

Original Research Article

Diagnostic accuracy of fine-needle aspiration cytology in diagnosis of thyroid nodules

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Received: 18 October 2016

Revised: 05 December 2016

Accepted: 06 December 2016

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ABSTRACT

Background: Thyroid nodules are a common clinical problem. Epidemiologic studies have shown the prevalence of palpable thyroid nodules to be approximately 5% in women and 1% in men living in iodine-sufficient parts of the world. The prevalence of thyroid nodules ranges from 4% to 10% in the general adult population and from 0.2% to 1.2% in children. Currently, many investigations including diagnostic imaging studies, serologic and cytogenetic tests as well as histopathological techniques are available to evaluate thyroid nodules. Of all these investigations, fine needle aspiration cytology (FNAC) has become the diagnostic tool of choice for the initial evaluation of solitary thyroid nodule.

Methods: A present prospective study was conducted in department of ENT, Dr. BRAM hospital, Pt. JNM Medical College, Raipur, Chhattisgarh, India during study period November 2011 to October 2012. Patients with thyroid nodule were selected for the study. After taking a detailed clinical history, all cases underwent a thorough ENT and head and neck examination. The clinical findings were recorded. Thyroid function tests and other necessary investigations were also done. Then the patients were referred for fine needle aspiration cytology to the department of Pathology. Depending on the nature of the lesion, decision had taken regarding need for surgery and the extent of surgery. All fine needle aspiration cytology (FNAC) reports were correlated with histopathology diagnosis.

Results: Male and female ratio was 1:3.5. Preoperatively FNAC done in 54 cases out of which 36 (66.66%) results were goiter followed by 4 (7.40%) Hurthle cell thyroiditis and 2 (3.87%) chronic thyroiditis. Among 54 cases 1.85% results were follicular neoplasia followed by 3 (5.55%). Fine needle aspiration cytology was 87.5% sensitive in detection of neoplastic lesion and 95.65% specific. Accuracy was 94.44%.

Conclusions: Fine needle aspiration cytology is a simple, rapid, inexpensive, well tolerated and harmless method of evaluation of mass lesions of the neck especially when there is a close cooperation between the clinician and cytopathologist.

Keywords: FNAC, Histopathology, Thyroid nodules

INTRODUCTION

Thyroid nodules are a common clinical problem. Epidemiologic studies have shown the prevalence of palpable thyroid nodules to be approximately 5% in women and 1% in men living in iodine-sufficient parts of the world. The prevalence of thyroid nodules ranges from

4% to 10% in the general adult population and from 0.2% to 1.2% in children. The majority of clinically diagnosed thyroid nodules are nonneoplastic; only 5%-30% are malignant and require surgical intervention.¹⁻⁵

Nodular thyroid disease describes the presence of a single or multiple nodules within the thyroid gland. Solitary

thyroid nodule is a common entity. Majority of these nodules are benign. Nodules are more frequent in women and prevalence increases with age, exposure to ionizing radiation and iodine intake.

The cause of thyroid nodules may be benign or malignant. The difficulty facing the clinician is to differentiate between the vast majority of benign of benign lesions and smaller proportion of malignant neoplasm.

Currently, many investigations including diagnostic imaging studies, serologic and cytogenetic tests as well as histopathological techniques are available to evaluate to evaluate thyroid nodules out. Of all these investigations, fine needle aspiration cytology (FNAC) has become the diagnostic tool of choice for the initial evaluation of solitary thyroid nodule. FNAC is, however, not without limitations; accuracy is lower in suspicious cytology and in follicular neoplasm.⁶⁻⁹

The main aim of FNAC is to identify nodules that require surgery and those benign nodules that can be observed clinically and decrease the overall the overall thyroidectomy rate in patients with benign diseases. FNAC is initial screening test and considered the gold standard diagnostic test in the evaluation of a thyroid nodule.

The aim of the current study was to evaluate the diagnostic accuracy of FNAC in the diagnosis of thyroid nodules and its correlation with histopathological findings.

METHODS

A present prospective study was conducted in department of ENT, Dr. BRAM hospital, Pt. JNM Medical College, Raipur Chhattisgarh, India during study period November 2011 to October 2012. Patients with thyroid nodule were selected for the study. Ethical approval was obtained from institutional ethical committee.

Inclusion criteria

All cases of thyroid swellings presenting or referred to the ENT outpatient department were included in the study.

Exclusion criteria

Neck swellings due to any pathology like lymphadenopathy

The history was elucidated as per predesigned proforma and the presenting complaints with their duration were noted in chronological order. Thyroid function tests like T3, T4, TSH and other necessary investigations were

done. Local examination of the swelling was done carefully and the fine needle aspiration was performed on patients.

Aspiration of lesions was performed as per standard protocol. Smear was prepared and wet fixed smears were stained with papanicolaou and haematoxylin and eosin stain and air dried smears were stained with May GrunwaldGiemsa (MGG) stain. After the FNAC is being done, all the cases were followed up as far as possible.

Depending on the nature of the goiter as reported in FNAC and depending on the thyroid function status decision had taken regarding need for surgery and the extent of surgery. All fine needle aspiration cytology (FNAC) reports were correlated with histopathology diagnosis. Data was compiled in MS Excel and checked for its completeness and correctness, and it was analyzed.

RESULTS

Maximum number of patients belongs to 31-40 year age group followed by in 41-50 year age group. Male and female ratio was 1:3.5 (Table 1).

Table 1: Age sex distribution of thyroid swelling.

Age (in Years)	Total	
	No.	%
11-20	03	5.55
21-31	11	20.37
31-40	19	35.18
41-51	13	24.07
51-60	07	12.96
61-71	01	1.85
Total	54	100

Swelling over anterior aspect of neck was observed in all 4 patients (Table 2).

Out of 54 cases maximum 34 (48.15%) cases were histopathologically confirmed as goiter followed by adenoma 12 (22.22%) Total 5 (9.26%) cases were hispathologically confirmed as carcinoma in which 3 (5.55%) were papillary carcinoma (Table 3, 4). Of the 54cases of aspirations from thyroid swellings 35 (64.81%) were goiter while in the neoplasm group, 4 (7.40%) were follicular thyroid neoplasia and 3 (5.55%) papillary carcinoma.

Preoperatively FNAC done in 54 cases out of which 36 (66.66%) results were goiter followed by 4 (7.40%) hurthel cell thyroiditis and 2 (3.87%) chronic thyroiditis. Among 54 cases 1.85% results were suspicious and 1 result was inconclusive. In neoplastic lesion 4 (7.40%) were follicular neoplasia followed by 3 (5.55%) papillary carcinoma and 2 (3.70%) thyroid neoplasia (Table 5).

Table 2: Duration of complaints.

Complaint	Sex	Duration (Month)						
		< 3	3-6	6-12	12-18	18-24	24-30	>30
Swelling	M	4	2	1	-	-	2	2
	F	6	8	8	3	1	8	8
Secondary Changes	M	1	-	-	-	-	-	-
	F	1	-	-	-	-	-	-
Pressure Changes	M	-	-	-	-	-	-	-
	F	-	-	-	-	-	-	-
Hoarseness	M	1	-	-	-	-	-	-
	F	-	-	1	-	-	-	-
Dyspnoea	M	1	-	-	-	-	-	-
	F	1	-	-	-	-	-	-
Dysphagia	M	1	-	-	-	-	-	-
	F	-	-	-	-	-	-	-
		16	10	10	3	1	10	11

Table 3: Preoperative fine needle aspiration cytology reports of 54 patients.

FNAC Diagnosis	Number of patients			%
	Male	Female	Total	
Nonneoplastic lesion (n=45)				
Colloid goiter	4	19	23	42.59%
Goiter	3	10	13	24.07%
Chronic Thyroiditis	0	2	2	3.70%
Hurthle cell thyroiditis	1	3	4	7.40%
Nodular hyperplasia	0	1	1	1.85%
Suspicious	0	1	1	1.85%
Inconclusive	1	0	1	1.85%
Neoplastic lesion (n=9)				
Thyroid neoplasia	0	2	2	5.55%
Follicular neoplasia	2	2	4	7.40%
Papillary carcinoma	2	1	3	5.55%
Total	12	41	54	

Table 4: Age, sex distribution and histopathological diagnosis of thyroid nodule.

HPE	Sex	Age Group						Total	
		10-20	21-30	31-40	41-50	51-60	61-70		
Goiter	M	-	-	-	-	-	-	6	34 (48.15%)
	F	3	9	10	3	3	-	28	
Adenoma	M	-	-	2	-	-	2	2	12 (22.22%)
	F	1	4	3	2	-	-	10	
Papillary Carcinoma	M	-	-	1	1	-	-	2	3 (5.55%)
	F	-	-	1	-	-	-	1	
Follicular Carcinoma	M	-	-	-	-	1	-	1	2 (3.70%)
	F	-	-	-	1	-	-	1	
Chronic Thyroiditis	M	-	-	-	-	-	-	0	3 (5.55%)
	F	-	1	2	-	-	-	3	
Total		4	14	23	8	4	1	54	
%		7.40	25.92	42.59	14.81	7.40	1.85	100	

Table 5: Results of fine needle aspiration cytology with subsequent histopathological diagnosis.

Fine needle aspiration cytology findings	Histopathological diagnosis							Total
	Colloid goiter	Nodular Goiter	Chronic thyroiditis	Colloid adenoma	Follicular adenoid	Follicular carcinoma	Papillary carcinoma	
Colloid goiter	15	2	0	5	0	0	0	22
Goiter	6	4	0	3	0	0	0	13
Hurthle cell thyroiditis	2	1	0	0	1	0	0	4
Thyroiditis	0	0	2	1	0	0	0	3
Nodular hyperplasia	1	0	0	0	0	0	0	1
Follicular neoplasia	0	0	0	0	2	2	0	4
Thyroid Neoplasia	0	0	0	0	0	0	0	2
Papillary carcinoma	0	0	2	0	0	0	3	3
Inconclusive	0	1	0	1	0	0	0	2
Total	24	8	0	10	3	0	3	54

Table 6: Nonneoplastic lesions diagnosed by FNAC and their comparison with histopathological diagnosis.

FNAC Report	n=45	HPE report	n=45	Remark
Colloid goiter	22	Colloid goiter	16	True positive
		Papillary carcinoma	1	False negative
		Colloid adenoma	5	True negative
Goiter	13	Colloid goiter	6	True negative
		Nodular goiter	4	True negative
		Colloid adenoma	3	True negative
Hurthle Cell Thyroiditis	4	Colloid goiter	2	True negative
		Nodular goiter	1	True negative
		Follicular adenoma	1	True negative
Thyroiditis	3	Chronic thyroiditis	2	True positive
		Colloid goiter	1	True negative
Nodular hyperplasia	1	Colloid goiter	1	True negative
Inconclusive	2	Nodular goiter	1	True negative
		Colloid adenoma	1	True negative

Table 7: Neoplastic lesions diagnosed by FNAC and their comparison with histopathological diagnosis.

FNAC report	Number of cases (n=9)	Histopathological report	Number of cases (n=9)	Remark
Follicular Neoplasia	4	Follicular carcinoma	2	True positive
		Follicular adenoma	2	True positive
Thyroid neoplasia	2	Chronic thyroiditis	2	False positive
Papillary carcinoma	3	Papillary carcinoma	3	True positive

Out of 22 colloid goiters reported in fine needle aspiration cytology, histopathological results were 16 colloid goiters i.e. true positive, 5 adenoma i.e. true negative and 1 papillary carcinoma i.e. false negative. Out of 13 goiter fine needle aspiration cytology positive cases histopathological results were 6 colloid goiter, 4 nodular goiter i.e. true negative and 3 colloid adenoma

i.e. true negative. Out of 2 inclusive FNAC reports 1 was nodular goiter and 1 colloid adenoma in histopathology report (Table 6).

Fine needle aspiration cytology reports of 4 follicular neoplasia were reported histopathologically as 2 follicular carcinoma and 2 follicular adenoma i.e. true positive. 3

cases of papillary carcinoma were reported same in both histological report and FNAC report i.e. true positive (Table 7). Fine needle aspiration cytology was 87.5% sensitive and 95.65% specific. Diagnostic accuracy was 94.44% (Table 8).

Table 8: Diagnostic accuracy for detection of neoplastic lesion by FNAC.

Parameters	Formula	%
Sensitivity	TP/TN+FN	87.5
Specificity	TN/TN+FP	95.65
Accuracy	TP+TN/Total case	94.44
Positive predictive value	TP/TP+FP	77.78
Negative predictive value	TN/TN+FN	97.78
False positive rate	FP/FP+TN	4.35
False negative rate	FN/FN+TP	12.5

DISCUSSION

In present study, among total of 54 patients, 12 (22.2%) were male and 42 (77.78%) were females with F; M ratio of 3.5:1. The majority of patients were in their fourth decade of life. The majority of the cases (92.58%) were seen in the age group 21-60 years.

The young age group 0-20 years and the elderly group above 60 years constituted 5.55% and 1.85% respectively. Although the mechanism underlying thyroid nodule formation and growth is poorly understood, nodules are more common in women, in older persons, in persons exposed to ionizing radiation, and in persons living in areas endemic for iodine deficiency.

In thyroid gland aspiration, various authors believed that FNAC should be performed on each solitary nodule at the time of its discovery as a first set to diagnosis. It should be performed on each dominant mass within goitre and for each rapidly changing diffuse lesion of the thyroid. In case of cysts, therapeutic drainage can be done. It is difficult to distinguish cytologically between follicular adenoma and well differentiated follicular carcinoma. Urgent excision with histopathological examination was advised in all these cases. To avoid "false negative report, FNAC of residual mass after evacuation of cyst is essential.

In present study 54 cases of thyroid swelling were histopathologically confirmed after FNAC. In FNAC results 83.34% cases were non neoplastic lesion consisting of 36 cases were goiter, 4 Hurthle cell thyroiditis, 3 thyroiditis and 16.66% were neoplastic lesion consisting of follicular neoplasia 4, papillary carcinoma 3, and thyroid neoplasia 2 cases.

Handa U et al, reported a study of FNAC in 434 thyroid swelling cases, out of which 57.60% FNAC reports was

Colloid goiter followed by 27.41% thyroiditis, 2.30% adenomatous goiter. In 7.14% neoplastic group, 1.38% reported as follicular neoplasm and 3.91% as malignant.¹⁰

Our finding was supported by the previous reports of Wahid FI et al and Handa U et al.^{10,11} All FNAC reports were correlated with histopathological diagnosis. Sensitivity, specificity, accuracy, positive predictive value, and negative predictive values were calculated for non-neoplastic and neoplastic lesions.

For the correlation purposes thyroid lesions have been divided in two major groups, non-neoplastic and neoplastic on the basis of cytology finding. Cytology finding of the non-neoplastic group (n=45 cases) included simple and nodular colloid goitre (36 cases), hurthle cell thyroiditis (4 cases), chronic thyroiditis (2 cases), nodular hyperplasia, suspicious and inconclusive (each one case). Neoplastic lesions (n=9 cases) included follicular neoplasm (4 cases), papillary carcinoma (3 case) and two cases of thyroid neoplasia.

Comparison of cytology with histopathological findings was performed. 35 cases were diagnosed as colloid goiter by FNAC. On HPE finding it confirmed as colloid goitre (22 cases, true negative), colloid adenoma (8 cases, true negative), nodular goiter (4 cases, true negative) and papillary carcinoma (1 case, false negative). Among 4 cases of Hurthle cell thyroiditis, two cases confirmed as colloid goiter (true negative) and one case as nodular goiter and follicular adenoma (true negative) on histopathological finding.

Three cases of thyroiditis confirmed on HPE finding as chronic thyroiditis (2 cases, true positive) and one case of colloid adenoma (true negative). One case of nodular hyperplasia confirmed on HPE as colloid goiter (true negative). Two cases were inconclusive on FNAC which were confirmed as nodular goiter and colloid adenoma on HPE (true negative).

Nine cases were diagnosed neoplastic lesions by FNAC and seven cases confirmed as neoplastic lesions on HPE (true positive). Among these 4 cases of follicular neoplasia were confirmed on HPE finding as follicular adenoma (2 cases) and follicular carcinoma (2 cases). Three cases of papillary carcinoma have same diagnosis confirmed on histopathological examination. Only two cases confirmed as chronic thyroiditis on HPE (false positive). In 34 (79.07%) cases of non-neoplastic lesions, all 22 (100%) histological finding were consistent with the cytology results.

Overall, cyto-histological correlation was found to be 86.15%. Statistical analysis and cyto-histologic correlation of thyroid lesions showed sensitivity, specificity and accuracy to be 87.5%, 95.65% and 94.44% respectively. Positive predictive value, negative predictive value, false positive rate and false negative rate

of FNAC found to be 77.78%, 97.78%, 4.35% and 12.5% respectively.

The false-negative rate is defined as the percentage of patients with "benign" cytological findings who are confirmed to have malignant lesions of the thyroid. In present study false negative rate was found 12.5%. False-negative errors are worrisome because they imply missed malignant lesions. False-negative diagnoses may occur because of sampling error or interpretive mistakes (Goelner et al and Hall et al).

Regardless of the cause, for fine-needle aspiration biopsy to be considered a useful and reliable diagnostic technique, false-negative results must be acceptably low. In a study by Gharib and Goelner, reported false-negative rates in the seven series ranged from 1.3% to 11.5%, with an average rate of 5.2%. Caruso and Mazzaferri found an identical false negative rate of 5% (range, 1% to 6%) based on pooled data from 10 series. Ashcraft and Van Hherle noted that false-negative results varied in reported series from 2% to 50%.

Gupta M et al, observed the false negative rate of 20% in cases of neoplastic lesions and mentioned that it constitutes a serious limitation of this technique since these malignant lesions would go untreated.^{8,12-15}

False-positive reports do not constitute a major problem with fine-needle aspiration. The false-positive rate is the percentage of patients with "malignant" fine needle

aspirates who are found to have benign lesions on histopathology.

In present study false positive rate was observed 4.35%. The false positive rate varied from 0% to 7.7% (average, 2.9%) in the seven series study. Two values used to estimate the accuracy of fine-needle aspiration biopsy for malignancy are sensitivity and specificity.

According to Goelner et al, The estimation of sensitivity and specificity depends on how the suspicious category is handled. If suspicious cytological results are considered as positive, then sensitivity will increase and specificity will decrease. On the other hand, if the suspicious results are considered as negative, specificity will increase and sensitivity will decrease.^{12,13}

Positive predictive value is defined as the proportion of those with a positive test result who actually have disease. Negative predictive value is defined as the proportion of those with a negative test result that do not have disease.

In present study Positive predictive value and negative predictive value of FNAC was found 77.78% and 97.78% respectively. Negative predictive value of 64% to 96% and positive predictive value of 72% to 99% was observed in a study of seven series.¹³

Table 9: Comparison of results of statistical analysis of FNAC with previous studies.

Study	Sensitivity (%)	Specificity (%)	Accuracy (%)	NPV (%)	PPV (%)
Al Sayer et al ¹⁶	86	93	92	96	80
Cusick et al ¹⁴	76	58	69	64	72
Bouvet et al ¹⁷	93.5	75	79.6	88.2	85.3
Kessler et al ¹	79	98.5	87	76.6	98.7
Wahid FI et al ¹¹	88.09	77.50	82.09	-	80.73
Present study	87.5	95.6	94.4	97.78	77.78

The methods used for the calculation of sensitivity, specificity, accuracy, positive predictive value and negative predictive value were similar to previous studies.^{11,14,16-18} Sensitivity and accuracy of FNAC for detection of neoplasm were 80% and 84%, respectively, whereas they were 76% and 69%, respectively, in a study by Cusick et al.¹⁴

The sensitivity, specificity, and accuracy of FNAC for solitary thyroid nodules were 80%, 86.6% and 84%, respectively, in study done by Gupta et al. Whereas sensitivity, specificity, and accuracy of FNAC were 93.5%, 75% and 79.6%, respectively, in a study by

Bouvet et al. and 79%, 98.5% and 87%, respectively, in a study by Kessler et al.^{15,17,18}

CONCLUSION

Fine needle aspiration cytology can be as effective a diagnostic aid as an open surgical biopsy. It is especially valuable for debilitated or critically ill patients where biopsy may be contraindicated on in patients with metastatic tumours when surgery would otherwise be contraindicated. Thus fine needle aspiration cytology is a simple, rapid, inexpensive, well tolerated and harmless method of evaluation mass lesions of the neck especially

when there is a close cooperation between the clinician and cytopathologist.

ACKNOWLEDGEMENTS

Authors would like to thank all the faculty and technical staff members of the Department of ENT, Pt. JNM Medical College and Dr. BAMH hospital, Raipur (C.G.), India, for their immense cooperation and support during the entire study period.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Damle GK, Daharwal AV. Diagnostic accuracy of fine-needle aspiration cytology in diagnosis of thyroid nodules. *Int J Res Med Sci* 2017;5:106-12.