International Journal Dental and Medical Sciences Research
Volume 5, Issue 2, Mar - Apr 2023 pp 519-527 www.ijdmsrjournal.com ISSN: 2582-6018

A Retrospective Study of Clinico-Radio Histopathological Assessment of Solitary Thyroid Nodule in Rural Medical College India

Dr.Arifa A. Khan [1], Dr.Syed Musab [2], Dr.Omar Khan[3]
[1] *Associate Professor,JIIU's IIMSR ,Jalna,Maharashtra,India*
[2,3]*Resident,JIIU's IIMSR ,Jalna,Maharashtra,India*

Date of Submission: 20-03-2023 Date of Acceptance: 30-03-2023

ABSTRACT:
BACKGROUND: Thyroid nodules are a common finding in general practice. These nodules are either solitary or multinodular. In the present study thorough evaluation of all the cases presenting with a solitary thyroid nodule (STN) is done. The clear overview of prevalence of STN, its distribution and its percentage of malignancy, clinic-pathological correlation and findings on ultra-sonogram.
METHODS: A two year retrospective observational study at a rural medical college was done after ethical committee approval. All cases of thyroid with solitary thyroid nodule were included and socio demographic data, clinical examination and USG data was noted. Thyroid hormone profile, FNAC and HPE was performed for every case enrolled and data was noted. The data was analyzed using SPSS version 22.
RESULTS: a total 56 cases were enrolled in this study with average age of the participants was 38.67±12.82 years in the range of 15 – 80 years. The highest incidence was 30.35% recorded in 4th decade of life. majority were Females 46 and 10 males. the commonest presentation swelling in the anterior part of neck in 98% with Maximum number of patients had euthyroid state (96%). FNAC reports, Colloid or adenomatous goiter (Cat II) as the most common benign finding (69%) followed by Follicular neoplasm (Cat IV). Out of 56 patients of STN confirmed by USG, 7 (12.5%) turned to be malignant on postoperative histopathology. Papillary carcinoma was the most common form of malignancy that occurred during the study. findings on FNAC were confirmed on Histopathology, Maximum number of patients 51.17% were confirmed with colloid goitre. Total number of patients diagnosed with malignancy on histopathology were 7 (12.5%). Majority of patients 82.15% were managed by Hemithyroidectomy based on FNAC and USG reports followed by total thyroidectomy (7%).
CONCLUSION: All cases of STN require a thorough clinical approach supported by ultra-sonogram, FNAC and detailed HPE after surgery for evaluation of benign and malignant lesions. Fine needle aspiration cytology AND USG has become an invaluable, minimally invasive and reliable tool in the preoperative assessment of patients with suspicion of malignancy.
KEYWORDS: Solitary Thyroid Nodule,Fine Needle Aspiration Cytology, Ultrasonograpgy, Euthyroid, Pappilary Carcinoma

I. INTRODUCTION

Thyroid disorders are the most common endocrine disorder seen in clinical practice and a solitary thyroid nodule is now one of the most common presentations of thyroid nodule. A solitary thyroid nodule is defined as palpably discrete swelling within an otherwise normal gland[1].Thyroid nodules are a common finding in general practice with an estimated prevalence of 3-7% by clinical examination and 20-60% on ultra-sonogram. Thyroid nodules are extremely prevalent, though their prevalence varies depending on where you live. The prevalence of palpable nodules is just 4 to 7 percent, despite autopsy data showing a 50% prevalence of thyroid nodules larger than one centimetre in people without clinical indication of thyroid illness. Women are almost four times more likely than men to have solitary thyroid nodules.[2-4]

The present study was undertaken to evaluate the Clinico-Radio Histopathological profile of solitary thyroid nodule. This will facilitate an in depth understanding of epidemiological and clinical understanding of the nodule and its pathological correlation.

The prevalence of solitary nodule increases with age at the rate of 0.8% per year[5].The prevalence of palpable thyroid nodules was found to be 4 to 7% with only 5 to 10% of nodules being malignant.[6]

Patients most frequently describe an accidental nodule discovered on imaging tests carried out for another cause or a large palpable lump in the neck when they first appear. A single nodule inside a multinodular gland is less likely to be carcinoma than a single dominant or isolated nodule.

International Journal Dental and Medical Sciences Research
Volume 5, Issue 2, Mar - Apr 2023 pp 519-527 www.ijdmsrjournal.com ISSN: 2582-6018

The choice to operate is decided on therapeutic or diagnostic grounds because the majority of nodules are asymptomatic and only 5 to 10 percent of nodules are malignant. The clinician's primary tools for determining whether surgical excision of a thyroid nodule is necessary are ultrasound imaging studies and cytology from fine-needle aspiration. Furthermore, it can be difficult to identify benign from malignant neoplasms using histologic criteria.[7-10]

II. MATERIAL AND METHODS:

The present retrospective observational study was conducted in department of general surgery at IIMSR and Noor Hospital. The study period was two years from January 2021 to December 2022. The study was approved by the institutional ethical committee and was conducted as per the protocol of the committee. All the thyroid cases reported to the OPD and referred from other departments were enrolled in the study group. All the cases were thoroughly examined clinically and cases diagnosed with STN were included in the study. The socio demographic data of the study group was collected in a predesigned structured data sheet which includes age, sex, history of thyroid disease in family, history of radiation exposure and any history of thyroid medication. A thorough clinical examination and history of clinical symptoms were noted in a separate Performa which was prepared in relation with signs and symptoms of thyroid swelling and general routine examination. All the cases enrolled in the study were subjected to routine biochemical and pathological investigations. Thyroid hormone profile which includes TSH, free T3 & T4 were estimated and noted for every case in the study. Fine needle aspiration cytology (FNAC) was performed and diagnosis was noted. Ultra sonogram of the nodule in every case was performed and characteristics of the nodules which include size, central micro-calcification, echogenicity, vascularity and borders were noted. The plan and type of surgery was decided based on FNAC report, ultra sonogram findings and hemi-thyroidectomy/ total thyroidectomy was done and specimen sent for histopathological examination (HPE). The report of the HPE was noted and correlated with the FNAC findings. The final management was based on the HPE report based on malignancy or benign nature of the nodule.
SAMPLE SIZE:56

Inclusion Criteria
1.All male and female patients presenting to OPD and admitted in surgery wards with features of solitary thyroid nodule.
2.Patients age above 10 years of age.
Exclusion Criteria
1.Patients with multi-nodular or diffuse enlargement of thyroid.
2.Patients who refused for investigations and further management.
Statistical analysis method:
All data was collected in paper-based case report forms and then it was entered in Microsoft excel 2016 format. Frequency tables and measures of central tendency (mean) and measures of dispersion (standard deviation) were obtained by using the software IBM SPSS version 20. Proportions were compared using Chi- square test and continuous variables were compared using student t test.

III. RESULTS

The study was a single centric, retrospective, observational study conducted in a rural medical college india, after obtaining permission from the Institutional Ethics Committee. The study is titled “A Retrospective Study Of Clinico-Radio Histopathological Assessment Of Solitary Thyroid Nodule In Rural Medical College India”. A total of 56 adult patients presenting with solitary thyroid nodule meeting the selection criteria were enrolled for the study. We examined patients for demographic data, signs and symptoms and were planned for surgery i.e (Hemi-thyroidectomy, Total Thyroidectomy, Subtotal Thyroidectomy). Findings of investigations i.e FNAC, ultrasonography with the histopathology of resected specimen were co-related and usefulness of FNAC, ultrasonography in the management of solitary thyroid nodule was studied. Findings obtained were then evaluated. After evaluation of the data we obtained the following results.

International Journal Dental and Medical Sciences Research
Volume 5, Issue 2, Mar - Apr 2023 pp 519-527 www.ijdmsrjournal.com ISSN: 2582-6018

Table No 1 – Age wise distribution in the study population (n=56)

Age wise distribution of study participants

Age (in years)	No. of patients	Percentage (%)
15-20	4	7.14%
21-30	14	25%
31-40	17	30.35%
41-50	12	21.42%
51-60	6	10.71%
61-70	2	3.57%
71-80	1	1.81%
Total	**56**	**100**

The average age of the participants was 38.67±12.82 years in the range of 15 – 80 years. Majority of the participants, 17, Youngest patient was 18 years old and oldest patient was 71 years old. The highest incidence was 30.35% recorded in 4th decade of life.Gender wise distribution of the study participants showed, that majority were Females 46 and 10 males. Female predominance was noted in the results.

Table No 2 : Presenting complaints in the study population (n=56)

Presenting Symptoms	No. of Patients	Percentage (%)
Swelling in front of neck	55	98.21%
Pain in swelling	5	8.92%
Dyspnoea	3	5.35%
Dysphagia	4	7.15 %
Change in voice	3	5.35%
Weight loss	5	8.92%
Palpitations	2	3.58%
Menstrual irregularities	2	3.58%

Various presenting complaints were observed in the study population of which the commonest presentation was neck swelling in the anterior part of neck in 98% of the patients followed by pain in swelling and weight loss in 8.92% of the patients and only 5% of the study population complained of dyspnea.

Table No 3: Hormonal status of the study population(n=56)

Hormonal Status	No. of Patients	Percentage (%)
Euthyroid	54	96.42%
Hypothyroid	2	3.58%
Hyperthyroid	-	-

Thyroid status in the study population was assessed. It was observed that Maximum number of patients had euthyroid state (96%) and only 3% patients were hypothyroid. Thyroxine supplementation was given according to requirement, patient were made euthyroid and then operated.

International Journal Dental and Medical Sciences Research
Volume 5, Issue 2, Mar - Apr 2023 pp 519-527 www.ijdmsrjournal.com ISSN: 2582-6018

Table No 4: Findings on fine – needle aspiration cytology Bethesda Classification in study population (n=56)

FNAC	No. of Patients	Percentage(%)
I	5	8.92%
II	39	69.64%
III	3	5.35%
IV	7	12.5%
V	2	3.59%
Total	56	100%

Among FNAC reports, Colloid or adenomatous goiter (Cat II) as the most common benign finding (69%) followed by Follicular neoplasm (Cat IV). Hashimoto thyroiditis was present only in 5% of the population (3 out of 56).

Table No 5: USG Neck (TIRADS grading) performed in the study population (n=56)

TIRADS	No of Patients	Percentage
1	-	-
2	25	44.64%
3	19	33.92%
4	12	21.42%
5	1	1.80%

Clinical diagnosis of STN was confirmed on USG in 56 (100%) patients. 8 patients (14%) out of 56 patients the revealed Multinodular goitre on postoperative histopathology,13 nodules were reported as malignant on the basis of findings such as raised internal vascularity, taller than wider, comet tail artefact Of 56 patients of STN confirmed by USG, 7 (12.5%) turned to be malignant on postoperative histopathology.

Table no 6: Features in sonography in the study population (n=56)

USG features	No.of Patients	% in benign lesions	No.of Patients	% in malignant lesions
Size <2cm	6	14.28%	-	
Size 2-4cm	36	80.95%	3	28.57%
Size >4cm	7	16.67%	4	28.57%
Taller than wide shape	1	2.3%	2	14.28%
Solid in nature	18	42.85%	13	92.85%
Hypoechoic	18	42.85%	4	28.57%
Hyperechoic	11	26.19%	-	-
Anechoic	4	9.52%	-	-
Irregular margin	-	-	2	14.28%
Microcalcification	2	4.76%	1	7.14%
Intranodular vascularity	12	28.57%	6	42.85%
Presence of cervical LNs	4	9.52%	5	35.70%
Internal septations	5	11.90%	-	

International Journal Dental and Medical Sciences Research
Volume 5, Issue 2, Mar - Apr 2023 pp 519-527 www.ijdmsrjournal.com ISSN: 2582-6018

Majority of the nodules (n=38, 67.85%) were 2-4 cm in size. However, there was significant correlation between tumor size and the risk of malignancy. Echogenicity was solid in 22 (40%) patients, purely cystic in 4(7%) patients and both solid and cystic (mixed echoic) in 30 (53%) patients. However, the distribution of these echogenicity patterns was different between benign and malignant nodules. Majority (75%) of the benign nodules were either cystic or of mixed echogenicity, whereas the vast majority (25%) of the malignant nodules were solid in echogenicity. In addition, USG detected micro calcification in 3 patients out of which 1 turned out to be malignant while 2 nodules with micro calcification were reported as benign. Thus, 1 out of a total 14 malignant case had micro calcification in contrast to 2 of 42 benign nodules. Lymph nodal enlargement was detected by USG in 9 patients. 12 patients with benign lesion showed raised vascularity on doppler while 6 out of 14 malignant demonstrated raised vascularity.

Table No 7: Findings on Histopathology in study population (n=56)

Histopathology	No. of patients	Percentage (%)
Colloid Goiter	29	51.17%
Colloid Cyst	2	3.59%
Adenomatous Goiter	1	1.80%
Multinodular Goiter	8	14.2%
Follicular Adenoma	5	8.92%
Follicular Carcinoma	1	1.80%
Papillary Carcinoma	5	8.92%
Hashimoto Thyroiditis	3	5.35%
Hurthle cell Neoplasm	3	5.35%
Neuroendocrine tumour	1	1.80%
Total	56	100

Various findings on FNAC were confirmed on Histopathology, Maximum number of patients 51.17% were confirmed with colloid goitre. Total number of patients diagnosed with malignancy on histopathology were 7 (12.5%). Papillary carcinoma was the most common form of malignancy that occurred during the study. None of our patients in the study group had history of radiation exposure.

Mean age of patients with malignancy (n = 14) was 38.07 ± 11.51 years. Out of them 4 were females and 3 were male patients (M: F ratio of 1:1). Rest 49 STNs were reported as benign (7 males and 42 females). Malignant STN was reported in 3 out of 10 (30%) males and 4 out of 46 (8.69%) females.

Table No 8: Surgical Management performed in the study population (n=56)

Management	No. of patients	Percentage
Hemithyroidectomy	46	82.15%
Total Thyroidectomy	04	7.15%
Subtotal Thyroidectomy	02	1.80%
Isthmectomy	01	1.80%
USG guided Aspiration	02	3.58%
Conservative	01	1.80%

Majority of patients 82.15% were managed by Hemithyroidectomy based on FNAC and USG reports followed by total thyroidectomy (7%). 4 patients underwent completion thyroidectomy after HPE reported malignancy. 2 patients were managed by USG guided aspiration. In view of benign nature (FNAC & USG) 1 patient was managed conservatively (since size of the nodule was <2cm with FNAC- Cat II and TIRADS 2 findings).

International Journal Dental and Medical Sciences Research
Volume 5, Issue 2, Mar - Apr 2023 pp 519-527 www.ijdmsrjournal.com ISSN: 2582-6018

Table 9: Co-relation of clinical examination with USG thyroid examination and Histopathology report (n=56)

Cases	Clincal	% cases	USG	% cases	Histopathology	% cases
Benign	46	82.14%	45	80.35%	49	87.50%
Malignant	10	17.86%	11	19.65%	7	12.5%
Total	56		56		56	

Clinical diagnosis was benign solitary thyroid nodule in 46 patients and 10 patients were diagnosed as patients of possible malignancy. Similar findings were confirmed on USG Neck. USG confirmed diagnosis of solitary thyroid nodule in 56 patients, was s/o malignancy in 11. Final histopathology report revealed malignancy in 7 patients. Multinodularity was found in 6 patients on final histopathology report which were diagnosed as solitary nodule on clinical examination as well as Ultrasound.

On applying Fisher test for clinical and USG findings, statistic value is 1, the result is not significant at p-value of < 0.05. There is no significant difference in findings obtained clinically and radiologically (USG).

USG and FNAC shown to be more sensitive, specific and accurate together than either technique alone and is recommended in the work-up of all thyroid nodules. After thorough clinical evaluation and before reaching to the final histopathology, the radiological examination plays a crucial role in making diagnosis in thyroid nodules.

IV. DISCUSSION

Thyroid nodules represent one of the common findings in the clinical practice. The causes of these are multifactorial where they range from family history to idiopathic. These nodules may be benign which may include the colloid goitre and the classic multinodular goitre. Hashimoto's disease and Grave's disease also represent rare causes of multinodularity. Malignant causes of nodularity in thyroid may include thyroid cancer, lymphomas and metastasis to the thyroid from other organs. Hence most of the studies recommend that all thyroid nodules whether solitary or multinodular should undergo a thorough clinical and ultrasonographic and histopathological examination for complete evaluation of study..

Solitary Thyroid Nodule is a clinical term it means the presence of a single palpable nodule in an otherwise normal thyroid gland. The solitary nodule in the thyroid gland has aroused the interest of general surgeons because of its malignant potential and because of possibility of toxicity in the nodule and also complications like pressure effects and hemorrhage.

Many investigations are used to differentiate between benign and malignant nodule so as to avoid surgery in those who don't need it. Among these FNAC, USG AND THYROID FUNCTION TEST are commonly used in association with the clinical feature but there are drawbacks of each technique and the final answer to the problem is still elusive.

The present study is undertaken to evaluate the utility of USG Neck & FNAC in preoperative diagnosis of thyroid swelling and evaluate the efficiency of USG, FNAC, TFT in differentiating between benign and malignant thyroid swelling.

Fine Needle Aaspiration cytology has good sensitivity and specificity. The distinction of benign and malignant follicular lesions is often not possible using cytologyalone. Having said that certain studies show that Follicular neoplasm can be diagnosed on FNAC if not a carcinoma based on the presence of follicular atypical cells. The functional nature of the nodule can be established by chemical hormonal analysis and nuclear imaging method and this also helps in deciding the clinical outcome in patients. But the most important diagnostic tool in initial evaluation of thyroid lesions is fine needle aspiration cytology.[11]

In the present study we observed the average **age** of the participants was 38.67± 12.82 years in the range of 15 – 80 years. Majority of the participants, 17, were in the age group of 31 to 40 years. Age group 21-40 years constituted 31, accounting to 55.35% of total study population. Similar results were obtained by the study conducted by Tabaqchali et al,[12] also observed the mean age in their similar to our study (40). Afroze N et al [13] also reported similar findings with mean age group in their study being 40.2 year. Majority of studies compared the mean age group variying from 35-45 as this is also the most common age group presenting with neck swelling in the literature and was also observed in our study.

We also studied the **gender** wise distribution of the study and participants showed, that majority were Females 46 and 10 males. Female predominance was noted in the results. Male to female ratio 1:4. Similar results were observed in the study conducted by Afroze et al.,[13] with M: F -1: 4. Another study conducted by Keshri et al.,[14] M:F

International Journal Dental and Medical Sciences Research
Volume 5, Issue 2, Mar - Apr 2023 pp 519-527 www.ijdmsrjournal.com ISSN: 2582-6018

was 1.233, but studies conducted by Popivanov et al.,[15] and Tabaqchali et al.[12] observed higher M: F ratio. But all the studies had female predominance similar to our study. Hence, it explains that females are more affected with thyroid swelling.

In our study, patients presenting with various **complaints** were observed in the study population of which the commonest presentation was neck swelling in the anterior part of neck in 98 % of the patients followed by pain in swelling and weight loss in 10% of the patients and only 5% of the study population complaint of dyspnea. Similar kind of complaints were also observed in the studies conducted by Dhanaram B et al. [16]

In our study, **FNAC reports** were assessed and among them the colloid or adenomatous goiter (Cat II) was the most common benign finding (69%) followed by malignancy Papillary carcinoma and Follicular neoplasm. Hashimoto thyroiditis was found only in 5% of the population.In study conducted by Bhargava et al,.[17] the FNAC findings observed were colloid goitre was the most common diagnosis (n=74; 61.7%) followed by colloid goitre with cystic changes (n=24; 20%), thyroiditis (n=18; 15%), follicular adenoma (n=2; 1.7%) and papillary/medullary carcinoma (n=2; 1.7%) respectively. All the study findings showed similar results to our study where colloid goitre was the commonest finding.

In our study we studied the co-relation between findings on FNAC and findings observed on Histopathology. It was observed that out of 39 cases of colloid goiter on FNAC 29 were colloid goiter on HPE and 1 malignancy reported as benign condition on FNAC and 6 multinodular goiter were diagnosed on HPE. Follicular neoplasm was diagnosed in 7 patients in FNAC, only 1 patient had follicular carcinoma, 3 follicular adenoma on HPE. In this study, total Malignancies according to HPE reports were 7 cases out of 56. True positive 5 malignancy on both HPE and FNAC), False Negatives 2 (malignant on HPE but benign on FNAC), True Negatives 41 (benign both on HPE and FNAC), False Positive 02 (report showed malignancy on FNAC and benign pathology on HPE).

Study	Sensitivity	Specificity	Positive Predictive value	Negative Predictive value
Afroze et al. [13]	61.9	99.3	92.8	94.7
Kessler et al.[18]	79	98.5	98.7	76.6
Gupta et al.[19]	80	86.6	80	86.6
Present study	71.42	89.80	71.42	95.30

Our studies corelated really well with few of studies mentioned in the above table but results were also contrary to some of the studies.

Clinical diagnosis was benign solitary thyroid nodule in 46 patients and 10 patients were diagnosed as patients of possible malignancy. Jayaram et al (2012) stated that nodules less than 1 cm in diameter are not detected by palpation, but rather detected during USG thyroid examination. Ultrasound suggested colloid nodule/cyst in 32 patients and malignancy in 11 patients. 3 patients had thyroiditis on USG. In our study on clinical examination 56 of thyroid cases which were solitary on palpation were similarly confirmed on USG evaluation**. Simeone et al (1982)[20] stated that the detection of more than one lesion with USG reduces the** probability of malignancy to 1-6%. Out of total study populations, 44 patients were having benign lesions on USG. Among them, 65% patients were having colloid nodule and 3.33% were having lymphocytic thyroiditis. Out of the 56 patients, 11 had features of malignant lesions and Clinically malignancy was suspected in 10 patients. Final Histopathology examination reported malignancy in 7 patients.

On USG evaluation. Simeone et al (1982)[20] stated that the detection of more than one lesion with USG reduces the probability of malignancy to 1-6%. Walker et al [21] (1985) have shown that the prevalence of multinodularity in clinically solitary thyroid nodules is between 20% and 40%. Out of total study populations, 44 patients were having benign lesions on USG. Among them, 65% patients were having colloid nodule and 3.33% were having lymphocytic thyroiditis. Out of the 56 patients, 11 had features of malignant lesions and Clinically malignancy was suspected in 10 patients. Final Histopathology examination reported malignancy in 7 patients.

The sensitivity and specificity of USG in detecting malignancy to be 75% and 89.36% respectively. Sensitivity and specificity is quite comparable to the other studies. Cai et al[22] (2006) study showed specificity of ultrasound to be 97.8%

and sensitivity 80.5%. Watters et al[23] (1998) interpreted an USG report as suggestive of malignancy if the nodule was solid or of a mixed solid-cystic variety and a hypoechoic and non-haloed lesion. Sensitivity of USG in his study was 74% and specificity was 83%. In the study of Pooja et al (2017) USG findings were correlated with histopathology, sensitivity of the test was found to be 69.23% and specificity was 91.49%. The result of our study shows that the incidence of malignancy in STNs is indeed high. The chance of malignancy is more in those nodules where USG shows solid echogenicity, presence of micro calcification in nodule and associated lymphadenopathy.

Study	Sensitivity	Specificity
Cai et al.[22]	80.5%	97.8 %
Watters et al.[23]	74%	83%
Pooja et al[24]	69.23%	91.49%
Present study	75%	89.36%

Based on the USG & FNAC findings, patients underwent Hemithyroidectomy, Isthmectomy, Total thyroidectomy and one patient underwent Subtotal thyroidectomy. The decision as to which surgery was done was taken not only based on the cytology findings but also on the intraoperative picture. Certain patients that showed a larger disease intraoperatively underwent Total thyroidectomy. Completion thyroidectomy was performed in 4 patients on detection of malignancy on histopathology report.

V. CONCLUSION

We concluded that Ultrasound is an inexpensive, readily available, and non-invasive investigation. USG for diagnosis of thyroid disorders especially malignancy is highly significant and acts as a good guiding tool. Comparison of clinical examination with radiological examination showed that USG thyroid was equivocal or better in diagnosing solitary thyroid lesions than clinical examination. All cases of STN require a thorough clinical approach supported by ultra-sonogram, FNAC and detailed HPE after surgery for evaluation of benign and malignant lesions. All cases of STN with suspicious of malignancy on USG should be performed a mandate FNAC before further proceeding for surgical management. Fine needle aspiration cytology has become an invaluable, minimally invasive and reliable tool in the preoperative assessment of patients with suspicion of malignancy.

REFERENCES

[1]. Rajesh Kakkeri, A clinical study of solitary nodule thyroid, International surgery Journal April-June 2016, Vol.3, Issue 2 page 872-875.
[2]. Mortensen JD, Woolner LB, Bennett WA. Gross and microscopic findings in clinically normal thyroid glands. J Clin Endocrinol Metab. 1955;15(10):1270–80.
[3]. Singer PA. Evaluation and management of the solitary thyroid nodule. Otolaryngol Clin North Am. 1996;29(4):577–91.
[4]. Dorairajan N, Jayashree N. Solitary nodule of the thyroid and the role of fine needle aspiration cytology in diagnosis. J Indian Med Assoc Feb 1996;94(2):50-2.
[5]. Larsen PR, Davies TF, Hay ID. The Thyroid Gland In: Wilson JD. Williams Textbook of Endocrinology, WB Saunders Company, Philadelphia. 1998:495-6.
[6]. Fraker DL. Radiation Exposure and other factors that predispose to human thyroid neoplasia. Surg Clin North Am. 1995;75(3):365-75.
[7]. Ezzat S, Sarti DA, Cain DR, Braunstein GD. Thyroid incidentalomas. Prevalence by palpation and ultrasonography. Arch Intern Med. 1994;154(16):1838–40.
[8]. Papini E, Guglielmi R, Bianchini A, Crescenzi A, Taccogna S, Nardi F, et al. Risk of malignancy in nonpalpable thyroid nodules: predictive value of ultrasound and colorDoppler features. J Clin Endocrinol Metab. 2002;87(5):1941–6.
[9]. Nam-Goong IS, Kim HY, Gong G, Lee HK, Hong SJ, Kim WB, et al. Ultrasonography-guided fine-needle aspiration of thyroid incidentaloma: correlation with pathological findings. Clin Endocrinol (Oxf) 2004;60(1):21–8.

[10]. Daniel J Kelley. Evaluation of Solitary Thyroid Nodule. Available at: https://emedicine.meds cape.com/article/850823-overview (Accessed on 17 June 2022)
[11]. Agrawal S. Diagnostic accuracy and role of fine needle aspiration cytology in management of thyroid nodules. Journal of surgical oncology. 1995 Mar;58(3):168-72.
[12]. Tabaqchali MA, Hanson JM, Johnson SJ, Wadehra V, Lennard TW, Proud G. Thyroid aspiration cytology in Newcastle: a six year cytology/histology correlation study. Annals of the Royal College of Surgeons of England. 2000 May;82(3):149.
[13]. Afroze N, Kayani N, Hasan SH. Role of fine needle aspiration cytology in the diagnosis of palpable thyroid lesions. Indian journal of pathology & microbiology. 2002 Jul 1;45(3):241-6.
[14]. Dr.Shyam Keshri, Dr.Shashi Kumar, Dr.Shiva Thakur. Clinico- Pathological Study of Solitary Thyroid Nodule with Special Reference to Fine Needle Aspiration Cytology. International Journal of Science and Research (IJSR), Index Copernicus Value (2015): 78.96.
[15]. Popivanov P, Boianov M, Temelkova N, Manolov D, Chavrakov G. Fine-needle aspiration biopsy and cytologic diagnosis in thyroid disease-a 3-year experience. Vutreshni bolesti. 2000 Jan 1;32(3):31-5.
[16]. Balaji Dhanaram, Jothi Aranachalam et al. A Clinicopathological study of solitary nodule of thyroid. International Surgery Journal. Dhanaram B et. el. Int Surg. J. 2017 Jul;4(7):2288-2290.
[17]. Bhargava A, Faiz SM, Shakeel M, Singh NJ, Singh S. Clinicopathological study of asymptomatic thyroid swelling and its correlation with thyroid function tests. Int J Otorhinolaryngol Head Neck Surg 2019;5:727-33.
[18]. A.Kessler, H. Gavriel, S. Zahav, et al., "Accuracy and consistency of fine-needle aspiration biopsy in the diagnosis and management of solitary thyroid nodules," Israel Medical Association Journal, vol. 7, no. 6, pp. 371–373, 2005.
[19]. Manoj Gupta Savita Gupta. Correlation of Fine Needle Aspiration Cytology with Histopathology in the Diagnosis of Solitary Thyroid Nodule. Journal of Thyroid Research 2010; Volume 2010, Article ID 379051, 5 pages
[20]. Simeone JF, Daniels GH, Mueller PR, Maloof F, vanSonnenberg E, Hall DA, et al. High-resolution real-time sonography of the thyroid. Radiology 1982;145;431-5.
[21]. Walker J, Findlay D, Amar SS, Small PG, Wastie ML, Pegg CA. A prospective study of thyroid ultrasound scan in the clinically solitary thyroid nodule. Br J Radiol 1985; 58:617-9.
[22]. Cai XJ, Valiyaparambath N, Nixon P, Waghorn A, Giles T, Helliwell T. Ultrasound-guided fine needle aspiration cytology in the diagnosis and management of thyroid nodules. Cytopathology 2006; 17:251-6.
[23]. Watters DA, Ahuja AT, Evans RM, Chick W, King WW, Metreweli C, et al, Role of USG in the management of thyroid nodule. Am J Surg 1998; 164:654-7.
[24]. Dr.Pooja Sharma, Dr. Nityasha, Dr. R.K. Karwasra, Dr. Ved Ratna Pathak Clinico-radiological profile of goitre and its correlation with histopathology. International J. of Healthcare and Biomedical Research, Volume: 05, Issue: 03, April 2017, 149-161