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Original Research Article

# Efficacy of cytological examination in comparision with gold standard histopathology in various palpable & non-palpable lesions- A study of 483 cases in a tertiary care centre

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ABSTRACT

**Background:** It has become important to diagnose the pathology of any site in early stage to improve the prognosis of the disease process since there is limited resources in our country. Since FNAC is easy to perform, simple, cost effective procedure requiring minimal setup, we conducted this study to evaluate its diagnostic accuracy, sensitivity and specificity in comparison to histopathology.
**Materials and Methods:** This was a retrospective and prospective study carried out for a duration of 4 years and included total of 483 cases referred to Pathology Department. Biopsy was performed in all cases after FNAC and the findings were correlated.
**Results:** Of the 483 cases, patients belonged to age group of 10 to 70 years. In case of breast lesions all were females, in lymph node, lung & miscellaneous lesions there was male preponderance while in thyroid female preponderance was observed. The sensitivity & specificity of cytopathology in Breast was 98.87% & 78.26%, in Lung 98.18% & 86.66%, in Lymph node 93.93% & 85.71%, in Thyroid 93.18% & 85.71%, while in Miscellaneous 93.33% & 87.5% respectively.
**Conclusion:** FNAC can be used safely and can be relied upon in diagnosis of various pathologies even in centres with limited facilities & it can be set up at OPD level also, thus aiding in timely management of the patient. The overall Sensitivity and Specificity of cytopathological examination was good. PPV & NPV were within acceptable range.



## 1. Introduction

Cytopathology is a branch of pathology that studies and diagnoses diseases at cellular level. This technique is generally used on samples of free cells or tissue fragments. This technique was first introduced by Martin and Ellis in 1930, for the diagnosis of different organ lesions.[1] Histopathology, on the other hand, studies the whole tissue. FNAC (Fine Needle Aspiration Cytology) is a useful technique for the initial diagnosis of various lesions as it is easy to perform, minimally invasive, cost effective, readily repeatable, provides early diagnosis and gives excellent patient compliance for Thyroid nodules[2] and other various lesions. FNAC procedures can be set up on OPD basis as it does not require sophisticated instruments or set up. It not only confirms the presence of metastatic disease but also gives clues regarding the nature and origin of malignant tumor.[3] This study was thus taken to evaluate the accuracy of cytopathology in comparison to histopathological diagnosis and also to validate the findings of other authors.

## 2. Aims and Objectives

1. To evaluate the diagnostic accuracy of FNAC by Cytopathology
2. To find out the sensitivity and specificity of FNAC of lesions of various site.
3. To estimate the Positive Predictive value and Negative Predictive value of various lesions.

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## 3. Materials and Methods

This was hospital based analytic retrospective & prospective study carried out for duration of 4 years among patients attending TBCD, ENT, Surgery and Radiotherapy out-patient (OPD) and in-patient (IPD) department. This study included total 483 cases out of which 200 cases of breast, 140 of lung, 58 cases of thyroid, 47 of lymph node and 38 cases of other miscellaneous sites such as skin/soft tissue/salivary glands/prostrate etc. were present. For all cases both FNAC and histopathological study was done.

Prior to FNAC, detailed clinical history, radiological findings and patient's informed consent was taken. All aseptic precautions and measures were followed. After positioning the patient, the lesion was thoroughly palpated, area was sterilized and lesion was fixed between fingers for the procedure (for superficial lesions) while for deeper and non-palpable lesions USG guided FNAC procedure was performed.

A 22-23-gauge needle with an 5cc or 10cc syringe was used without anesthesia. After piercing the lesion, to and fro method was applied and the tissue material was aspirated by negative suction. Smears were prepared then fixed in methanol and stained by Hematoxylin and Eosin, Pap stain and MGG stain. Ziehl and Nelson (Z.N.) stain for acid fast bacilli was done in cases suspected for tuberculosis. Subsequent biopsies/mastectomy specimens sent were grossed, processed by paraffin embedding and stained with Hematoxylin and Eosin.

## 4. Results: (Tables 1 and 2)

Total 483 cases were included in this study over the period of 4 years between 2016 to 2019, which had undergone Cytological/FNAC and Histopathological examination. Of these, 290 were female and 193 were male. Patients belonged to age ranging from 10 years to 75 years. All these cases were categorized on the basis of site of origin into lesions of Breast, Lung, Thyroid, Lymph node and miscellaneous (skin, soft tissue, salivary glands, prostate etc.) and were classified broadly into Benign and Malignant.

Table 1 shows the age wise distribution of various lesions. Maximum number of Breast occurred in $4^{th}$ decade of life, maximum cases of lung pathology were observed in age group of 50-70 years, thyroid and other miscellaneous pathologies showed almost similar incidences in all age groups while in case of lymph node pathology, children and young adults were observed to be affected but more or less incidence was similar in other age groups as well. The overall incidence of pathological lesions was found to be common in the age group of 30-40 yrs.

Table 2 shows gender involvement in lesions of different sites. Breast pathologies showed involvement only in female. Male predominance was seen in lung, lymph node and miscellaneous group pathologies while female predominance in case of thyroid lesions.

### *4.1. Breast*

200 were of breast lesions and all the patients were female. Of these, 193 cases were concordant with histopathological findings whereas 07 cases had discordant results. 126 were benign and 74 were Malignant.

### *4.2. Lung*

140 cases were of lung pathology. 123 patients were male while 17 female. Majority of the patients had a chronic history of smoking. 134 cases were concordant with histopathological diagnosis, while 06 cases were found to be discordant. 16 were benign, 123 malignant and 01 inconclusive.

### *4.3. Thyroid*

58 cases belonged to lesions concerned with thyroid. 08 were male while 50 were female patients. 53 were concordant, whereas 05 cases were discordant with their histopathological diagnosis. 43 cases were Benign and 15 were malignant.

### *4.4. Lymph node*

47 cases belonged to lesions of lymph node of mainly cervical, submandibular, axillary and inguinal lymph nodes. 33 patients were male while 14 were female patients. 43 were concordant with their histopathological findings, while 04 were discordant. 44 diagnosed as benign lesions and 3 were malignant.

### *4.5. Miscellaneous*

This category included wide range of lesions of skin, soft tissue, salivary glands, liver, prostate etc. Total cases in this group were 38. Of these, 35 cases had diagnosis concordant with histopathology while 03 were discordant.Tables 3 and 4

### *4.6. Breast: (Tables 5 and 6)*

**Breast:** Maximum number of concordant cases (96.5%) were from lesions of breast. There were 5 false positive and 2 false negative cases. Out of the 129 benign cases, 45 cases were diagnosed as Fibroadenoma, 22 with Fibrocystic disease of breast, 21 as Inflammatory conditions, 18 as Fibroadenoma with atypia, 21 benign ductal papilloma, 01 as sclerosing adenosis and 01 as Benign Phyllode tumor. From the remaining 71 malignant cases, 28 as ductal carcinoma in situ, 25 as Invasive Ductal carcinoma and 18 as Invasive lobular carcinoma.

Figure 1 a,b showing cytopathology & histopathology of Invasive Ductal Carcinoma of breast

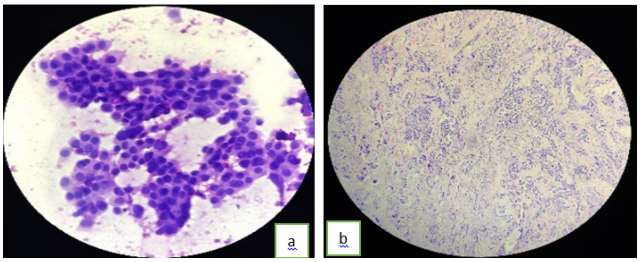


**Fig. 1: a:** H&E stained(40x) FNAC smear from breast lump diagnosed as Invasive Ductal Carcinoma, shows cluster of malignant ductal cells showing nuclear pleomorphism, nuclear hyperchromasia, high N:C ratio and nuclear overlapping; **b:** H&E stained(40x) section from lung biopsy diagnosed as Adenocarcinoma of lung showing large round cells with hyperchromatic nuclei, nuclear pleomorphism, high N:C ratio, at places prominent nucleoli and moderate amount of eosinophilic cytoplasm.

### *4.7. Lung: (Table 7&8Tables 7 and 8 )*

**Lung:** Out of the total 140 cases, 123 were malignant (including 02 cases which were suspicious for malignancy and considered as False negative), 16 Benign and 01 was inconclusive due to inadequate cellular material. There were 4 false positive and 2 false negative cases. On histopathology, 13 cases were confirmed as Tuberculosis, 02 diagnosed with Reactive changes and 01 as Pneumonitis. Out of the 123 malignant cases, 46 were confirmed as Squamous cell carcinoma, 51 as Adenocarcinoma, 18 as Small cell carcinoma, 06 as Small cell- Neuroendocrine carcinoma of lung and 02 as suspicious for malignancy. Total of 134 cases were concordant, while 06 were discordant with the histopathological diagnosis.

Figure 2 a,b showing cytopathology & histopathology of Adenocarcinoma of lung

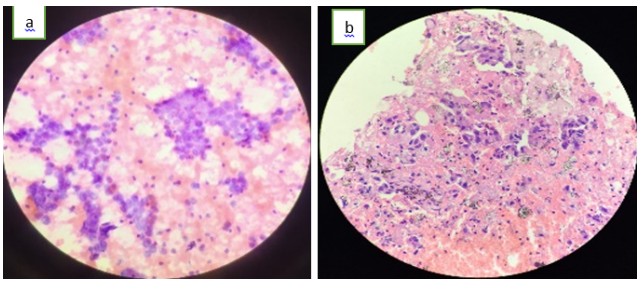


**Fig. 2: a:** H&E stained(40x) smear from Lung FNAC showing clusters of round pleomorphic cells with regular borders, cellular pleomorphism, prominent nucleoli and scant eosinophilic cytoplasm, diagnosed as Adenocarcinoma of Lung; **2b:** H&E stained(40x) section from lung biopsy diagnosed as Adenocarcinoma of lung showing large round cells with hyperchromatic nuclei, nuclear pleomorphism, high N:C ratio, at places prominent nucleoli and moderate amount of eosinophilic cytoplasm.

### *4.8. Thyroid:(Tables 9 and 10 )*

**Thyroid:** Out of the total 58 cases, 40 were diagnosed as benign lesions and 18 as Malignant. There were 02 false positive and 03 false negative on cytopathological examination. On histopathological examination, 15 cases were diagnosed as Colloid goiter, 07 as Thyroglossal cyst, 05 as granulomatous thyroiditis, 10 as Follicular adenoma, 03 cases as Hashimoto thyroiditis and 02 as Colloid goiter with secondary changes. Out of the 18 malignant cases, 10 were diagnosed as Papillary carcinoma thyroid, 05 as Medullary carcinoma thyroid and 03 as Hurthle cell carcinoma.

Figure 3 a,b showing cytopathological and histopathological features of Papillary carcinoma of Thyroid

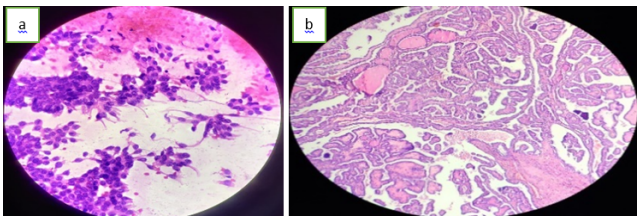


**Fig. 3: a:** H&E stained(40X) FNAC smear from thyroid lesion diagnosed as Papillary carcinoma thyroid, showing nuclear grooving; **3b:** H&E(10X) stained biopsy of same patient showing papillary pattern with glass ground opacity of nuclei in Papillary Thyroid Carcinoma.

### *4.9. Lymph node: (Tables 11 and 12)*

**Lymph node:** Out of the total 47 cases, 34 cases were confirmed as Benign and 13 were diagnosed as malignant. There were 2 false positive and 2 false negative cases. Amongst the benign conditions, 17 as Chronic Granulomatous lymphadenitis including Koch's lymphadenitis and sarcoidosis, 10 as Reactive lymphadenitis and 07 as Necrotizing lymphadenitis. Amongst the 13 malignant cases, 06 were metastasis to lymph node, 05 were diagnosed as Hodgkin lymphoma, 02 as Non-Hodgkin lymphoma. Out of the total 47 cases, 43 were concordant and 04 cases were discordant with their Histopathological diagnosis.

Figure 4 a,b showing cytopathological & Histopathological findings of Non Hodgkin lymphoma

### *4.10. Miscellaneous: (Tables 13 and 14)*

**Miscellaneous:** Total 38 miscellaneous cases of skin, soft tissue, salivary glands, vascular, oral cavity, liver and Prostate lesions were included together in this category. 35 were concordant and 03 were discordant with histopathological findings. 34 were benign and 04

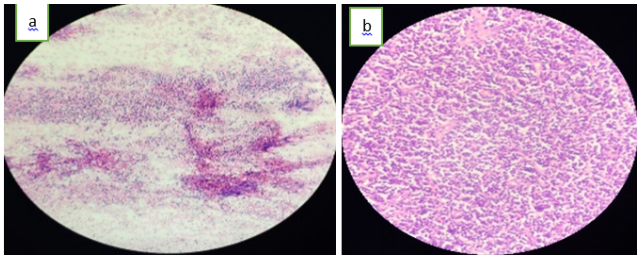

**Fig. 4: a:** H&E stain(10x) from cervical lymph node showing monomorphic population of lymphocytic cells, diagnosed as Non Hodgkin Lymphoma; **4b:** H&E stained section (40x) showing monomorphic population of lymphocytic cells in lymph node, diagnosed as Non Hodgkin Lymphoma

were malignant. There was 01 false positive and 02 false negative cases. Benign lesions included 07 of lipoma, 03 Pleomorphic adenoma, 03 sebaceous cyst, 02 Epidermal cyst, 03 Dermoid cyst, Dentigerous cyst and Odontogenic keratocyst were 01 each, 04 Chronic sialolithiasis + chronic sialadenitis, 02 Warthin tumor, 02 Hydatid cyst, 02 Benign prostatic hyperplasia, 01 Thymoma and 01 Schwannoma. Of the 04 malignant cases, 02 were mucoepidermoid carcinoma, 01 Acinic cell carcinoma, 01 Adenocarcinoma prostate and 01 was Carcinoma ex Pleomorphic adenoma.

Figure 5 a,b showing cytopathological & Histopathological findings of Acinic cell carcinoma of salivary gland.

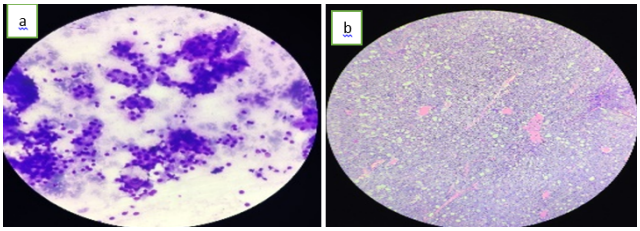

**Fig. 5: a:** MGG stained FNAC smear from salivary gland showing acinar like arrangement. Cells are mostly monomorphic having bland nuclear chromatin with fine vacuolated and granular cytoplasm, diagnosed as Acinic cell carcinoma; **5b:** H&E stained(10x) biopsy specimen showing large, polygonal cells with basophilic, granular cytoplasm and eccentric nuclei, diagnosed as Acinic cell carcinoma

## 5. Discussion: (Tables 15, 16, 17 and 18)

Similar studies have been conducted by Panjvani et al (2013)[4] on 222 cases, Kujur P[2] on 106 cases and Damle et al (2019)[6] on 273 cases, for cytological efficacy in breast lesions. In comparison to these studies, the present study conducted on 200 cases showed sensitivity (98.87%), specificity (78.26%), PPV (97%) and NPV (90%). The findings were observed to be in a closer range and the overall findings were comparable.

We compared our present study of 140 cases, with other similar studies by Modi et al (2016)[7] and Ghildiyal et al (2018)[8] and carried out on 70 and 99 cases respectively. The present study showed highest sensitivity (98.18%), concordance (95.71%), PPV (96.42%) and NPV (92.85%) as compared with other two studies with lowest Discordance (4.28%) and specificity in comparable range.

The present study was compared with 3 other studies done by Pandey et al (2012)[9] on 112 cases, Bamanikar et al (2014)[10] on 300 cases and Ramteke et al (2017)[11] on 385 cases. Though the present study had lower number of cases compared to others, a humble effort was made to cover all criteria with regard to age, sex and previous or family history if any. Present study showed highest sensitivity (93.18%) as compared to others. Accurate diagnosis on cytopathological examination was seen to be challenging due to presence of colloid material on aspiration and chances of missing out on small neoplastic focus, which were observed on Hemi/Total thyroidectomy specimens.

Study conducted by Malhotra et al (2017)[12] was on total 238 cases but only 113 were followed by histopathological examination and hence only those findings were compared and included in the discussion. Same with study by Pathy (2017)[13] with total cases being 1129 but only 399 followed up for histopathology. The present study showed close similarity with other studies in case of sensitivity (93.33%) and PPV (93.33%). Overall giving good comparison with other two.

## 6. Conclusion

FNAC is a simple, cost effective, rapid and fairly accurate method for diagnosing various palpable and deep-seated lesions, providing a high diagnostic accuracy. Hence it can be used safely and conveniently and can be relied upon in diagnosis of various pathologies even in centres with limited facilities. According to our study out of total 483 cases 396 were concordant and 87 were discordant with histopathological diagnosis. Hence, the overall Sensitivity and Specificity of cytopathological examination in present study was calculated to be 96.16% and 80.43% respectively while Positive Predictive value (96.47%) and Negative Predictive value (87.20%).

## 7. Acknowledgement

I am thankful to Dr Vijay C. Popat sir (Faculty Dean and Head of Department of Pathology, M. P. Shah Govt. Medical College- Jamnagar, Gujarat) for his guidance and support throughout the study.

## 8. Source of Funding

None.

**Table 1:** Age distribution for various lesions (n=483)

| Age | Breast | Lung | Thyroid | Lymph Node | Miscellaneous | Total |
|---|---|---|---|---|---|---|
| 10-19 | 18 | 00 | 06 | 13 | 06 | 45 |
| 20-29 | 50 | 04 | 17 | 08 | 09 | 88 |
| 30-39 | 73 | 05 | 10 | 11 | 05 | 104 |
| 40-49 | 41 | 07 | 15 | 10 | 11 | 84 |
| 50-59 | 12 | 48 | 07 | 02 | 04 | 73 |
| 60-69 | 06 | 52 | 02 | 01 | 01 | 60 |
| >70 | 00 | 24 | 01 | 02 | 02 | 29 |
| Total | 200 | 140 | 58 | 47 | 38 | 483 |

**Table 2:** Gender wise distribution of cases (n=483)

| Site | Male | Female | Total |
|---|---|---|---|
| Breast | 00 | 200 | 200 |
| Lung | 123 | 17 | 140 |
| Thyroid | 08 | 50 | 58 |
| Lymph node | 33 | 14 | 47 |
| Miscellaneous | 29 | 09 | 38 |
| Total | 193 | 290 | 483 |

**Table 3:** Distribution of Concordant and Discordant cases (n=483)

| Site | Concordant | Discordant | Total | Sensitivity | Specificity |
|---|---|---|---|---|---|
| Breast | 193 | 07 | 200 | 98.87% | 78.26% |
| Lung | 134 | 06 | 140 | 98.18% | 86.66% |
| Thyroid | 53 | 05 | 58 | 93.18% | 85.71% |
| Lymph node | 43 | 04 | 47 | 93.93% | 85.71% |
| Miscellaneous | 35 | 03 | 38 | 93.33% | 87.5% |
| Total | 458 | 25 | 483 | 96.16% | 80.43% |

**Table 4:** Positive & Negative Predictive Value (n=483)

| Site | Total cases | Positive Predictive value | Negative Predictive value |
|---|---|---|---|
| Breast | 200 | 97.00% | 90.00% |
| Lung | 140 | 96.42% | 92.85% |
| Thyroid | 58 | 95.34% | 80 % |
| Lymph node | 47 | 93.93% | 85.71 % |
| Miscellaneous | 38 | 96.55% | 77.77% |
| Total | 483 | 96.47% | 87.20% |

**Table 5:** Concordant cases on Cytopathology & Histopathology (Breast)**:** (n=193)

| S. No. | Diagnosis | No. of Cases | Percentage |
|---|---|---|---|
| 1. | Inflammatory (Mastitis) | 19 | 9.5% |
| 2. | Fibroadenoma | 43 | 21.5% |
| 3. | Fibrocystic breast disease | 22 | 11% |
| 4. | Fibroadenoma with atypia | 18 | 9% |
| 5. | Benign ductal papilloma | 21 | 10.5% |
| 6. | Ductal carcinoma in situ | 28 | 14% |
| 7. | Invasive ductal carcinoma | 24 | 12% |
| 8. | Invasive lobular carcinoma | 18 | 9% |
| | Total | 193 | 96.5% |

**Table 6:** Discordant cases (Breast) (n=07)

| S. No. | Cytopathological diagnosis | Histopathological diagnosis | No. of cases | Percentage |
|---|---|---|---|---|
| 1. | Fibrocystic disease of breast with hyperplasia with atypia | Intraductal carcinoma | 01 | 0.5% |
| 2. | S/o Ductal carcinoma | Sclerosing adenosis | 01 | 0.5% |
| 3. | S/o Ductal carcinoma | Inflammatory condition | 02 | 01% |
| 4. | Ductal carcinoma | Cellular fibroadenoma | 02 | 01% |
| 5. | Fibroadenoma | Intraductal carcinoma | 01 | 0.5% |
| | Total | | 07 | 3.5% |

**Table 7:** Concordant cases on Cytopathology & Histopathology (Lung)**:** (n=134)

| S. No. | Diagnosis | No. of Cases | Percentage |
|---|---|---|---|
| 1. | Tuberculosis | 13 | 9.28% |
| 3. | Squamous Cell carcinoma | 46 | 32.85% |
| 4. | Adenocarcinoma | 51 | 36.42% |
| 5. | Small cell Carcinoma | 18 | 12.85% |
| 6. | Small Cell-Neuroendocrine Carcinoma | 06 | 4.28% |
| | Total | 134 | 95.72% |

**Table 8:** Discordant cases of Lung (n=06)

| S. No. | Cytopathological diagnosis | Histopathological diagnosis | No. of cases | Percentage |
|---|---|---|---|---|
| 1. | Adenocarcinoma | Reactive changes | 02 | 1.42% |
| 3. | Small cell carcinoma | Inconclusive | 01 | 0.71% |
| 5. | Non-small cell carcinoma | Pneumonitis | 01 | 0.71% |
| 6. | Negative for malignancy | Suspicious for malignancy | 02 | 1.42% |
| | Total | | 06 | 4.28% |

**Table 9:** Concordant cases on Cytopathology & Histopathology (Thyroid) (n=53)

| S. No. | Diagnosis | No. of Cases | Percentage |
|---|---|---|---|
| 1. | Colloid Goiter | 13 | 22.41% |
| 2. | Thyroglossal Cyst | 07 | 12.06% |
| 3. | Hashimoto‘s Thyroiditis | 03 | 5.17% |
| 4. | Granulomatous thyroiditis | 05 | 8.62% |
| 5. | Follicular Adenoma | 10 | 17.24% |
| 6. | Hurthle Cell Carcinoma | 02 | 3.44% |
| 7. | Papillary Thyroid carcinoma | 08 | 13.79% |
| 8. | Medullary Carcinoma | 05 | 8.62% |
| | Total | 53 | 91.37% |

**Table 10:** Discordant cases of Thyroid (n=05)

| S. No. | Cytopathological diagnosis | Histopathological diagnosis | No. of cases | Percentage |
|---|---|---|---|---|
| 1. | Bethesda category IV | Colloid goitre with secondary changes | 01 | 1.72% |
| 2. | Bethesda category II | Papillary carcinoma of thyroid | 02 | 3.44% |
| 3. | Suspicious for malignancy (Bethesda category V) | Colloid goitre with secondary changes | 01 | 1.72% |
| 4. | Bethesda category II | Hurthle cell carcinoma | 01 | 1.72% |
| | Total | | 05 | 8.62% |

**Table 11:** Concordant cases on Cytopathology & Histopathology (Lymph node) (n=43)

| S. No. | Diagnosis | No. of Cases | Percentage |
|---|---|---|---|
| 1. | Chronic Granulomatous inflammation | 15 | 31.91% |
| 2. | Reactive Lymphadenitis /Hyperplasia | 10 | 21.27% |
| 3. | Necrotizing Lymphadenopathy | 07 | 14.89% |
| 4. | Metastasis | 06 | 12.76% |
| 5. | Hodgkin Lymphoma | 03 | 6.38% |
| 6. | Non-Hodgkin Lymphoma | 02 | 4.25% |
| | Total | 43 | 91.48% |

**Table 12:** Discordant cases of Lymph Node (n=4)

| S. No. | Cytopathological diagnosis | Histopathological diagnosis | No. of cases | Percentage |
|---|---|---|---|---|
| 1. | Non-Hodgkin lymphoma | Necrotizing granulomatous lesion TB | 01 | 2.13% |
| 2. | Small cell neuroendocrine carcinoma | Non caseating granulomatous sarcoidosis | 01 | 2.13% |
| 3. | Reactive lymphadenitis | Hodgkin lymphoma | 01 | 2.13% |
| 4. | Chronic granulomatous inflammation | Nodular lymphocyte prominent Hodgkin lymphoma | 01 | 2.13% |
| | Total | | 04 | 8.52% |

**Table 13:** Concordant cases on Cytopathology & Histopathology (miscellaneous)**:** (n=35)

| Sr. No. | Diagnosis | No. of Cases | Percentage |
|---|---|---|---|
| 1. | Lipoma | 07 | 18.42% |
| **Cystic lesions** | | | |
| 2. | Benign cystic lesion (Dermoid cyst) | 03 | 7.89% |
| 3. | Benign cystic lesion (Epidermal cyst) | 02 | 5.26% |
| 4. | Hydatid cyst (Liver) | 02 | 5.26% |
| 6. | Dentigerous cyst | 01 | 2.63% |
| 7. | Benign cystic lesion (Sebaceous cyst) | 03 | 7.89% |
| 8. | Odontogenic keratocyst | 01 | 2.63% |
| **Inflammatory lesions** | | | |
| 9. | Chronic sialolithiasis | 03 | 7.89% |
| 10. | Benign prostatic hyperplasia | 02 | 5.26% |
| **Benign lesions** | | | |
| 11. | Thymoma | 01 | 2.63% |
| 13. | Schwannoma | 01 | 2.63% |
| 14. | Warthin tumor | 01 | 2.63% |
| 15. | Pleomorphic adenoma | 03 | 7.89% |
| 16. | Capillary hemangioma | 02 | 5.26% |
| **Malignant lesions** | | | |
| 17. | Mucoepidermoid carcinoma | 02 | 5.26% |
| 18. | Acinic cell carcinoma | 01 | 2.63% |
| | Total | 35 | 92.11% |

**Table 14:** Discordant cases of miscellaneous (n=3)

| S. No. | Cytopathological diagnosis | Histopathological diagnosis | No. of cases | Percentage |
|---|---|---|---|---|
| 1. | Benign prostatic hyperplasia | Adenocarcinoma of prostate | 01 | 2.63% |
| 2. | Possibility of low grade mucoepidermoid carcinoma | Warthin's tumor of parotid | 01 | 2.63% |
| 3. | Pleomorphic Adenoma | Carcinoma ex pleomorphic adenoma | 01 | 2.63% |
| | Total | | 03 | 7.89% |

**Table 15:** Comparison study of Breast cases:

| Studies | No. of cases | Sensitivity | Specificity | PPV | NPV | Concordance |
|---|---|---|---|---|---|---|
| Panjvani et al (2013)[4] | 222 | 97.82% | 100% | 100% | 97.85% | 98.90% |
| Kujur P (2015)[5] | 106 | 96.15% | 96.29% | 96% | 96.29% | - |
| Damle et al (2019)[6] | 273 | 100% | 97.77% | 91.53% | 100% | 98.16% |
| Present (2020) | 200 | 98.87% | 78.26% | 97% | 90% | 96.5% |

**Table 16:** Comparison Study of Lung Cases:

| Studies | No. of cases | Sensitivity | Specificity | PPV | NPV | Concordance | Discordance |
|---|---|---|---|---|---|---|---|
| Modi et al (2016)[7] | 70 | 91.5 % | 72.5% | 94.7% | 61.5% | 88.5% | 11.5% |
| Ghildiyal et al (2018)[8] | 99 | 81.48% | 93.33% | 93.62% | 80.77% | 85.85% | 14.5% |
| Present study (2020) | 140 | **98.18%** | 86.66 % | **96.42%** | **92.85%** | **95.71%** | **4.28%** |

**Table 17:** Comparison study of thyroid cases:

| Studies | No of cases | Sensitivity | Specificity | PPV | NPV | Concordance | Discordance |
|---|---|---|---|---|---|---|---|
| Pandey et al (2012)[9] | 112 | 57.14% | 90% | 70.58% | 83.33% | 80.28% | 19.71% |
| Bamanikar et al (2014)[10] | 300 | 50% | 100% | 100% | 100% | 94.2% | 5.7% |
| Ramteke et al (2017)[11] | 385 | 92.31% | 97.01% | 85.71% | 98.48% | 96.25% | - |
| Present study (2020) | 58 | **93.18%** | 85.71% | 95.34% | 80% | 91.37% | 8.62% |

**Table 18:** Comparison Study of Lymph node cases:

| Study | No. of cases | Sensitivity | Specificity | Positive Predictive value |
|---|---|---|---|---|
| Malhotra et al (2017)[12] | 113 | 94.49% | 91.15% | 96.26% |
| Pathy et al (2017)[13] | 399 | 93.88% | 94.64% | 99.8 % |
| Present study (2020) | 47 | 93.33% | 85.71% | 93.33% |

## 9. Conflict of Interest

None.

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