Role of fine-needle aspiration cytology in the diagnosis of thyroid diseases

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Background
Fine-needle aspiration cytology (FNAC) is a gold standard investigation in the diagnosis of thyroid diseases. It is a simple, safe, cost-effective, and quick-to-perform procedure, with excellent patient compliance. It has high sensitivity, specificity, and accuracy as a preoperative investigation of thyroid gland diseases.
Aim
To determine the accuracy of FNAC in the diagnosis of thyroid diseases and to correlate the relationship between FNAC findings and histopathology of excised specimen.
Patients and methods
This was a prospective study conducted on 80 patients between September 2015 and September 2017. All patients with thyroid lesions were subjected to FNAC at Al Zahraa University Hospital. All patients with a clinically diagnosed solitary thyroid nodule, euthyroid multinodular goiter, and hypothyroid or hyperthyroid were excluded from this study.
Results
The study population was female predominant, represented by 73 (91.25%) patients, with age ranging from 18 to 65 years. Most cases were non-neoplastic, representing 42 (52.5%) cases, whereas 12 (15%) cases were neoplastic. The commonest lesion in thyroid gland was colloid goiter, and papillary carcinoma was the commonest among malignant lesion. On statistical analysis of our study, data showed the diagnostic accuracy of FNAC to be 80%, sensitivity to be 80%, and specificity to be 87.5% in neoplastic lesions, but results in carcinomatous lesions had accuracy of 92.5%, sensitivity of 80%, and specificity of 95.38%.
Conclusion
FNAC is an excellent first-line method as a preoperative investigation of thyroid swelling showing the nature of the lesion. It is a safe, minimally invasive, cost-effective diagnostic tool and correlates with the findings of tissue biopsy.

Keywords:
histopathology, neoplasm, solitary thyroid nodule, thyroid

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Introduction

Fine-needle aspiration cytology (FNAC) is a well-established technique for preoperative investigation of thyroid nodule [1]. It is considered the gold standard diagnostic test in the evaluation of thyroid nodule [2]. FNAC can provide an equivocal benign diagnosis in 60% of patients with benign nodules, and its potential to reduce the number of necessary surgeries is significant [3]. The prevalence range of thyroid nodule is 4–10% in the adult and 0.2–1.2% in children. The most clinically diagnosed thyroid nodules are neoplastic, only 5–30% are malignant and require surgical intervention [4]. The main goal of evaluating nodules by FNAC is to identify nodules with malignant potential and getting prompt management of them considering the limitation of open biopsy and advantages of FNAC [5]. In the preoperative decision making of the thyroid swelling, FNAC is becoming a more vital tool when comparing the advantages of preoperative FNAC of thyroid swelling with the postoperative histopathology to reach a consensus protocol as a simple procedure for diagnosis and optimal management of thyroid diseases [5]. With the increase in the use of imaging over the past decades, the number of incidentally discovered nodules is rising, and this image is used for guidance of FNAC [6].

FNAC is widely recognized as the gold standard initial diagnosis tool in the differential diagnosis of thyroid nodules [7].

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Patients and methods

Between September 2015 and September 2017, 80 patients were diagnosed as having solitary thyroid nodule in the Department of General Surgery at Al Zahraa University Hospital. Female predominated in this study with 73 (91.25%) cases. The age of the patients ranged from 18 to 65 years. All 80 patients who underwent FNAC for thyroid swelling were evaluated.

All patients were evaluated by thorough clinical examination and followed by all routine investigation, complete blood count, liver function, kidney function, chest radiograph, thyroid function, and FNAC.

Inclusion criteria

Patients with solitary thyroid nodule with normal thyroid function were included.

Exclusion criteria

The following were the exclusion criteria:

(1) Multinodular goiter.
(2) Hypothyroidism.
(3) Hyperthyroidism.

Preoperative preparation

All patients were subjected to the following:

(1) Complete history taking including feeding history.
(2) History of type 2 diabetes mellitus, type with onset, course, duration medication, controlled or not, and if the patient was on oral medication or insulin.
(3) Cardiac or respiratory problem.
(4) Hypertension.
(5) Lastly consultation for proper control of diabetes preoperatively.
(6) Thyroid-stimulating hormone, T3, and T4 laboratory investigations.

FNAC was performed without local anesthesia in some patient we used 23 & in other 24 needle aspiration technique, smears were fixed with either 95% alcohol solution and staining was performed with hematoxylin and eosin stain. After that the patients were prepared for operation, and anesthesia checkup was done. Thyroidectomy was done, and the specimen of the thyroid was evaluated by histopathological examination; and the specimen also was processed in an automated tissue processor with stain of hematoxylin and eosin. FNAC results were classified into three groups.

(1) No diagnosis was made owing to inadequate material.
(2) Non-neoplastic (including MNG colloid – thyroiditis).
(3) Neoplasm, papillary – follicular.

In this study, no inadequate material occurred. Following the operation, preoperative FNAC results were compared with the definitive histological diagnosis. The sensitivity, specificity, and accuracy of FNAC in the diagnosis of thyroid lesions were calculated for neoplastic and malignant lesions.

Results

This study included 80 cases of solitary thyroid nodule diagnosed clinically. There were 73 females and seven males. The age of the patients ranged from 18 to 65 years with mean age of 33 years. Most patients presented with lesions in the third and fourth decade of life.

The main complaint of these patients was neck swelling, with 65 (81.25%) cases. The solitary nodule was found mainly in the right lobe of thyroid in 56 (70%) cases, and the least involvement was of thyroid isthmus (Tables 1 and 2 and Figs 1 and 2).

Table 1 Characteristics of patients presented with a clinically solitary thyroid nodule

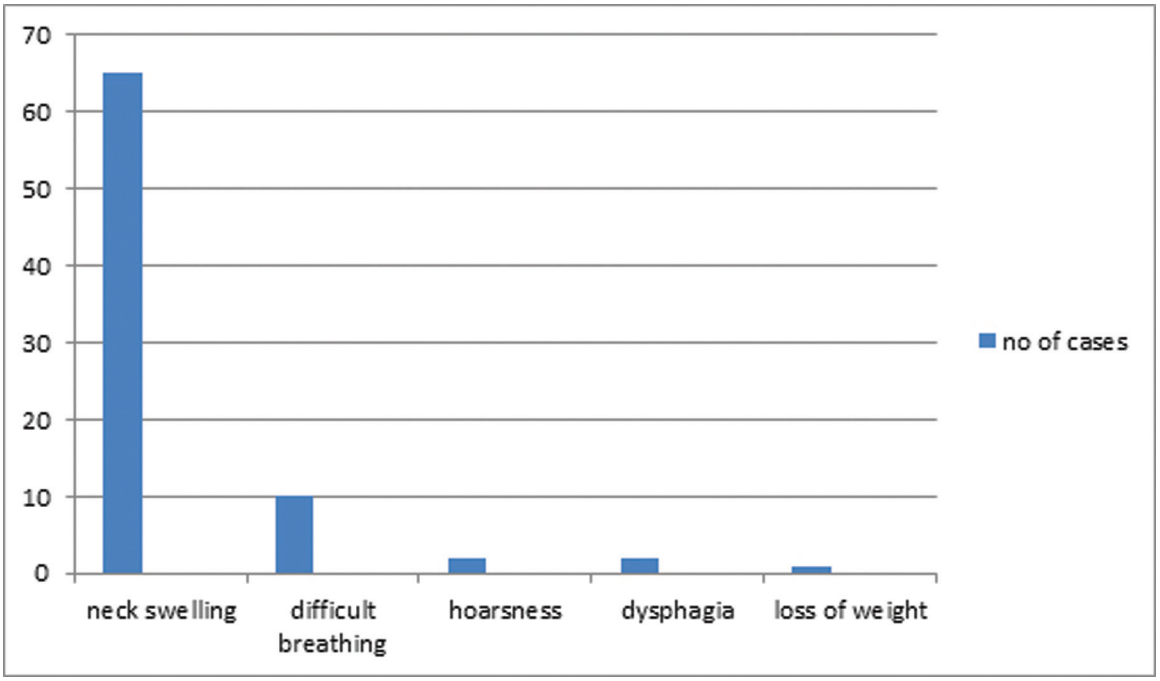
Characteristics	Total patients (*n*=80)
Age (years)	
18–29	15
30–44	35
45–55	14
55–65	16
Sex	
Male	7
Female	73
Complaint	
Neck pain	10
Neck swelling	65
Neck discomfort	5
Duration of complain	
1≤1 month	15
1–12 months	60
1–2 years	5
Site of swelling	
Right lobe	56
Left lobe	9
Isthmus	5
History of treatment	
Yes	25
No	55

Table 2 Clinical features of patients

N	Symptom and sign	*n* (%)
1	Neck swelling	65 (81.25)
2	Difficult breathing	10 (12.5)
3	Hoarseness	2 (2.5)
4	Dysphagia	2 (2.5)
5	Loss of weight	1 (1.25)

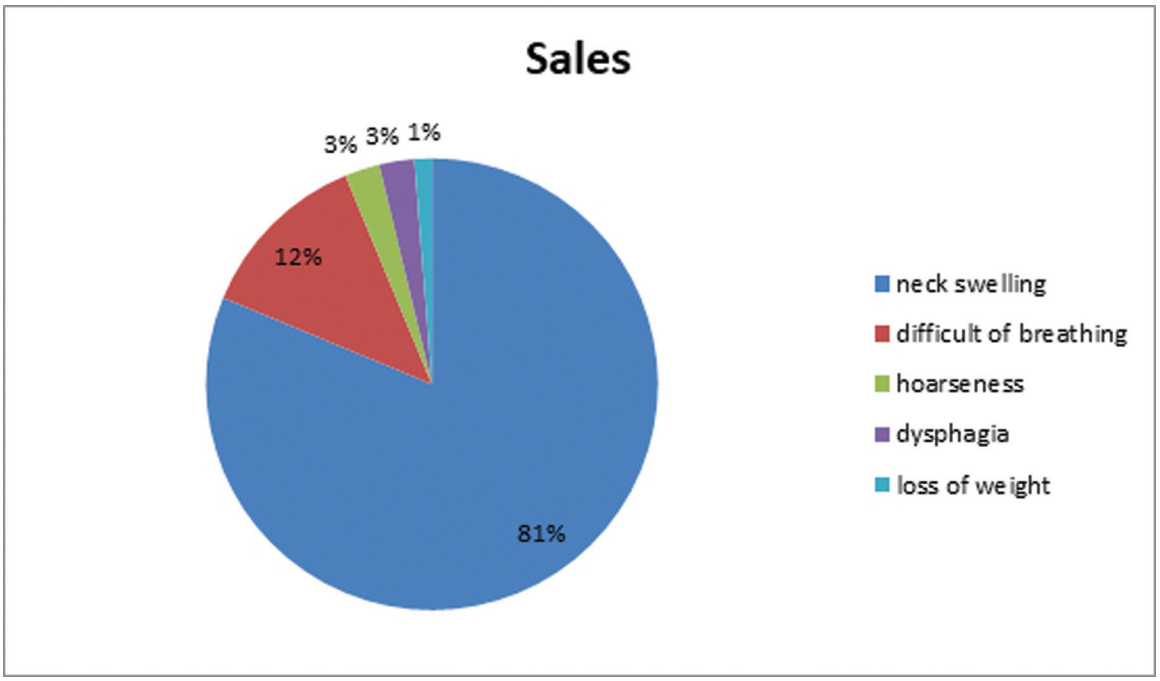
In this study, FNAC of solitary thyroid nodule revealed that 42 (52.5%) cases were nodular goiter, eight (10%) cases were benign lesions, 12 (15%) cases were follicular carcinoma, nine cases were papillary carcinomas, three cases were suspicious of neoplasm, and six cases were Hurthle cell tumors (Fig. 3). However, histopathological findings of thyroid nodules were

Figure 1



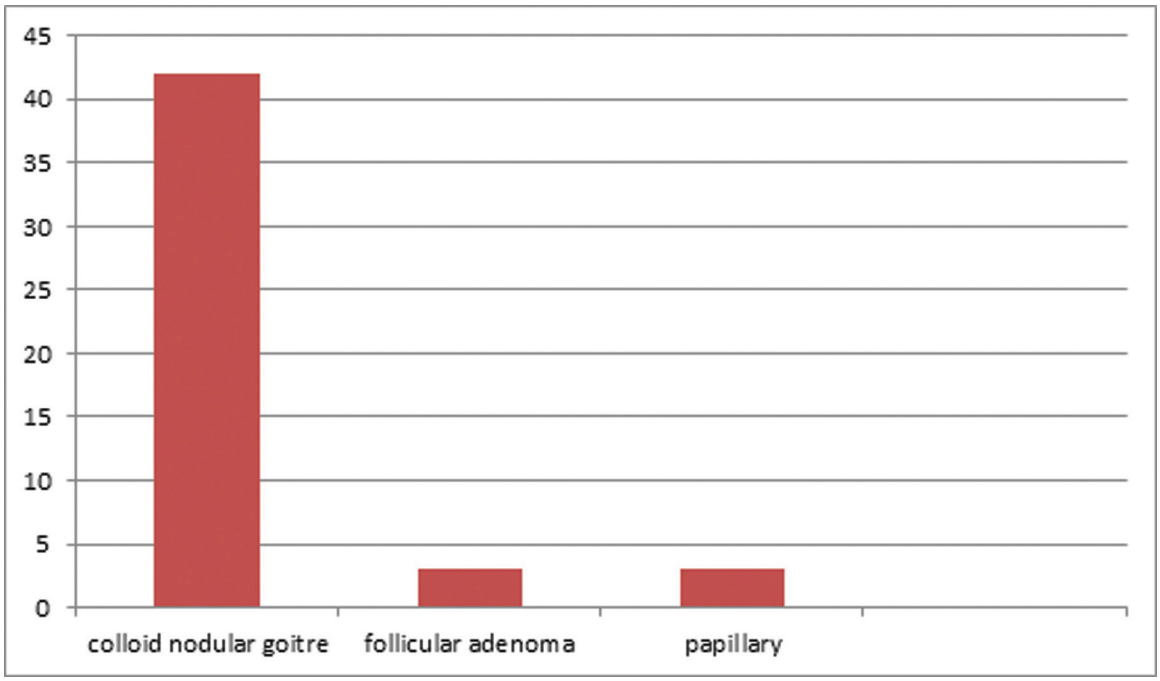
Clinical features of patients.

Figure 2



Clinical features in percentage.

Figure 3



Histopathological report for six patients who had Hurthle cell tumors by fine-needle aspiration cytology report.

Table 3 Non-neoplastic lesions diagnosed by fine-needle aspiration cytology and by histopathology

Fine-needle aspiration cytology result	Number of patients (*n*=45)	Histopathological result	Number of patients (*n*=45)	Remarks
Benign cystic lesions and colloid nodular goiter	45	Follicular adenoma	3	False negative
		Papillary carcinoma	3	False negative
		Colloid nodular goiter	42	True negative

Negative result.

45 (56.25%) cases of colloid nodules and three cases of Hashimoto's thyroiditis among benign conditions, whereas neoplastic lesion represented 12 cases of follicular adenoma, 12 cases of papillary carcinoma, four cases were Hurthle cell adenoma, and four cases of Hurthle cell carcinoma (Table 3 and Fig. 4).

Thirty cases were diagnosed as neoplastic lesions, 12 as follicular neoplasm, six as Hurthle cell tumors, nine as papillary carcinoma, and three as suspicious of malignancy by FNAC (Fig. 5). By histopathology, three were not neoplastic, 12 were benign neoplastic, and 12 neoplastic lesions and three cases suspicious of malignancy as thyroiditis (Table 4 and Fig. 6). The false positive and negative result with analysis of neoplastic and carcinomatous lesions is described in Tables 5–7.

Discussion

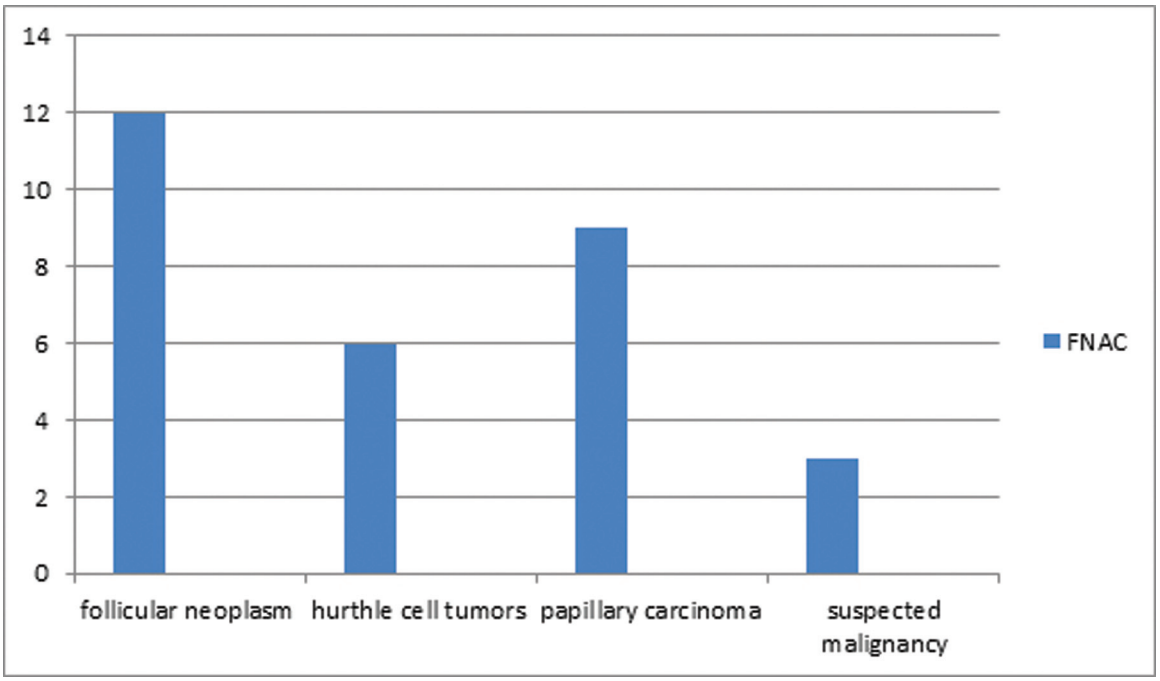
Thyroid diseases are a common clinical problem worldwide, and other investigations such as thyroid function, ultrasound, thyroid scan, and antibody levels, are done aiming to select the patients who can be managed conservatively and patients who need surgery (Figs 7–16). The incidence of thyroid cancers is ~122 000 new cases per years [8].

FNAC is regarded as the gold standard initial investigation in the diagnosis of thyroid swelling, and it has been shown to have similar or even higher sensitivity and accuracy levels than frozen section examination [4].

FNAC based on detection of solitary thyroid lesions remain challenging in spite of tireless effort to establish cytological and clinical criteria for diagnosing follicular neoplasm and distinguishing between benign and malignant lesions [9]. So FNAC is considered the diagnostic technique of choice in the assessment of thyroid lesions.

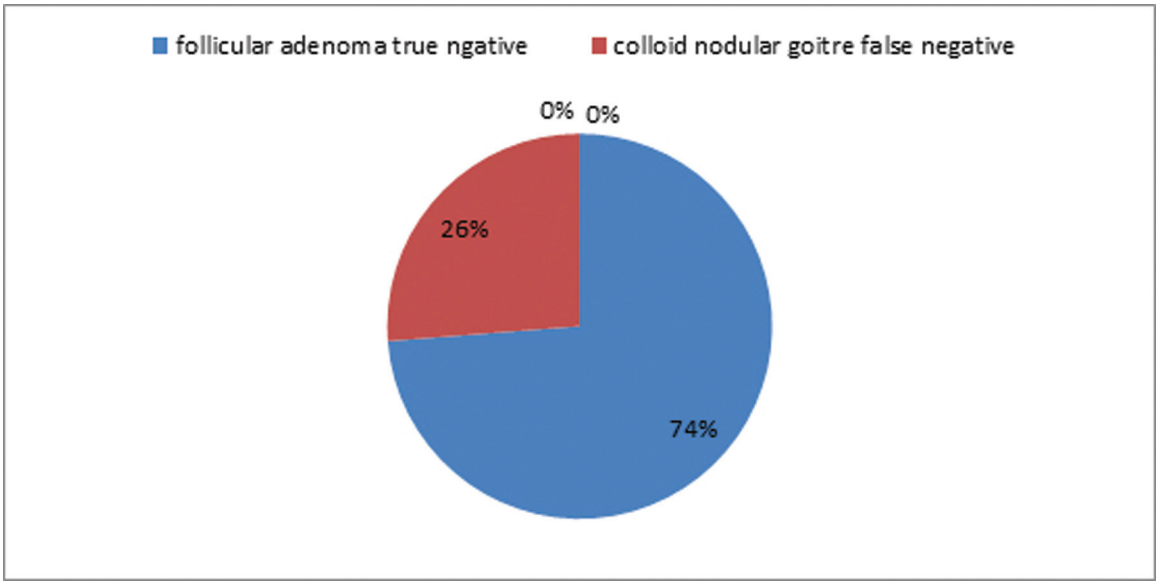
The management of the patients with thyroid diseases has radically changed according to the result of FNAC [10].

Figure 4



Histopathological result. Negative result.

Figure 5



Histopathological report for 12 patients who had follicular neoplasm by fine-needle aspiration cytology.

In this study, most of the patients were women, as thyroid nodule is more common in women than men, with female to male ratio of 73 : 7, and patients presented mostly in third and fourth decades, which is in accordance to the study of Bukhari *et al.* [11].

In this study, FNAC findings revealed 42 (52.5%) cases as non-neoplastic colloid thyroid lesions, which was in accordance with a study by Korah and El-Habashi [12], reporting benign lesions in 69%, whereas in some studies, benign lesions have been found to be in 50% of cases.

In some studies, benign lesion was present in 18 (22.5%) cases, and nodular goiter was the most common finding among benign lesions [13]; however, in this study, colloid nodular goiter was

seen in 42 (52.5%) cases, which agrees with studies of Gupta *et al.* [14], who revealed 39 (52%) cases as colloid nodular goiter, and Saddique *et al.* [15], who reported 30 (52%) cases as nodular goiter. The second most common finding in FNAC is cystic lesions, represented by eight (11%) cases, which is variant from the results of Abu-Salem [16], who found cysts in the result of FNAC in 43 (8.3%) cases. Malignant lesions in this study were present in 11.25% of case, which is comparable to other studies having malignant lesions in 29% (*n*=110). Follicular carcinoma was seen in 12 (15%) cases, which is different from the study of Pai *et al.* [17] where the malignancy was seen in 15 (23%) cases.

Table 4 Benign and neoplastic lesions diagnosed by fine-needle aspiration cytology and by histopathology

Fine-needle aspiration cytology result	Number of patients (*n*=30)	Histopathological result	Number of patients (*n*=30)	Remarks
Hurthle cell tumors	6	Hurthle cell carcinoma	3	True positive
	–	Hurthle cell adenoma	3	True positive
Follicular neoplasm	12	Follicular adenoma	9	True positive
	–	Colloid nodular goiter	3	False positive
Suspected malignancy	3	Hashimoto thyroiditis	3	False positive
Papillary carcinoma	9	Papillary carcinoma	9	True positive

Positive result.

Table 5 False-positive and false-negative results by fine-needle aspiration cytology and by histopathology

Fine-needle aspiration cytology finding	Histopathology result
False negative	
Colloid nodular goiter	Follicular adenoma
Colloid nodular goiter	Papillary carcinoma
False positive	
Follicular neoplasm	Colloid nodular goiter
Suspected malignancy	Hashimoto's thyroiditis

Table 6 Analysis of neoplastic lesions

Fine-needle aspiration cytology diagnosis	Histopathology diagnosis	
	Benign	Malignant
Positive	24 (TP)	6 (FP)
Negative	6 (FN)	42 (TN)

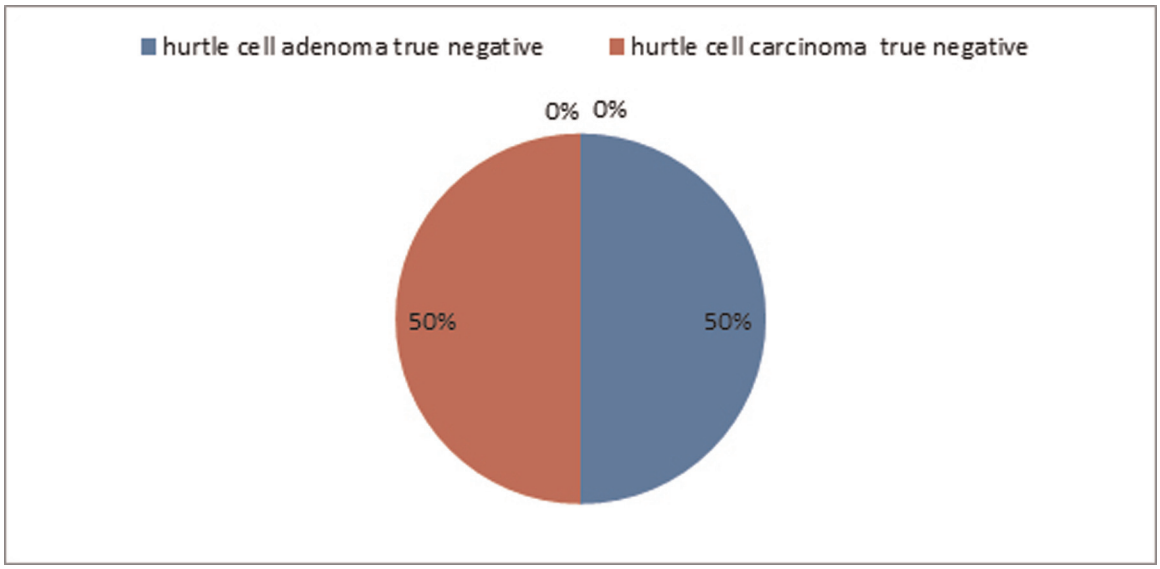
Sensitivity=80%, specificity=87.5%, accuracy=80%, false positive result=20%, false negative result=20%, positive predictive value=68.75%, and negative predictive value=87.5%. FN, false negative; FP, false positive; TN, true negative; TP, true positive.

Table 7 Analysis of carcinomatous lesions

Fine-needle aspiration cytology diagnosis	Histopathology diagnosis	
	Benign	Malignant
Positive	12 (TP)	3 (FP)
Negative	3 (FN)	62 (TN)

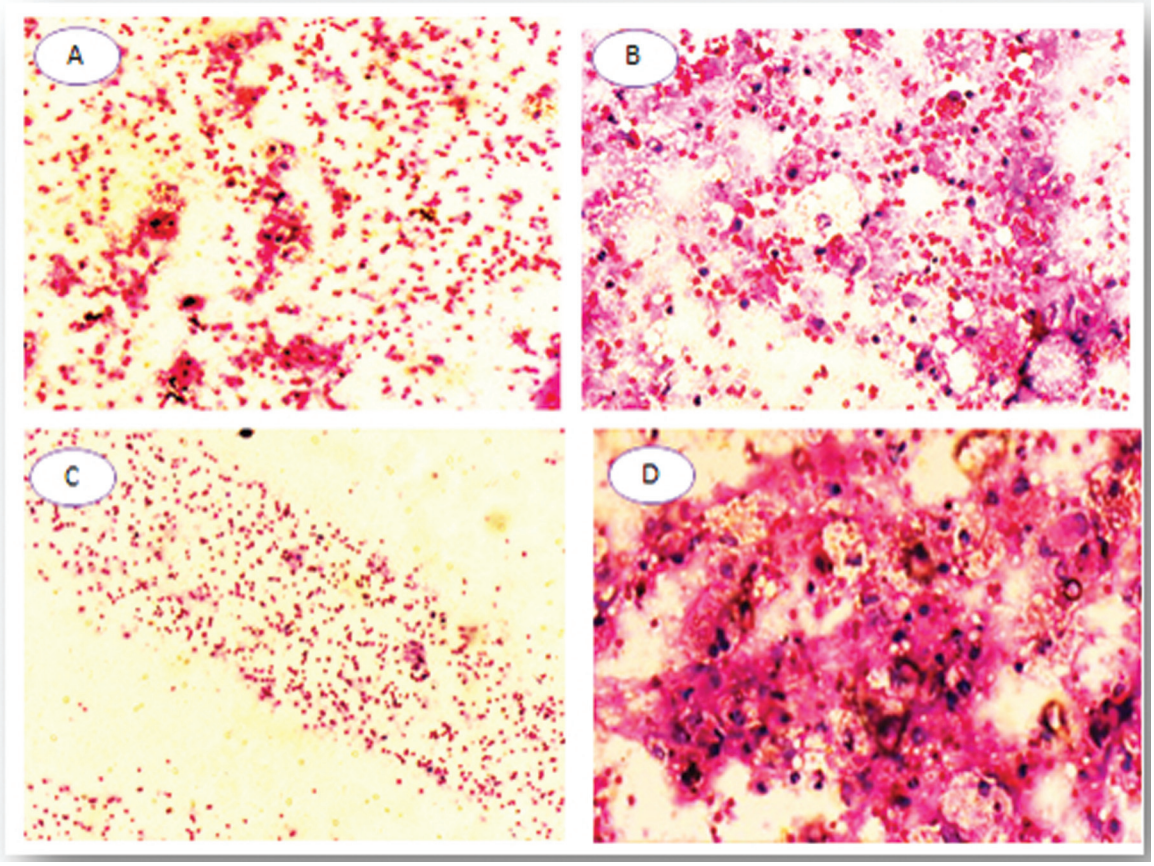
Sensitivity=80%, specificity=95.38%, accuracy=92.5%, false-positive result=4.81%, false-negative result=20%, positive predictive value=80%, and negative predictive value=95%. FN, false negative; FP, false positive; TN, true negative; TP, true positive.

Figure 6



Fine-needle aspiration cytology. Positive result.

Figure 7



Photograph for cytology fine-needle aspiration cytology of thyroid lesions.

On histopathology, non-neoplastic lesions were seen in 15 (18.75%) cases, and in the study of Mehmood *et al.* [18], non-neoplastic lesions were seen in 49%. Among neoplastic lesion, follicular adenoma was seen in 12 (14%) cases, whereas in the study by Tabaqchali *et al.* [3], follicular adenoma was seen in 60 (25%) cases; in this study, 12 cases were diagnosed as having papillary carcinoma on histopathology.

In another study, malignancy was seen in eight (9.75%) cases on histopathology, the case of suspicions of malignancy was three (3.75%) cases. The false-positive rate was 4.8–20% of cases whereas the false-negative rate was 20% of cases in this study, which is in contrast with another other study, where false negative rate was 1–11% and false positive rate was 1–8% [19].

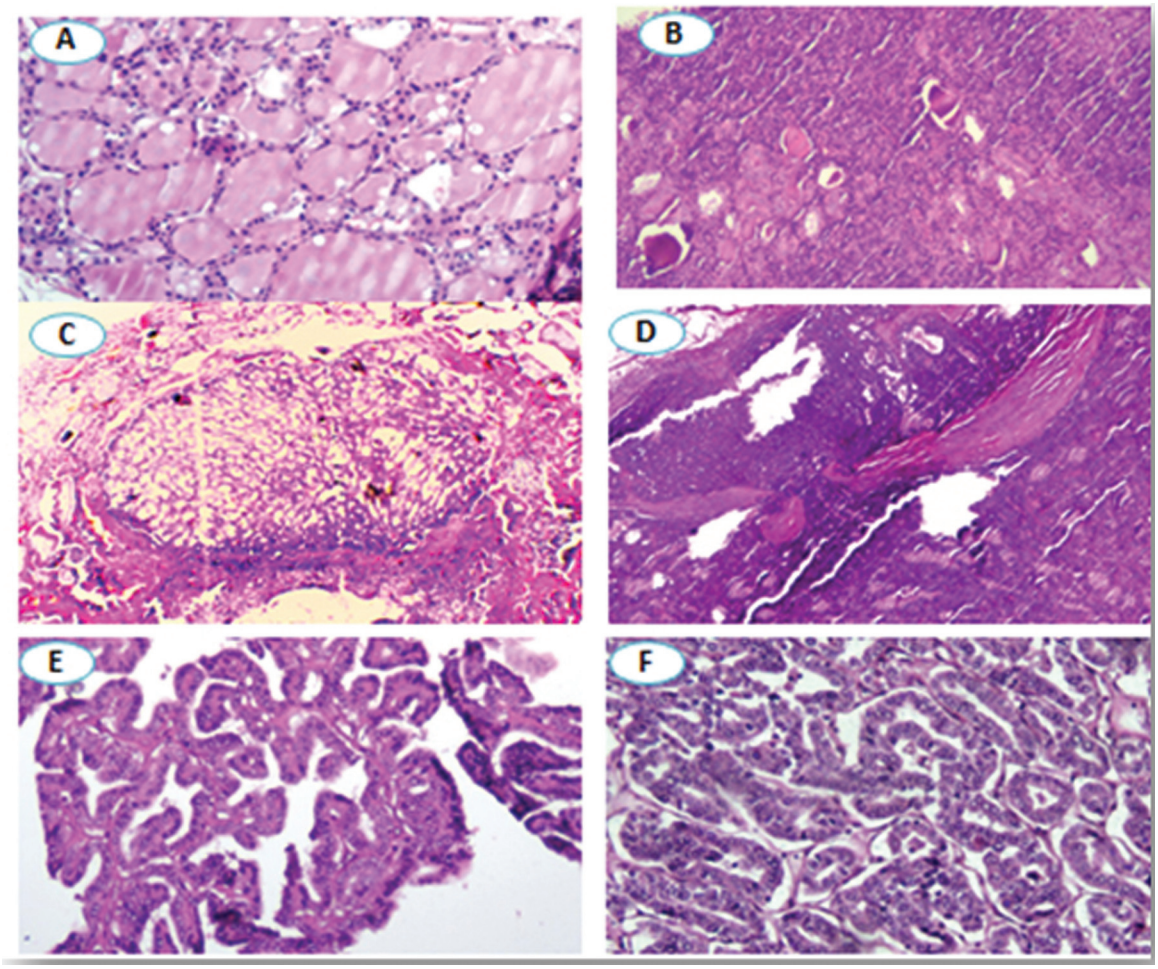
The sensitivity, specificity, and accuracy of FNAC in this study was 80, 87.5, and 80%, respectively; in the study by Bouvet *et al.* [20], sensitivity was 93.5% and specificity was 75.0%; in study by Kessler *et al.* [21] sensitivity, specificity, and accuracy were 79, 98.5, and 87%, respectively; Kumar *et al.* [22] revealed 77% sensitivity and 100% specificity; in the study by Moosa *et al.* [23], sensitivity was 77.7% and specificity was 98.9%; Abu-Salem revealed specificity of 99% and sensitivity of 93%; Tariq *et al.* [24] reported sensitivity of 75% and specificity of 97.6%; and Alam *et al.* [25] reported 100% sensitivity and 95.12% specificity .Korah and El-Habashi [12] reported 88% sensitivity, 98% negative predictive value, and 100% specificity. In this study, accuracy was 80%, which is comparable to studies of Bukhari *et al.* [11] where accuracy was 87%, and Pai *et al.* [17], where accuracy 89%.

If cytologic finding is nondiagnostic, repeat fine-needle aspiration should be done. Small cystic lesions that collapse after aspiration can be observed. FNAC has the key role in the diagnosis of thyroid disease. It can be used as an initial investigation for diagnosis of thyroid disease. It is safe, cost-effective, diagnostic modality, minimal invasive, and rapid as a diagnostic tool for preoperative assessment and helps surgeon in management [26].

Conclusion

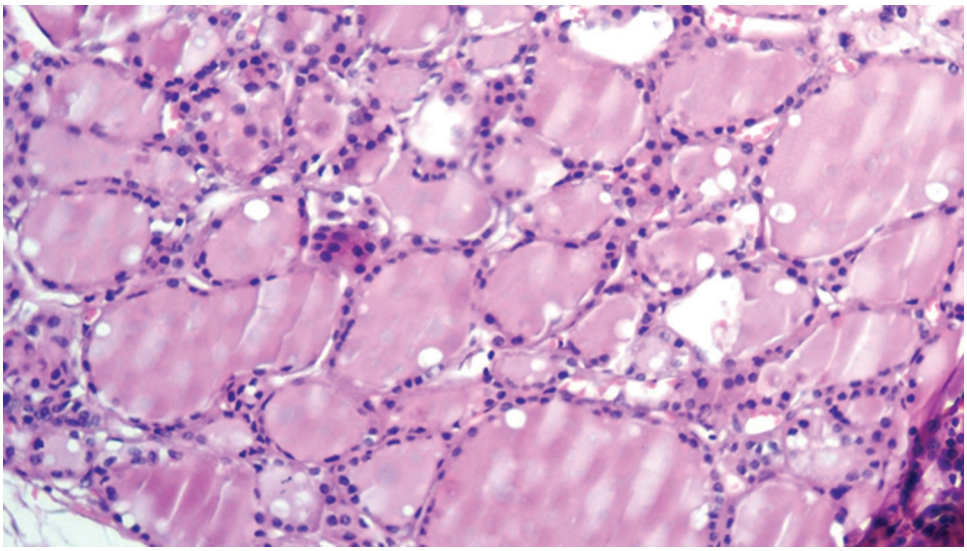
FNAC is still a vital reliable tool, easy to be performed, cost-effective, and minimally invasive with few

Figure 8



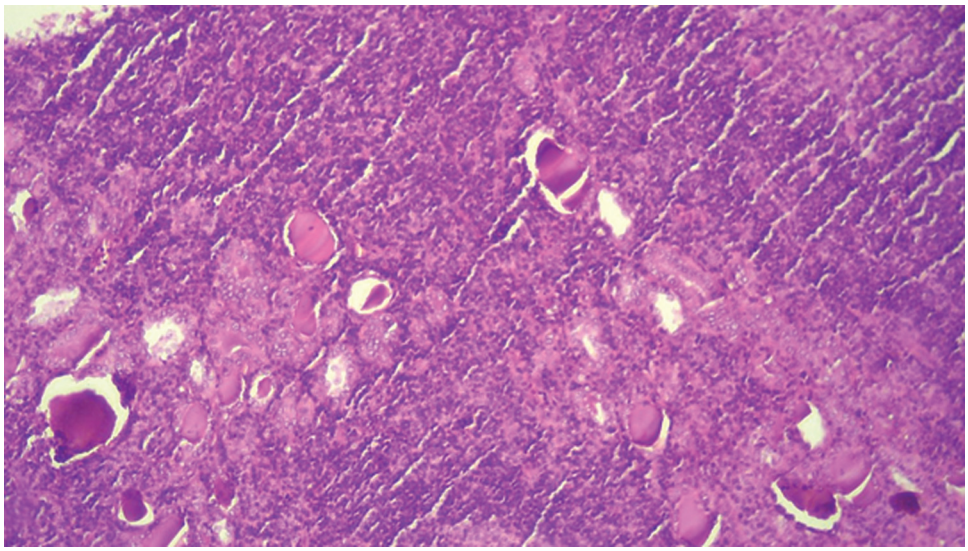
Photograph for cytology fine-needle aspiration cytology of thyroid lesions.

Figure 9



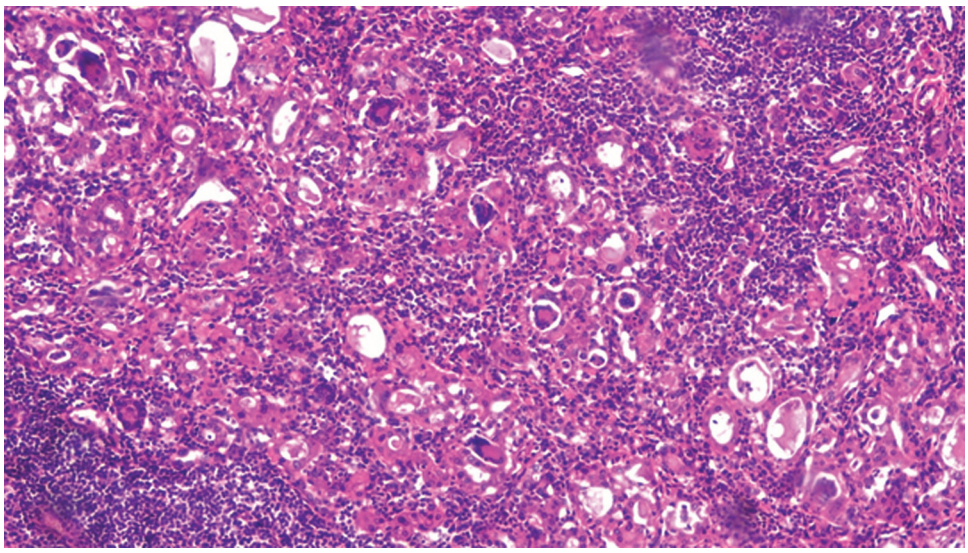
Photographs for histopathology.

Figure 10



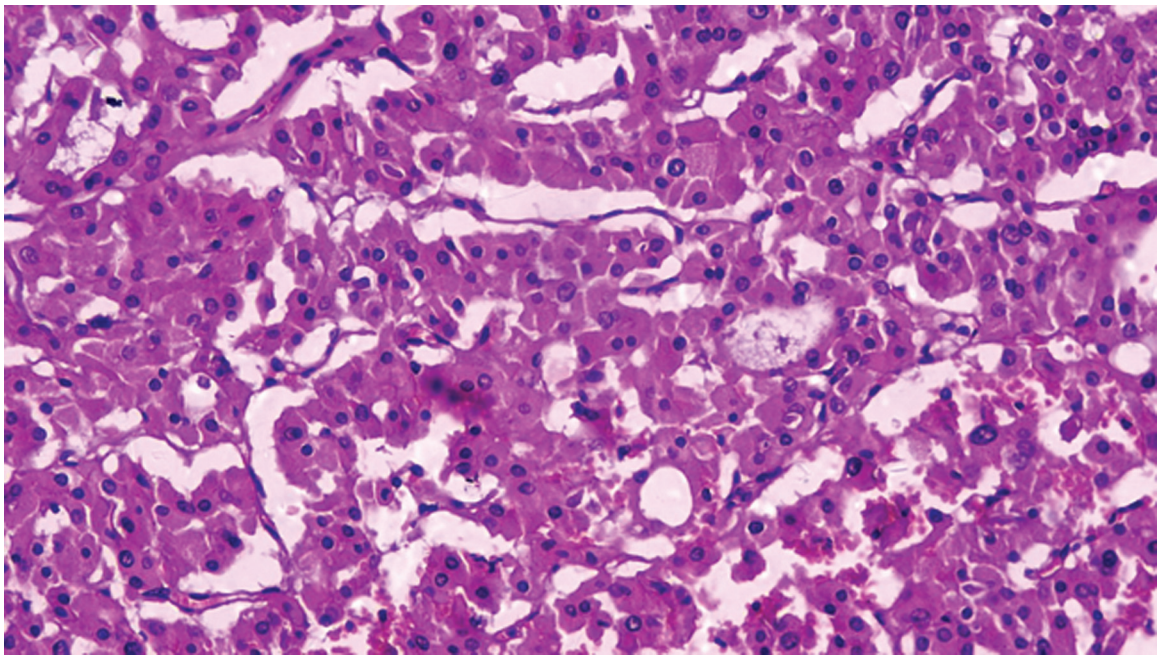
Photographs for histopathology.

Figure 11



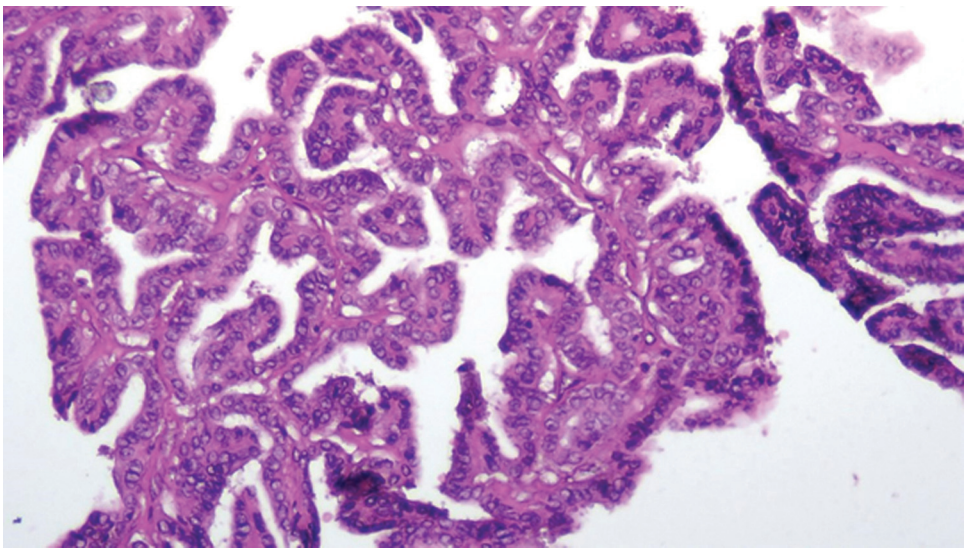
Photographs for histopathology.

Figure 12



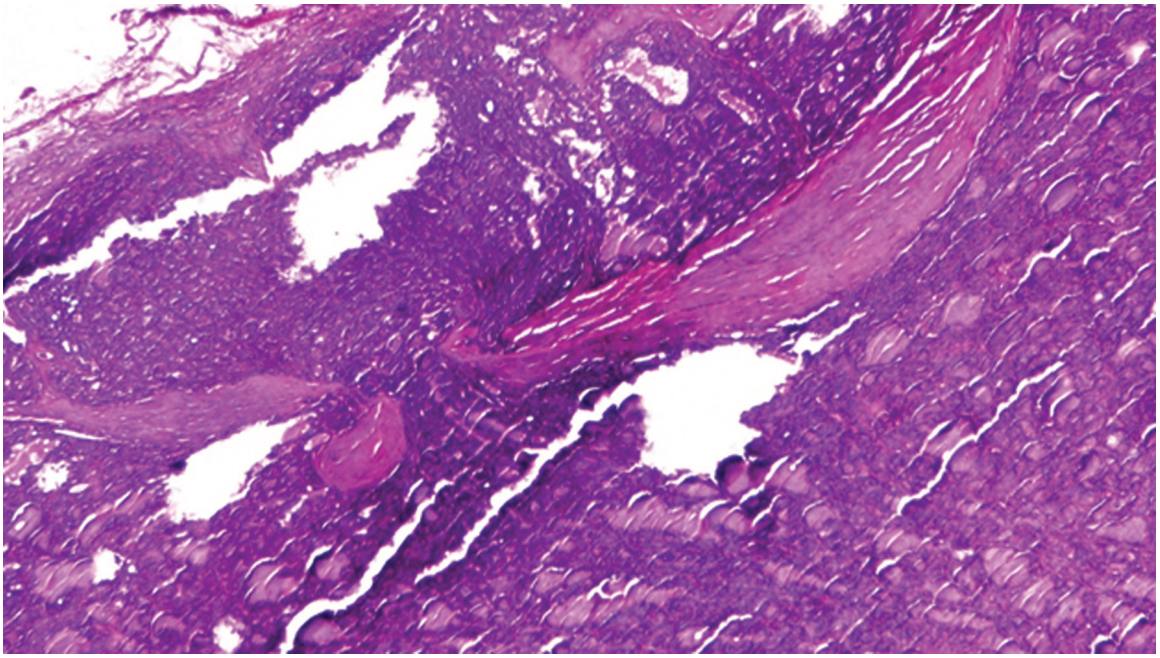
Photographs for histopathology.

Figure 13



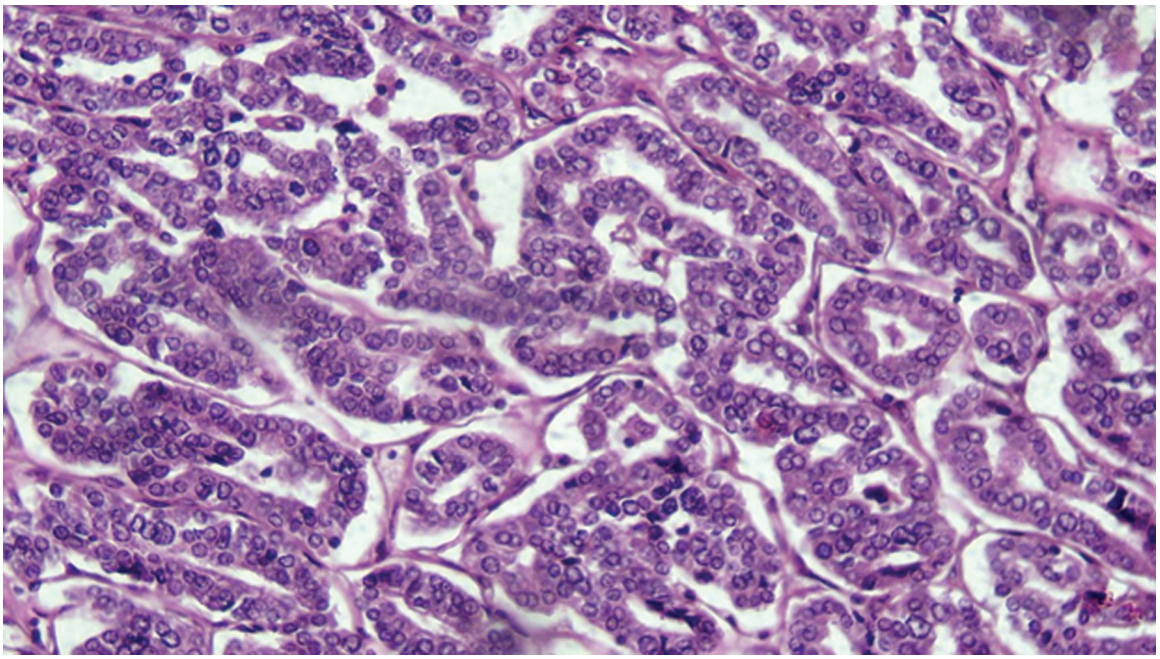
Photographs for histopathology.

Figure 14



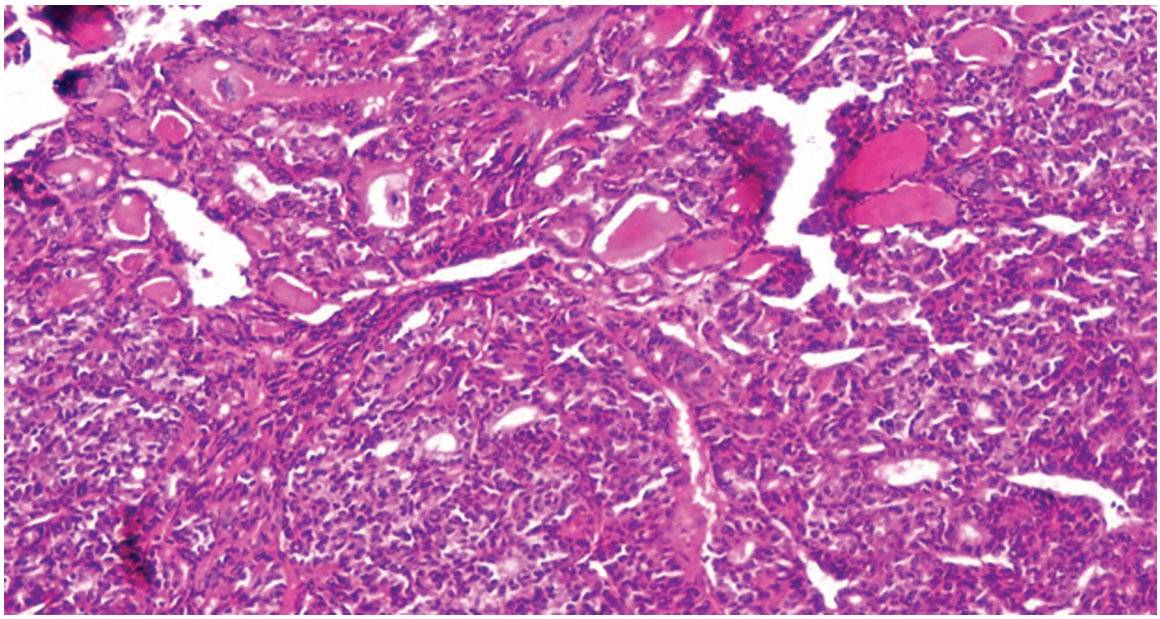
Photographs for histopathology.

Figure 15



Photographs for histopathology.

Figure 16



Photographs for histopathology.

complications, and it is also a safe and accurate method in the diagnosis of thyroid diseases. So we can depend on it to detect the patients who need follow-up and who need surgical interference.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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