



# ULTRASOUND GUIDED FINE NEEDLE ASPIRATION CYTOLOGY IN DIAGNOSIS OF THYROID NODULE

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## ABSTRACT

**Introduction:** The prevalence of clinically palpable thyroid nodules is approximately 4–7%, but the prevalence of ultrasound-detectable nodules is 19 to 67%. FNAC is widely accepted and has become cornerstone in evaluation of thyroid nodules, because it is a simple and accurate screening test with high sensitivity and specificity in the preoperative evaluation of thyroid lesions. Ultrasound guided FNAC is the most cost-effective and accurate way to evaluate thyroid nodules.

**Aim:** This study was done in an attempt to identify the Sensitivity, Specificity, Positive predictive value, Negative predictive value and diagnostic accuracy of ultrasound guided FNAC of thyroid nodules and to correlate with the findings of previous authors.

**Methodology:** Thirty two patients with age group greater than 15 years of age presenting with thyroid nodules were included in the study. Ultrasound Guided FNAC was done for all the patients before surgery. Results of Ultrasound Guided FNAC and Histopathology were tabulated and statically analysed to identify the Sensitivity, Specificity, Positive predictive value, Negative predictive value and Diagnostic Accuracy of ultrasound guided FNAC of thyroid nodules.

**Results:** Female patients were dominant when compared to male patients. The mean age was 49 and 44 for female and male patients respectively. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of ultrasound guided FNAC of the thyroid swelling were 87.5%, 91.67%, 77.78%, 95.65% and 90.62% respectively.

**Conclusion:** In our study, ultrasound guided FNAC proved to be a better modality for diagnosing the etiology in thyroid nodules that gave a high accuracy rate of 90.62%. Further more studies are needed with the larger sample size to confirm it.

**Key Words:** Thyroid nodule, Ultrasound guided FNAC, Sensitivity, Specificity, Positive predictive value, Negative predictive value, Diagnostic accuracy

## INTRODUCTION

The prevalence of clinically palpable thyroid nodules is approximately 4–7%, but the prevalence of ultrasound-detectable nodules is 19 to 67%.<sup>1</sup> Prevalence of thyroid nodules increases in frequency with age and decreasing iodine intake, history of head and neck irradiation and are more common in females.<sup>2,3,4</sup> A family history of thyroid cancer also increases a patient's risk to develop a thyroid nodule.<sup>5</sup> FNAC was first reported by Manheim with the use of fine, 22-gauge needle. The elaboration of FNA by the Swedish school in the forthcoming years was crucial for the establishment of the technique and its world-wide acceptance.<sup>6</sup> FNAC is widely accepted

and has become cornerstone in the preoperative evaluation of thyroid lesions because it is a simple and accurate screening test with high sensitivity and specificity. It is considered as the gold standard investigation in diagnosis of thyroid nodules. Ultrasound guidance is being increasingly used to direct the fine needle into minute non palpable thyroid nodules or into the solid or peripheral areas of complex nodules to avoid cystic or necrotic areas, which might lead to inadequate samples.<sup>7</sup> FNAC done under ultrasound guidance is the most cost-effective and accurate way to evaluate a thyroid nodule.<sup>8–11</sup> This study was done in an attempt to identify the Sensitivity, Specificity, Positive predictive value, Negative predictive value and diagnostic accuracy of Ultrasound

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guided FNAC in diagnosing thyroid nodules and to correlate with the findings of previous authors.

## MATERIALS AND METHODS

Thirty two consecutive patients presenting with thyroid nodule to the surgery outpatient department of Mahatma Gandhi Medical College and Research Institute Pondicherry during the period from 01.02.2013 to 31.07.2014 were included in the study. Cases previously diagnosed by FNAC, pregnant women and toxic nodules were excluded. Ultrasound Guided FNAC was done with the patient in supine position with slight hyperextension of the neck. Local anaesthetic was not routinely used unless requested by the patient. A 7.5-mega-hertz probe was placed on the neck perpendicular to the thyroid, allowing clear visualization of the nodule. A 23 gauge needle was used and the tip of the needle was visualized while it was being guided to the biopsy site. Once the needle was into the solid part of the nodule, 3–5 ml of negative syringe pressure was applied. The aspirate was smeared on slide and fixed in 95% ethyl alcohol for haematoxylin and eosin staining. FNAC reports were documented and correlated with post operative Histopathology report. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were calculated statistically analyzed and documented. The results were compared with those of previous authors.

## RESULTS

Out of 32 patients, 27 patients (84.38%) were females and 5 patients (15.62%) were male in this study. Female patients were dominant when compared to male patients. The mean age was 49 and 44 for female and male patients respectively (Figure 1 and Table 1).

Out of 32 patients, Multinodular goitre was more common than solitary thyroid nodule. Multinodular goitre was seen in 17 (53%) patients. Solitary thyroid nodule was found in 15 (47%) patients (Figure 2 and Table 2).

Out of 32 patients, the benign swelling was found in 24 patients (75%) and the remaining 8 patients (25%) were found to be malignant. In case of male patients, 2 patients were malignant and remaining 3 patients had benign colloid goitre. In case of female patients, 21 patients had benign swelling and 6 patients had malignant swelling (Table 3).

Ultrasound guided FNAC was done for all 30 patients. Benign colloid goitre was found in 21 patients (65.63%), papillary carcinoma in 7 patients (21.87%), inadequate sample in 3 patients (9.37%), and follicular neoplasm in 1 patient (3.12%) (Figure 4 and Table 4).

Histopathological examination was done for all 32 thyroid swellings in which benign colloid goitre was found in 21 patients (65.63%), papillary carcinoma in 8 patients (25.00%), follicular adenoma in 2 patients (6.25%) and Hashimoto's thyroiditis in 1 patient (3.12%) (Figure 5 and Table 5).

Out of 17 patients who presented with multinodular goitre, 11 patients (64.70%) were benign, 5 patients (29.41%) were malignant and 1 patient (5.89%) was not reported due to inadequate sample (Figure 6 and Table 6).

Out of 15 patients who presented with solitary thyroid nodule, 10 patients (66.67%) were benign, 3 patients (20.00%) were malignant and 2 patients (13.33%) were not reported due to inadequate sample (Figure 7 and Table 6).

The results of FNAC showed malignancy in 7 patients in which, 4 patients were presented with MNG and remaining 3 patients presented with STN and also showed follicular neoplasm in 1 patient which was presented as MNG. The frequency of malignancy is more in MNG when compared to STN (Table 7).

The result obtained by ultrasound guided FNAC was compared with the postoperative histopathology result. 3 patients showed inadequate sample on FNAC has turned to be benign in 2 patients and malignancy in 1 patient, which was papillary carcinoma. Over all, out of 32 patients, 24 patients (75%) had benign pathology and 8 patients (25%) had malignant pathology (Table 8).

The Sensitivity, Specificity, Positive predictive value, Negative predictive value and Diagnostic Accuracy of Ultrasound guided FNAC of the thyroid swelling were 87.5%, 91.67, 77.78%, 95.65% and 90.62% respectively (Table 9).

## DISCUSSION

There were 32 patients totally, in which 5 were males and 27 were females with the male to female ratio of 1:5.4 in this study, which correlates with KC S et al<sup>12</sup> and in contrast with Gupta et al<sup>11</sup> with the ratio of 1:11.1, this may be due to double the number of patients (table 10).

In the present study of 32 patients who undergone ultrasound guided FNAC showed 21 were benign colloid goitre, 1 was follicular neoplasm, 7 were papillary carcinoma, 3 were inadequate samples. 3 inadequate samples were found in this study when compared to 1 inadequate sample in the study of Chandanwale et al<sup>13</sup>. The study by Gupta et al<sup>11</sup>, KC S et al<sup>12</sup> and Rajbhandari et al<sup>14</sup> had no inadequate sample, which is a demerit in this study. In the present study, follicular neoplasm has been diagnosed as Hashimoto's thyroiditis in histopathology

and 3 inadequate samples were diagnosed as 1 with papillary carcinoma and other 2 with colloid goitre in histopathology. (Table 11)

A study done by Braga et al<sup>15</sup>, non-diagnostic and false-negative results on conventional fine needle aspiration cytology were probably due to cystic thyroid nodules. Ultrasound-guided fine-needle aspiration cytology has been a highly effective diagnostic method for the assessment of non palpable nodules which yielded a satisfactory cytology in 94% of the nodules.<sup>15</sup>

In the study by Gupta et al, there were total of 75 patients who had undergone surgery and their histopathology results showed 42 were benign colloid goitre, 12 were follicular adenoma, 3 were hashimoto's thyroiditis, 12 were papillary carcinoma, 3 were hurtle cell adenoma, 3 were hurtle cell carcinoma. In the study by Chandawale et al, there were total of 46 patients who had undergone surgery and their histopathology results showed 29 were benign colloid goitre, 3 were follicular adenoma, 3 were hashimoto's thyroiditis, 5 were papillary carcinoma, 1 hurtle cell adenoma, 1 medullary carcinoma 4 follicular carcinoma and 1 was follicular neoplasm with un malignant potential. In the study by KC S et al, there were total of patients who had undergone surgery and their histopathology results showed 20 were benign colloid goitre, 3 were follicular adenoma, 3 were hashimoto's thyroiditis, 27 were papillary carcinoma, 1 medullary carcinoma, 1 thyroglossal cyst and 1 Graves disease. In the study by Rajbhandari et al, there were total of 24 patients who had undergone surgery and their histopathology results showed 6 were benign colloid goitre, 8 were follicular adenoma, 3 were hashimoto's thyroiditis, 4 were papillary carcinoma and 3 were follicular carcinoma. In the present study, there were total of 32 patients who had undergone surgery and their histopathology results showed 21 were benign colloid goitre, 2 were follicular adenoma, 1 was hashimoto's thyroiditis and 8 were papillary carcinoma. (Table 12)

In the study of Gupta et al, 9 of the 12 cases of papillary carcinoma were correctly diagnosed on FNAC with the diagnostic accuracy of 75%. In the study of KC S et al, 17 of the 27 cases of papillary carcinoma were correctly diagnosed on FNAC with the diagnostic accuracy of 63%. In the study of Chandanwale et al, 4 of the 5 cases of papillary carcinoma were correctly diagnosed on FNAC with the diagnostic accuracy of 80%. In the study of Rajbhandari et al, 3 of the 4 cases of papillary carcinoma were correctly diagnosed on FNAC with the diagnostic accuracy of 75%. In the present study, 7 of the 8 cases of papillary carcinoma were correctly diagnosed on FNAC with the diagnostic accuracy of 87.5%. 1 case of inadequate.

In the study by Gupta et al, there were 60 non neoplastic and 15 neoplastic lesions with a ratio of 1:4 In the

study by KC S et al, there were 27 non neoplastic and 29 neoplastic lesions with a ratio of 1:1 In the study by Rajbhandari et al, there were 17 non neoplastic and 7 neoplastic lesions with a ratio of 1:2.4 In the present study, there were 24 non neoplastic and 8 neoplastic lesions with a ratio of 1:3 which is consistent with Rajbhandari et al. The study by KC S et al and Gupta et al is contrast from the present study which showed a ratio of 1:1 and 1:4. (Table 14)

Gupta et al in their study had a sensitivity of 80%, specificity of 86.6% and diagnostic accuracy of 84%. KC S et al in their study had a sensitivity of 62.6%, specificity of 100% and diagnostic accuracy of 82.1%. Chandanwale et al in their study had a sensitivity of 90%, specificity of 100% and diagnostic accuracy of 87.5%. The present study had a sensitivity of 87.5%, specificity of 91.67, positive predictive value of 77.78%, negative predictive value of 95.65% and diagnostic accuracy of 90.62% which is consistent with chandanwale et al which a sensitivity of 90%, specificity of 100% and diagnostic accuracy of 87.5%. (Table 15)

Izquierdo et al<sup>16</sup> has compared cytologic diagnostic accuracy, sensitivity, and positive predictive value of Ultrasound guided FNAC and palpation guided FNAC. This study showed better results with Ultrasound guided FNAC in comparison with Palpation guided FNAC. The malignancy rate for nonpalpable thyroid nodules and palpable nodules were similar in this study. Krishnappa et al<sup>17</sup> has compared the free-hand FNA with US-guided FNA in the evaluation of thyroid nodules. Sensitivity, specificity and diagnostic accuracy of US-guided FNA to detect neoplastic lesions were 81.81%, 92.85%, and 88% respectively, compared with free hand FNA, for which the sensitivity, specificity and diagnostic accuracy were 54.54%, 92.85%, and 76% respectively. Ultrasound guided FNAC provides a better diagnostic rate in the evaluation of thyroid lesions. Cesur M et al<sup>18</sup> had compared palpation-versus ultrasound-guided fine-needle aspiration biopsies in the evaluation of thyroid nodules. And he concluded that ultrasound guided FNAC to be superior to palpation guided FNAC for providing more accurate cytological results. 20 dollars was the difference as cost wise. Can et al<sup>19</sup> compared the cost-effectiveness between palpation and ultrasound-guided thyroid fine-needle aspiration. Authors concluded that universal application of ultrasound guided FNAC for all thyroid nodules is cost-effective and saves 138 Euros per additional accurate diagnosis of benign versus malignant thyroid nodular disease.

The study is limited due to its small sample size, so a study with a larger sample will be needed to confirm that ultrasound guided FNAC can be used for all patients to know the etiology of the thyroid swelling.

## CONCLUSION

Based on the results of our study, we have concluded that:

1. Ultrasound guided FNAC of thyroid nodules helps in taking sample from the representative part of the nodule, avoiding the cystic areas.
2. In our study, the ultrasound guided FNAC of thyroid nodule has given a sensitivity of 87.5%, positive predictive value of 77.78% and negative predictive value of 95.65%, it has yielded a high specificity rate of 91.67% and diagnostic accuracy rate of 90.62%.
3. Hence ultrasound guided FNAC seems to be a promising investigation for thyroid swellings.
4. Since our study sample is very small, further studies involving larger sample is needed.

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### Conflict of interest:

All authors declare that there is no conflict of interest.

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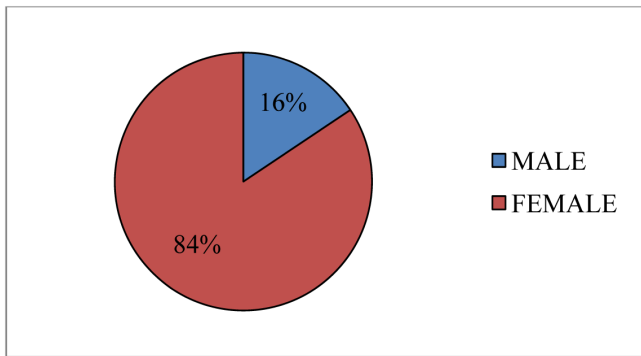


Figure 1: Male: Female ratio with female dominance

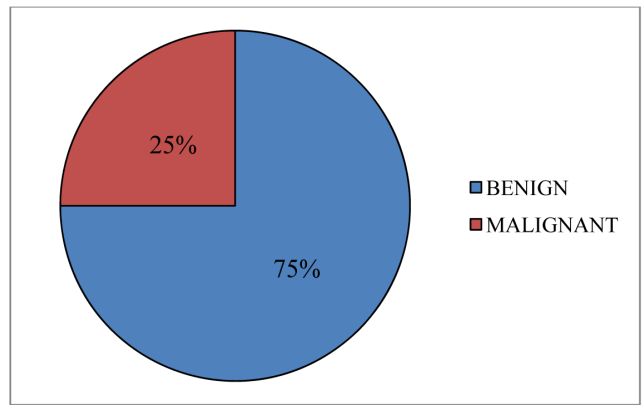


Figure 5: Showing histopathology results of 32 patients

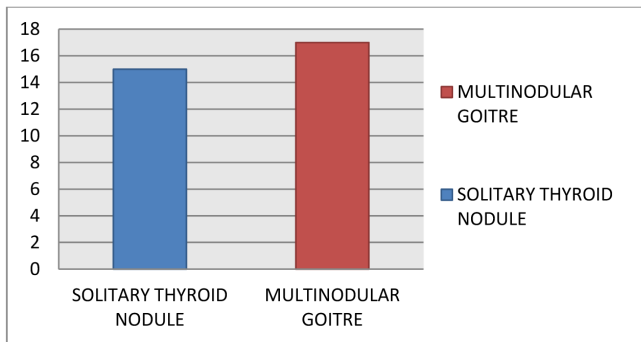


Figure 2: Total no of patients in clinical presentation

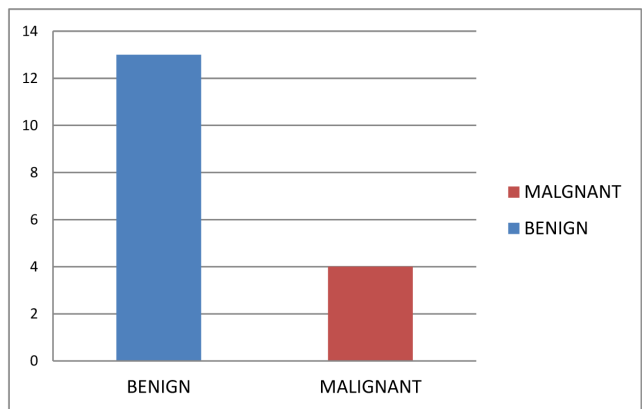


Figure 6: Histopathological types in multinodular goitre

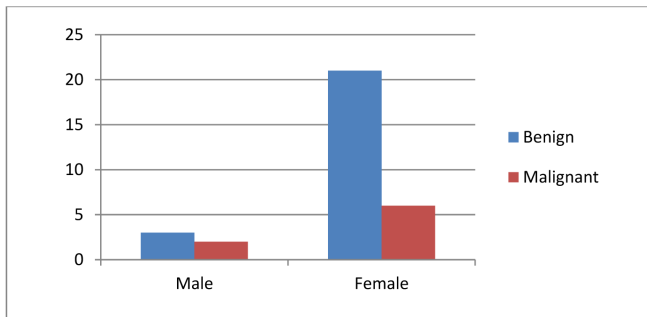


Figure 3: Genders and histopathology results

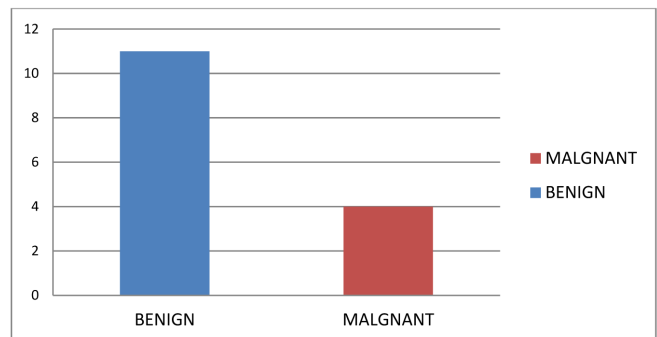


Figure 7: Histopathological types in solitary thyroid nodule

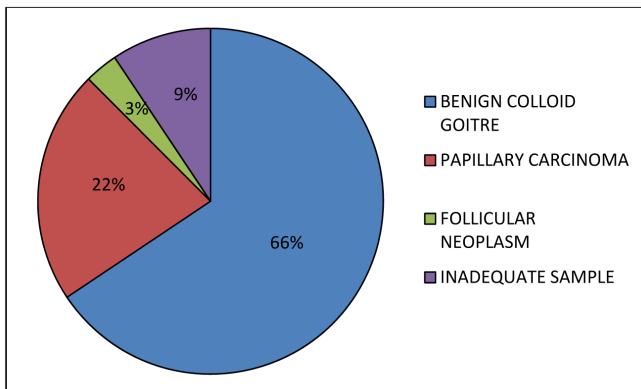


Figure 4: Showing FNAC results of 32 patients

**Table 1 : The demographic data of the study**

Age	No. of patients	Male	Female
21-30	7	2	5
31-40	10	-	10
41-50	8	2	6
51-60	5	-	5
61-70	1	-	1
71-80	1	1	-
Total	32	5 (15.32%)	27 (84.62%)

**Table 2: Age with Clinical presentation**

Age	No. of patients	Clinical presentation	
		Solitary Thyroid Nodule	Multinodular Goitre
21-30	7	5	2
31-40	10	3	7
41-50	8	6	2
51-60	5	-	5
61-70	1	1	-
71-80	1	-	1
Total	32	15 (46.9%)	17(53.1%)

**Table 3: Genders and histopathology results**

Gender	Histopathology result	
	Benign	Malignant
Male	3	2
Female	21	6
Total	24 (75%)	8 (25%)
Grand total	32	

**Table 4 : FNAC results of 32 patients**

FNAC result	No. of patients
Benign colloid goitre	21 (65.63%)
Papillary carcinoma	7 (21.87%)
Inadequate sample	3 (9.37%)
Follicular neoplasm	1 (3.12%)

**Table 5 : Histopathology results of 32 patients**

Histopathology result	No. of patients
Colloid goitre	21 (65.63%)
Papillary carcinoma	8 (25.00%)
Follicular adenoma	2 (6.25%)
Hashimoto's thyroiditis	1 (3.12%)

**Table 6: Comparison of clinical diagnosis with the FNAC diagnosis**

FNAC diagnosis	No of patients	Clinical diagnosis	
		STN	MNG
Benign colloid goitre	21 (65.63%)	10 (47.62%)	11 (52.38%)
Neoplasm	8 (25.00%)	3 (40.00%)	5 (60.00%)
Inadequate sample	3 (9.37%)	2 (66.67%)	1 (33.33%)
Total	32	15	17

**Table 7: Clinical presentation and histopathology result**

Clinical presentation	No of patients	Histopathology result	
		Benign	Malignant
Solitary thyroid nodule	15	11	4
Multinodular goitre	17	13	4
Total	32	24	8

**Table 8 : Comparison of pre operative FNAC diagnosis with postoperative Histopathology diagnosis**

Pre op FNAC diagnosis	No. of patients	Histopathology diagnosis	
		Benign	Malignant
Benign	21	21	-
Follicular neoplasm	1	1	-
Malignant	7	-	7
Inadequate sample	3	2	1
Total	32	24 (75%)	8 (25%)

**Table 9 : Statistical results of the study**

SENSITIVITY	87.50%
SPECIFICITY	91.67%
POSITIVE PREDICTIVE VALUE	77.78%
NEGATIVE PREDICTIVE VALUE	95.65%
DIAGNOSTIC ACCURACY RATE	90.62%

**Table 10: Male to Female Ratio in Different Studies**

Study	No of patients	Male	Female	Male: Female ratio
Gupta et al 11	75	6	69	1 : 11.1
KC S et al 12	56	8	48	1 : 6
Rajbhandari et al 14	24	3	21	1 : 7
Present study	32	5	27	1 : 5.4

**Table 11: FNAC results in different studies**

Study	FNAC results					
	Benign colloid goitre	Follicular neoplasm	Papillary carcinoma	Hurtle cell neoplasm	Inadequate samples	Others
Gupta et al 11	45	12	9	6	-	SM:3*
KC S et al 12	39	-	17	-	-	-
Chandanwale et al 13	32	5	4	1	1	TY:2,* MC:2*
Rajbhandari et al 14	7	11	3	-	-	TY:3*
Present study	21	1	7	-	3	-

TY – THYROIDITIS, SM – SUSPECTED MALIGNANCY, MC – MEDULLARY CARCINOMA

**Table 12 : Histopathology Results In Different Studies**

Study	HPE results				
	Benign colloid goitre	Follicular adenoma	Hashimoto's thyroiditis	Papillary carcinoma	Others
Gupta et al 11	42	12	3	12	HCA:3* HCC:3*
KC S et al 12	20	3	3	27	MC:1, * TGC:1*,GD:1*
Chandanwale et al 13	29	3	3	5	MC:1*, HCA:1*, FC:4* FNUMP*:1
Rajbhandari et al 14	6	8	3	4	FC:3*
Present study	21	2	1	8	-

HCA – HURTLE CELL ADENOMA, HCC – HURTLE CELL CARCINOMA,  
MC – MEDULLARY CARCINOMA, FC – FOLLICULAR CARCINOMA  
TGC–THYROGLOSSAL CYST, GD – GRAVES DISEASE,  
FNUMP– FOLLICULAR NEOPLASM WITH UNMALIGNANT POTENTIAL,

**Table 13: Diagnostic Accuracy Of Papillary Carcinoma**

STUDY	FNAC	HPE	ACCURACY
Gupta et al 11	9	12	75%
KC S et al 12	17	27	63%
Chandanwale et al 13	4	5	80%
Rajbhandari et al 14	3	4	75%
Present study	7	8	87.5%

**Table 14 : Comparative Incidence Of Benign And Malignant Lesions In Different Studies**

STUDY	BENIGN	MALIGNANT
Gupta et al 11	60(80%)	15(20%)
KC S et al 12	27 (48%)	29 (52%)
Rajbhandari et al 14	17 (71%)	7 (29%)
Present study	24 (75%)	8 (25%)

**Table 15: Comparing Statistical Results in Different Studies**

Study	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Diagnostic accuracy Rate (%)
Gupta et al 11	80	86.6	80	86.6	84
KC S et al 12	62.6	100	100	74.5	82.1
Chandanwale et al 13	90	100	100	90	87.5
Present study	87.5	91.67	77.78	95.65	90.62