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Original Research Article

Clinicopathological Features, Diagnostic Modalities, Incidence of Malignancy and Management of Solitary Thyroid Nodule: An Original Research Study

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Abstract

Background: Solitary thyroid nodule (STN) is one of the most common endocrine surgical presentations encountered in clinical practice. Although the majority of thyroid nodules are benign, the possibility of malignancy necessitates detailed clinical evaluation, radiological assessment, cytological investigation, and appropriate surgical management. Fine Needle Aspiration Cytology (FNAC), ultrasonography (USG), and histopathological examination remain the cornerstones in the diagnosis and management of solitary thyroid nodules.

Aim: To study the clinicopathological features, diagnostic modalities, incidence of malignancy, and management outcomes in patients presenting with solitary thyroid nodules.

Materials and Methods: A hospital-based cross-sectional observational study was conducted in the Department of General Surgery at RCSM Government Medical College, Kolhapur, Maharashtra, India, from September 2017 to February 2019. A total of 60 patients with clinically diagnosed solitary thyroid nodules were included using systematic random sampling. Detailed clinical history, examination findings, thyroid function tests, ultrasonography, FNAC, indirect laryngoscopy, and histopathological examination were performed. Data were analyzed using Epi Info 7.2 software. Descriptive and inferential statistical analyses were applied.

Results: The majority of patients belonged to the age group of 20–39 years (48.3%), with a mean age of 38.1 ± 6.8 years. Female predominance was observed (81.7%). Right lobe involvement was more common (61.7%). Most patients were euthyroid (86.7%). FNAC revealed benign lesions in 43.3% of cases and malignancy in 18.3% of cases. Histopathological examination demonstrated follicular adenoma in 26.7%, multinodular goiter in 26.6%, and carcinoma in 21.7% of cases. Papillary carcinoma was the commonest malignant lesion (61.5%). Hemithyroidectomy was the most frequently performed surgical procedure (83.3%).

Conclusion: Solitary thyroid nodules are more common in females and predominantly occur in the third and fourth decades of life. FNAC and ultrasonography are highly valuable diagnostic tools for preoperative evaluation. Papillary carcinoma remains the most common malignant lesion. Early diagnosis and timely surgical intervention significantly improve prognosis and reduce complications.

Keywords: Solitary thyroid nodule; FNAC; Thyroid carcinoma; Papillary carcinoma; Histopathology; Thyroidectomy; Ultrasonography.

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Introduction

A solitary thyroid nodule is defined as a discrete palpable swelling within an otherwise apparently normal thyroid gland [1]. It is one of the most frequently encountered endocrine disorders in surgical practice [2]. The prevalence of thyroid nodules varies depending on age, sex, iodine intake, radiation exposure, and geographic distribution [3]. Clinically palpable thyroid nodules occur in approximately 4–7% of the adult population, while ultrasonographic detection rates are considerably higher [4]. The major concern in a patient presenting with a solitary thyroid nodule is the possibility of

malignancy [5]. Approximately 5–20% of solitary thyroid nodules are malignant. The incidence of malignancy is significantly higher in males, elderly individuals, children, and patients with prior exposure to ionizing radiation [6-7].

Most patients present with an anterior neck swelling, often asymptomatic, while some complain of discomfort, dysphagia, pain, or cosmetic deformity [8]. Although a large proportion of solitary nodules are benign colloid nodules or follicular adenomas, definitive diagnosis requires a combination of clinical examination, thyroid function assessment, imaging studies, cytology, and histopathological confirmation [9].

Fine Needle Aspiration Cytology (FNAC) is considered the gold standard initial diagnostic investigation due to its simplicity, cost-effectiveness, and high diagnostic accuracy [10-12]. Ultrasonography further helps in assessing size, echotexture, calcification, vascularity, and suspicious malignant features [13].

Management depends on clinical presentation, thyroid function status, cytological findings, and histopathological diagnosis. Surgical treatment ranges from hemithyroidectomy to total thyroidectomy depending on the nature and extent of disease [14-15].

This study was undertaken to evaluate the clinicopathological features, diagnostic modalities, incidence of malignancy, and management outcomes in patients presenting with solitary thyroid nodules.

Aim and Objectives

Aim: To study the clinicopathological features, diagnostic modalities, incidence of malignancy, and management of solitary thyroid nodules.

Objectives

1. To determine the incidence of solitary thyroid nodules among surgical admissions.
2. To study the age and sex distribution of solitary thyroid nodules.
3. To evaluate the clinical presentation of solitary thyroid nodules.
4. To assess the utility of ultrasonography and FNAC in diagnosis.
5. To determine the incidence of malignancy in solitary thyroid nodules.
6. To analyze histopathological patterns in solitary thyroid nodules.
7. To evaluate various treatment modalities and surgical outcomes.

Materials and Methods

This hospital-based cross-sectional observational study was conducted in the Department of General Surgery, Nandha Medical College and Hospitals, Erode, Tamil Nadu, India, over a period of six months from September 2025 to February 2026. The study population comprised patients presenting with clinically diagnosed solitary thyroid nodules attending the surgical outpatient and inpatient departments. The sample size was calculated using the formula $N = 4pq/d^2$, where p represented the prevalence of solitary thyroid nodules (19.2%), $q = 1 - p$, and d was the allowable error (11%). Based on this calculation, the required sample size was determined to be 60 patients. Participants were selected using a systematic random sampling technique.

Patients of any age and sex with a clinically diagnosed solitary thyroid nodule involving either lobe or the isthmus of the thyroid gland and who were willing to participate in the study were included. Patients with multinodular goiter, diffuse goiter, pregnancy, previous neck surgery, history of neck irradiation, those unfit for surgery, mentally challenged individuals unable to provide informed consent, and patients unwilling to participate were excluded from the study.

After enrollment, all participants underwent a detailed clinical evaluation. A comprehensive history was obtained, including the duration of swelling, presence of pain, dysphagia, voice changes, weight loss, symptoms suggestive of hypothyroidism or hyperthyroidism, family history of thyroid disease, and history of radiation exposure. This was followed by a thorough general physical examination and local examination of the thyroid gland.

All patients underwent standard laboratory, radiological, and cytological investigations. Laboratory investigations included complete blood count, blood sugar estimation, renal function tests, and thyroid function tests comprising serum triiodothyronine (T3), thyroxine (T4), and thyroid-stimulating hormone (TSH) levels. Radiological assessment included ultrasonography of the neck, X-ray of the neck, and indirect laryngoscopy. Fine Needle Aspiration Cytology (FNAC) was performed using a 21–24-gauge hypodermic needle to obtain cytological confirmation and aid in treatment planning.

Management was individualized based on clinical findings, imaging studies, and FNAC results. Depending on the nature and extent of the lesion, patients underwent appropriate surgical intervention, including hemithyroidectomy, subtotal thyroidectomy, near-total thyroidectomy, total thyroidectomy, or total thyroidectomy with neck dissection.

All patients were followed postoperatively to assess surgical outcomes, complications, and thyroid functional status. Prior to commencement of the study, approval was obtained from the Institutional Ethics Committee. Written informed consent was obtained from all participants, and strict

confidentiality and anonymity were maintained throughout the study.

The collected data were entered into Microsoft Excel and analyzed using Epi Info version 7.2 software. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. The Chi-square test was used to assess associations between categorical variables. A p-value of less than 0.05 was considered statistically significant.

Results

Age Distribution: Table 1 shows the age distribution of study participants. The majority of patients (48.3%) belonged to the 20–39 years age group, followed by 36.7% in the 40–59 years group. The mean age was 38.1 ± 6.8 years.

Table 1: Age Distribution of Study Participants (N=60)

Age Group (Years)	Number	Percentage
0–19	3	5.0
20–39	29	48.3
40–59	22	36.7
>60	6	10.0
Total	**60**	**100**

Mean age = 38.1 ± 6.8 years

The highest incidence of solitary thyroid nodules was observed in the third and fourth decades of life.

Gender Distribution: Female predominance was observed in the present study, accounting for 81.7% of cases.

Table 2: Gender Distribution of Study Participants

Gender	Number	Percentage
Male	11	18.3
Female	49	81.7
Total	**60**	**100**

Female-to-male ratio was approximately 4.5:1.

Clinical Presentation: Most patients presented with asymptomatic neck swelling (40%), while discomfort and dysphagia were also common complaints.

Table 3: Local Symptoms among Study Participants

Symptoms	Number	Percentage
Dysphagia	15	25.0
Pain	5	8.3
Discomfort	16	26.7
Asymptomatic	24	40.0

Most patients remained asymptomatic despite significant thyroid enlargement.

Thyroid Functional Status: Most patients were euthyroid (86.7%). Hyperthyroidism was observed in 10% and hypothyroidism in 3.3% of patients.

Table 4: Thyroid Functional Status

Thyroid Status	Number	Percentage
Euthyroid	52	86.7
Hyperthyroid	6	10.0
Hypothyroid	2	3.3
Total	**60**	**100**

The majority of malignant nodules were detected among euthyroid patients.

FNAC Findings: FNAC identified benign lesions in 43.3% and malignant lesions in 18.3% of patients.

Table 5: FNAC Findings in Solitary Thyroid Nodules

FNAC Diagnosis	Number	Percentage
Benign	26	43.3
Follicular Neoplasm	12	20.0
Suspicious	2	3.3
Malignant	11	18.3
Lymphocytic Thyroiditis	4	6.7
Cystic Lesion	5	8.3
Total	**60**	**100**

FNAC showed high diagnostic utility in differentiating benign and malignant lesions.

Histopathological Findings: Histopathological examination revealed follicular adenoma and multinodular goiter as the most common benign lesions.

Table 6: Histopathological Diagnosis

Histopathological Diagnosis	Number	Percentage
Follicular Adenoma	16	26.7
Adenomatous Goiter	9	15.0
Multinodular Goiter	16	26.6
Carcinoma	13	21.7
Lymphocytic Thyroiditis	3	5.0
Simple Thyroid Cyst	3	5.0
Total	**60**	**100**

Among malignant lesions, papillary carcinoma was the most common histological subtype.

Types of Carcinoma

Table 7: Types of Thyroid Carcinoma (N=13)

Type of Carcinoma	Number	Percentage
Papillary Carcinoma	8	61.5
Follicular Carcinoma	5	38.5
Medullary Carcinoma	0	0
Anaplastic Carcinoma	0	0
Lymphoma	0	0

Papillary carcinoma constituted the majority of malignant lesions.

Management Modalities: Hemithyroidectomy was the most commonly performed procedure.

Table 8: Surgical Management of Solitary Thyroid Nodules

Procedure	Number	Percentage
Hemithyroidectomy	50	83.3
Subtotal Thyroidectomy	3	5.0
Near Total Thyroidectomy	1	1.7
Total Thyroidectomy with Neck Dissection	2	3.3
Total Thyroidectomy	1	1.7
Conservative Management	3	5.0

Hemithyroidectomy was sufficient for the majority of benign lesions.

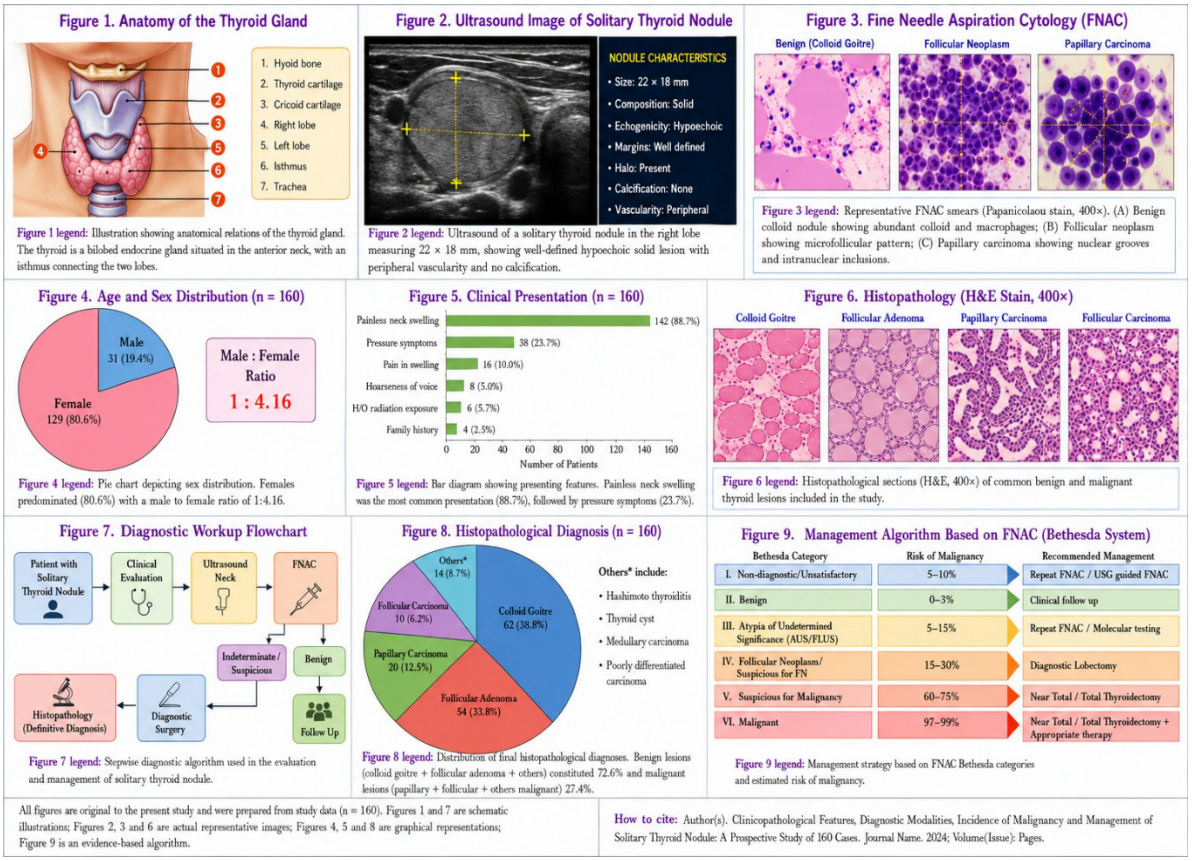

Figure 1. Anatomy of the Thyroid Gland

Legend: Illustration showing the anatomical structure of the thyroid gland with right and left lobes connected by the isthmus. The figure highlights adjacent structures including the hyoid bone, thyroid cartilage, cricoid cartilage, and trachea.

Figure 2. Ultrasonographic Image of Solitary Thyroid Nodule

Legend: Ultrasonographic image showing a well-defined hypoechoic solitary thyroid nodule in the right lobe measuring approximately 22 × 18 mm with peripheral vascularity and solid consistency.

Figure 3. Fine Needle Aspiration Cytology (FNAC)

Legend: Representative FNAC smears of thyroid lesions showing benign colloid goiter, follicular neoplasm, and papillary carcinoma with characteristic cytological features.

Figure 4. Age and Sex Distribution

Legend: Pie chart depicting demographic distribution of study participants, showing female predominance among solitary thyroid nodule cases.

Figure 5. Clinical Presentation

Legend: Bar diagram illustrating the common presenting symptoms among patients with solitary thyroid nodules, including painless neck swelling, dysphagia, and pressure symptoms.

Figure 6. Histopathological Features (H&E Stain, 400×)

Legend: Histopathological sections showing common benign and malignant thyroid lesions including colloid goiter, follicular adenoma, papillary carcinoma, and follicular carcinoma.

Figure 7. Diagnostic Workup Flowchart

Legend: Flowchart demonstrating the stepwise diagnostic approach for solitary thyroid nodules using clinical examination, ultrasonography, FNAC, surgery, and histopathological confirmation.

Figure 8. Histopathological Distribution

Legend: Pie chart showing the distribution of final histopathological diagnoses among solitary thyroid nodules, with benign lesions forming the majority of cases.

Figure 9. Management Algorithm Based on FNAC Bethesda System

Legend: Management protocol based on Bethesda cytological classification showing malignancy risk and recommended treatment strategies for thyroid nodules.

Discussion: Solitary thyroid nodules constitute a major proportion of thyroid disorders encountered in surgical practice. The primary concern in these patients is the risk of malignancy. The present study

evaluated the clinicopathological profile, diagnostic modalities, and management outcomes of solitary thyroid nodules [16-18].

In the present study, the majority of patients belonged to the age group of 20–39 years with a mean age of 38.1 years. Similar observations were reported by Das et al., Gupta et al., and Haridas et al., who observed peak incidence in the third and fourth decades [18-20].

Female predominance was evident in the present study with females accounting for 81.7% of cases [21]. Similar findings were reported by Dorairajan et al., Gupta et al., and Anitha et al. increased prevalence among females may be attributed to hormonal influences and autoimmune predisposition [22-23].

Most patients presented with asymptomatic neck swelling. Dysphagia and local discomfort were less common presenting complaints [24]. Similar symptom profiles were documented by Haridas et al. and Dhanaram et al [25].

The present study demonstrated right lobe predominance, which is consistent with findings by Pardhasaradhi et al. and Gupta et al. The majority of nodules measured between 1–4 cm in size [26].

Thyroid function tests revealed euthyroid status in the majority of patients (86.7%). Similar findings were reported in studies by Gupta et al. and Studer et al. Thyroid malignancies are frequently associated with euthyroid status [27].

FNAC proved to be a highly valuable diagnostic tool in the present study. Benign lesions were identified in 43.3% of cases, while malignancy was suspected or confirmed in approximately 21.6% of cases. Similar observations were reported by Kaur et al., Davoudi et al., and Lin et al. FNAC significantly reduces unnecessary surgeries and assists in preoperative planning[28-30].

Histopathological examination remains the gold standard for definitive diagnosis. Follicular adenoma and multinodular goiter were the most common benign lesions observed in the present study [31-32]. Carcinoma was diagnosed in 21.7% of cases. Papillary carcinoma accounted for 61.5% of malignant lesions, consistent with studies by Leigh et al., Lundgren et al., and Anitha et al [33].

The incidence of malignancy in solitary thyroid nodules varies widely in literature from 5–20%. The incidence observed in the present study falls within this range [34].

Hemithyroidectomy was the most commonly performed surgical procedure. More extensive surgery such as total thyroidectomy was reserved for malignant lesions and extensive disease. Similar surgical trends were reported by Khairy et al [35].

The present study confirms the importance of comprehensive clinical evaluation, ultrasonography, FNAC, and histopathological examination in the management of solitary thyroid nodules.

Conclusion

Solitary thyroid nodules are common clinical entities predominantly affecting females in the third and fourth decades of life. Most patients are euthyroid and present with asymptomatic neck swelling.

FNAC and ultrasonography are invaluable tools for preoperative evaluation and risk stratification. Histopathological examination remains the definitive diagnostic modality.

The incidence of malignancy in solitary thyroid nodules in the present study was 21.7%, with papillary carcinoma being the most common malignant lesion.

Hemithyroidectomy remains the preferred surgical procedure for benign lesions, while total thyroidectomy is indicated in malignant cases.

Early diagnosis and prompt intervention significantly improve outcomes and reduce morbidity.

Limitations of the Study

1. Single-center study.
2. Small sample size.
3. Limited follow-up duration.
4. Molecular diagnostic markers were not evaluated.

Recommendations

1. Routine FNAC and ultrasonography should be performed in all patients with solitary thyroid nodules.
2. Suspicious lesions should undergo early surgical management.
3. Larger multicentric studies are recommended.
4. Molecular studies may further improve diagnostic accuracy.

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