46	100

Figure 3 show the benign form of the thyroid nodules which was presented with fine needle aspiration cytology which shows that 37/41 patient (90.2%) were colloid nodule and 4/41 patient (9.8%) were benign cyst.

Regarding the management of patient, all had been treated surgically,55 (78.6%) by subtotal thyroidectomy,7 (10%) patient treated by total thyroidectomy because U/S guided FNAC showed malignancy, and 8 (11.4%) patient were treated by lobectomy and isthemusectomy Table 8.

**Table 8:** Types of surgical procedures

Type of surgery	No.	%
Subtotal thyroidectomy	55	78.6
Lobectomy + isthemusectomy	8	11.4
Total thyroidectomy	7	10.0
Total	70	100.0

FOR 30 patient U/S guided FNAC had been done due to suspicious in FNAC or insufficient aspiration or malignant features in U/S as hypochoic nodule with calcification and irregular margins.

Cytology result showed: colloid nodule with follicular epithelium in 17/30 (56.6%) patient, colloid nodular in 4 (13.3%) patient adenomatous nodule one patient, 2 (6.7%) with hashimotothyroiditis,4 (13,3%) patient with papillary carcinoma and one patient (3.3%) patient had a typical cells with suspicion of malignancy which suggest secondary metastasis from gastric cancer this patient presented with painful thyroid swelling and dyspnea, dysphagia and long standing anemia, U/S showed an enlarge thyroid gland with solid right lobe nodule with calcification, OGD was done after FNAC showed large gastric ulcer with features of malignancy, it was adenocarcinoma, one case (3%) was indeterminate follicular cells with suspicion of follicular neoplasm. Table 9.

**Table 9:** Results of fine needle aspiration under ultrasound group C, no 30 .

Finding	No.	%
Colloid nodule	17	56.6
Nodular colloid goiter	4	13.3
Papillary carcinoma	4	13.3
Hashimotos	2	6.7
Indeterminate	1	3.3
Secondary metastasis (adenocarcinoma)	1	3.3
Adenomatous nodule	1	3.3
Total	30	100

Histopathology for this group showed: 15 (50%) patient had colloid nodules with focal fibrosis and hemorrhage,4 (13.3%) patient had colloid nodular goiter with cystic degeneration and calcification,2 (6.7%) patient had follicular adenoma, 2 (6.7%) patient had Hashimoto thyroiditis, and regarding carcinoma 4 (13.3%) patient had papillary cell carcinoma, 1 (3.3%) patient had follicular carcinoma and one case (3.3%) had poorly differentiated adenocarcinoma (secondary metastasis ). Table 10.

**Table 10:** Results of histopathology

Histopathology	No.	%
Colloid nodule	15	50.0
Nodular colloid goiter	4	13.3
Papillary carcinoma	4	13.3
Follicular adenoma	3	10.0
Hashimoto	2	6.7
Follicular carcinoma	1	3.3
Adenocarcinoma (secondary metastasis )	1	3.3
Total	30	100

The validity of FNAC guided by U/S test was assessed in comparison with the gold standard (histopathology) and revealed a sensitivity [ability of the test to reveal really malignant patients as positive cases] of 5/6 (83.3%) and specificity [ability of the test to reveal negative results in really malignant free patient ] of 23/24 (95.8%) with test accuracy of28/30 (93.3%).Table 11.

**Table 11:** Comparison of the validity of fine needle aspiration cytology under ultrasound for goiter with histopathology result

	FNAC & U/S	Histopathology		Total
		Malignant	Benign	
	Malignant	5(83.3) (TP)	1(4.2) (FP)	6(20)
	Benign	1(16.7) (FN)	23(95.8) (TN)	24(80)
	Total	6(100)	24(100)	(30)(100)

Sensitivity = 5/6=0.833=83.3%

Specificity = 23/24 =0.984=95.8%

Test accuracy = (5+23)/30 =0.933 =93.3%.

#### 4. Discussion

Thyroid nodules are found in 4-8% of adult by palpation and in 13-67% if U/S used [10].

A solitary thyroid nodule is palpable swelling in the gland that has normal appearance, majority of nodule are a symptomatic, thyroid cancer is about 5%of all nodule. It is important to assess thyroid nodule to determinate the need of surgery & its type [11].FNAC under control of U/S is an essential tool, it has high diagnostic accuracy and frequently obviate surgery in patient whom finding at FNAC can't differentiate between follicular adenoma and carcinoma.aim of our study is to evaluate accuracy of FNAC under U/S guidance. In our study found nodule in female at age 21-58 y,and in male 23-63 y with female to male ratio 5.4:1.in study done by Rabia B et al [12] found age for male and female range from 10-70 y with female to male ratio 4.6:1 which was compatible with our study.



Anatomically 50% were in the right lobe, 44% in the left lobe and 5.7% in isthmus. In study done by Veith FJ et al [13] found 52% in the right lobe, 39% in the left lobe and 9% in the isthmus.

Thyroid function tests should be done as part of evaluation of solitary nodule. Hyperthyroidism is commonly associated with benign disease, which either euthyroid or thyrotoxic nodule, in our study 85.7% of tests were euthyroid (60) patient and hyperthyroidism were 14.3% (10) patient.

In a study done by Ahmet SC and Kamel P found that 90% euthyroid, 5% hyperthyroidism and 5% hypothyroidism (35), while Wong CK and Wheeler MH showed 10% in hyperthyroidism as a functioning benign adenoma [14]. Thyroglobulin is the major constituent of colloid and precursor of thyroid hormones, it elevates in most thyroid diseases so not recommended as a routine test [15].

FNAB is the most crucial step in evaluation [16,17], it has been shown that this test decreases false negative from needle misplacement and reduces rate of non diagnostic smears from 15-3% [11,17].

U/S is a safe and effective method of assessing nodule if cystic or solid. High resolution U/S improved diagnostic accuracy of U/S, by U/S we assessed the nodule size, calcification, margin and vascularity, lymph node involvement and we used it as a guide for fine needle aspiration biopsy [18,19].

U/S has had superiority on physical examination, one study showed U/S changed management of 44% of patients who had been referred for a solitary nodule on physical exam [20]. For assessment of malignancy no single feature carries a high sensitivity for thyroid cancer [21].

Papillary thyroid cancer is identified in 87% of thyroid solid nodule, 7% of mixed composition nodule and 6% of predominantly cystic nodules [22]. Large cystic or mixed lesion may represent large papillary thyroid cancer that have undergone cystic degeneration, the cystic component is often at the periphery of the nodule while solid epithelial portion representing a small compressed part of the lesion, it is important to direct FNAC to the solid part to rule out malignancy.

Calcification if present within nodule increases possibility of malignancy. Microcalcification represents the superimposition of Psammoma bodies upon one another [22], these lesions are most indicative of papillary thyroid cancer and has specificity up to 95% [23], in our study 6 patients were malignant (20%), 5 of 6 were papillary carcinoma, one patient was atypia and one was indeterminate, all 6 patients proved malignancy by histopathology and all were euthyroid.

In study done by Linda B et al [24] found that 67% were benign and 7% were malignant and suspicious carcinoma in 2%, 17% follicular neoplasm, atypia was 1%. In Zubair WB et al study showed benign 63% and malignant 10% [25]. In Miseskyte-Kaubriene study showed benign in 59.8% and malignancy in 22.5% [26].

In our study the sensitivity of U/S guided FNAC for thyroid nodule was 83.3%, specificity 95.8% and accuracy 93.3%. In study done by Mikosch P. et al shows sensitivity of FNAC under U/S control is 87.84%, specificity 78% and accuracy 79.53% [27]. While Ming JK, shows sensitivity 96%, specificity 85.9% and accuracy 89.4%, and in study done by Takya H shows sensitivity 62%, specificity 74% and accuracy 68%.

## 5. Conclusion

- 1) U/S guided FNAC is essential and reliable tool in evaluation and management of patient with solitary thyroid nodule.
- 2) Results of malignant or suspicious by U/S guided FNAC are helpful for recommending total or near total thyroidectomy.
- 3) U/S guided FNAC is a minimally invasive procedure for pre-operative evaluation of thyroid nodules.
- 4) U/S guided FNAC has accuracy in diagnosis of thyroid nodules.
- 5) U/S guided FNAC has an essential tool in evaluation of incidental and non-palpable thyroid nodules.
- 6) U/S guided FNAC in diagnosis of suspicious results of FNAC of thyroid nodules.
- 7) Application of molecular genetics to cytological smear can help to differentiate benign from malignant nodule.
- 8) To increase accuracy of FNAC guided by U/S for follicular carcinoma need to apply immunocytochemistry.

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