

Evaluating Surgical and Pathological Outcomes in Multi-nodular Goiter: A Study of 200 Near-Total Thyroidectomy Cases

M. Ponmalai¹, Sankara Narayanan G¹, Anbarasan A¹, Srinivasan S¹, Sameen Taj¹ and M. Arun suriyan A²

¹Department of Anatomy, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai 602105, Tamil Nadu, India.

²Department of Pharmacology, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai 602105, Tamil Nadu, India.

*Corresponding Author
Arun suriyan A

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Abstract: *Background:* Multi-nodular goiter (MNG) is a common thyroid condition, characterized by diffuse thyroid enlargement and nodules of varying sizes. While predominantly benign, the potential for malignancy necessitates a structured approach to diagnosis and management. *Objective:* This study evaluates the clinical, diagnostic, and histopathological outcomes of 200 patients with MNG undergoing near-total thyroidectomy (NTT) at Saveetha Medical College and Hospital, affiliated to SIMATS, Chennai, India. *Methods:* Between 2022 and 2023, 200 patients (165 women, 35 men; mean age: 50 years) diagnosed with MNG were retrospectively reviewed. Preoperative assessments included clinical evaluation, ultrasonography, fine-needle aspiration (FNA), and advanced imaging when indicated. Near-total thyroidectomy was performed, and histopathological analysis of surgical specimens was conducted. *Results:* Among the patients, primary indications for surgery included pressure symptoms (38%), thyrotoxicosis (27.5%), intrathoracic extension (20%), suspected malignancy (8%), and cosmetic deformity (6.5%). Histopathological analysis revealed benign pathology in 90% of cases, with adenomas and colloid goiters being the most common findings (62.5%). Malignant pathology was identified in 10% of cases, with papillary carcinoma being the predominant type (7%), followed by follicular, medullary, and undifferentiated carcinomas. *Conclusion:* Near-total thyroidectomy effectively manages MNG by addressing compressive symptoms, cosmetic concerns, and malignancy risks while preserving parathyroid function. The findings highlight the importance of integrating clinical, radiological, and pathological evaluations for individualized treatment. Future research should explore molecular diagnostic advancements and long-term outcomes for patients with malignant MNG.

Keywords: Multi-nodular Goiter (MNG), Near-Total Thyroidectomy (NTT), Histopathological Analysis, Thyroid Malignancy, Surgical Management of Goiter.

INTRODUCTION

Few topics in surgery have sparked as much debate as the management of multi-nodular goiter (MNG). [1] Autopsy findings indicate a significant prevalence of benign nodular thyroid conditions, affecting approximately 37% of the general population. In cases of nodular thyroid disease, the incidence of malignancy varies between 10% and 30%, depending on the criteria used for surgical intervention. MNG, by clinical definition, is a diffuse enlargement of the thyroid, often representing the advanced stage of benign disease characterized by nodules of varying sizes. [2] A consistent feature of MNG is the regional variability in growth, attributed to differences in the growth potential of follicular epithelial cells. Intrathyroidal scar formation, resulting from localized necrosis and subsequent fibrotic repair, contributes to the network-like structure observed. Despite its generally benign nature, MNG encompasses a broad range of histopathological characteristics that necessitate tailored management and vigilant follow-up. This retrospective study evaluates the histopathological outcomes of near-total thyroidectomy, which serves as the standard treatment for MNG. [3, 4]

MATERIALS AND METHODS

Study Population

Between 2022 and 2023, 200 patients diagnosed with multi-nodular goiter (MNG) involving the entire thyroid gland were admitted to the Department of surgery at Saveetha Medical College and Hospital, affiliated to SIMATS, Chennai, India. These patients, comprising 165 women and 35 men (mean age: 50 years; range: 20–80 years), underwent near-total thyroidectomy (NTT). None of the patients had undergone previous thyroid surgeries. Preoperative investigations followed a structured algorithm (details provided in Table 1), with tumors clinically suspected based on the presence of a hard or fixed nodule, neck nodes, vocal cord paralysis, rapid nodule growth, or a history of neck irradiation. Figure 1 shows the patients diffuse neck swelling. Patients with Graves' disease were excluded from this study. Table 2 summarizes the indications for surgical management of MNG.

Surgical Technique for Near-Total Thyroidectomy (NTT)

A transverse incision, 3 cm above the clavicular head, was made along natural skin creases. The superior pole of the thyroid lobe on the most affected side was

mobilized first, employing the Thompson technique to preserve the external branch of the superior laryngeal nerve.

The recurrent laryngeal nerve (RLN) was identified inferior to the thyroid artery and carefully preserved, ensuring no direct trauma or devascularization, especially near the ligament of Berry-Gruber. Vessels adhering to the capsule were clamped to maintain lateral blood supply to the parathyroid glands.

Lobes, the isthmus, and pyramidal structures were systematically resected, ensuring thorough removal of all palpable nodules. [5] Figure 2 shows the thyroid gland specimens removed after surgery.

Approximately 4–5 grams of visually normal thyroid tissue were intentionally retained on the less affected superior pole to safeguard against accidental parathyroid injury. Bilateral drainage was routinely placed and maintained for 48 hours post-surgery to mitigate potential complications. [6]

Histopathological Analysis

Surgical specimens were fixed in formalin for 24 hours, processed into paraffin blocks, and sectioned for hematoxylin and eosin staining. Gross examination revealed diffuse or nodular thyroid enlargement. Encapsulated, firm lesions, which were occasionally calcified, hemorrhagic, or necrotic, were examined for malignancy. [7] Histologically, both adenomatous and multi-nodular goiters predominantly displayed follicular patterns. Differential diagnosis involved distinguishing papillary carcinoma from nodular goiters with hyperplastic changes and identifying the follicular variant of papillary carcinoma.

Diagnostic features of papillary carcinoma included fibrovascular papillae, distinct nuclear morphology (enlarged, grooved, and overlapping nuclei), and the presence of psammoma bodies. [8] In follicular carcinomas, capsular invasion and vascular penetration were critical diagnostic criteria, differentiating them from benign lesions. These parameters were consistent for both oxyphilic (Hürthle cell) and clear-cell variants.

This approach ensured a comprehensive assessment of the histopathological diversity and malignancy potential in patients undergoing surgical management for MNG at our institution.

Figure 1: Shows one of the patient with diffuse swelling at the anterior midline of neck.



RESULTS

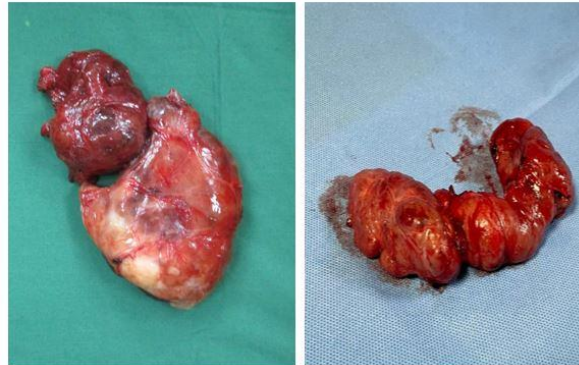
A total of 200 patients with multi-nodular goiter (MNG) underwent surgical management, with findings categorized into investigations, indications for surgery, and histopathological results. [9-12] Routine investigations (Table 1) included history, physical examination, indirect laryngoscopy, and serum levels of TSH, T3, T4, calcium, phosphorus, and thyroid antibodies, performed for all patients. [13] Ultrasonography was conducted to evaluate nodule size and composition, while chest roentgenograms were used in 25 patients with suspected thoracic extension. Special studies (Table 1), such as iodine scintigraphy in 20 patients and CT/MRI in 15 cases with compressive signs or intrathoracic extension, aided in determining surgical necessity. Calcitonin levels were elevated in 10 patients, indicating the need for further evaluation and total thyroidectomy. [14] Fine-needle aspiration (FNA) was performed in 120 patients, confirming malignancy in 40 cases.

The primary indications for surgery (Table 2) included pressure on cervical structures, which accounted for 38% (76 patients), followed by thyrotoxicosis or toxic multi-nodular goiter in 27.5% (55 patients). Intrathoracic extension was observed in 20% (40 patients), suspected malignancy in 8% (16 patients), and significant cosmetic deformity in 6.5% (13 patients).

Histopathological analysis revealed that 62.5% (125 patients) had adenomas, either follicular or microfollicular, along with colloid goiter (Table 3). [15] Toxic multi-nodular goiter was present in 32% (64 patients), while Hürthle cell adenomas and Hashimoto's thyroiditis were observed in 4% (8 patients) and 1.5% (3 patients), respectively. Malignant pathology was identified in 10% (20 patients, Table 4). Papillary carcinoma was the most common malignancy, occurring in 7% (14

patients), with 1% (2 patients) presenting with its follicular variant. Undifferentiated (anaplastic) carcinoma and medullary carcinoma were each observed in 1% (2 patients). Other malignancies included lymphoma with Hashimoto's thyroiditis (1%, 2 patients), follicular carcinoma (1%, 2 patients), and Hürthle cell carcinoma (0.5%, 1 patient). [16]

Figure 2: Shows thyroid gland specimens removed after the near total thyroidectomy.



These findings (Tables 1–4) underscore the importance of comprehensive diagnostic evaluations and appropriate surgical interventions in managing multi-nodular goiter. Most cases were benign, but 10% of patients presented with malignancies requiring more aggressive treatment approaches.

Table 1: Investigative Approach and Outcomes for 200 Patients with Multi-nodular Goiter (MNG)

Category	Investigations	Findings and Outcomes
Routine	- History and physical examination	Conducted for all 200 patients.
	- Indirect laryngoscopy	Performed to assess vocal cord function in all patients.
	- Serum levels of TSH, T3, T4, calcium, phosphorus, and thyroid antibodies	Evaluated in all 200 patients.
	- Ultrasonography of the neck	Conducted in all patients to assess nodule size, composition, and features.
	- Chest roentgenogram	Performed in patients with suspected thoracic extension (n=25).
Special Studies	- Abnormal TSH → iodine scintigraphy	Indicated for 20 patients with abnormal TSH levels, leading to a recommendation for near-total thyroidectomy (NTT) in surgical candidates.
	- Compressive signs or intrathoracic extension → CT scan or MRI	CT/MRI performed in 15 patients with suspected intrathoracic extension, resulting in NTT recommendations.
	- Calcitonin serum level (CL)	Elevated CL in 10 patients led to total thyroidectomy (TT) after confirmation of malignancy.
	- Fine-needle aspiration (FNA)	Conducted in 120 patients with suspicious or malignant nodules on ultrasonography.
Clinically Suspected Tumor	- Abnormal CL → TT	TT performed in 10 patients with abnormal CL suggestive of medullary thyroid carcinoma.
	- FNA malignant or suspicious → NTT and frozen sections; if malignant → TT	FNA confirmed malignancy in 40 patients, leading to TT in 25 patients after frozen section confirmation, while NTT was performed in the remainder.
	- FNA benign/inadequate → NTT if surgical indication or repeat FNA and clinical follow-up	In 80 patients with benign/inadequate FNA, 50 underwent NTT due to surgical indications, while 30 were managed with repeated FNA and follow-up.

Table 2: Indications for Surgery in 200 Patients with Multi-nodular Goiter (MNG)

Indication for Surgery	n	%
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Suspected malignancy (by fine-needle aspiration and/or clinically)	16	8.0
Thyrotoxicosis (toxic MNG)	55	27.5
Pressure on cervical structures (e.g., tracheal deviation)	76	38.0
Significant cosmetic deformity	13	6.5
Intrathoracic extension of thyroid goiter (MRI findings)	40	20.0
Total	200	100

Table 3: Final Benign Pathology in 200 Patients with Multi-nodular Goiter (MNG)

Pathological Finding	n	%
Adenoma, follicular or microfollicular, and colloid goiter	125	62.5
Hürthle cell adenoma	8	4.0
Hashimoto's thyroiditis	3	1.5
Toxic multi-nodular goiter (hyperthyroidism)	64	32.0
Total	200	100

Table 4: Final Malignant Pathology in 200 Patients with Multi-nodular Goiter (MNG)

Pathological Finding	n	%
Usual type of papillary carcinoma	14	7.0
- ≥10 mm	7	3.5
- <10 mm (in one lobe)	4	2.0
- Microscopic multi-centric disease	3	1.5
Follicular variant of papillary carcinoma	2	1.0
Undifferentiated (anaplastic) carcinoma	2	1.0
Medullary carcinoma	2	1.0
Lymphoma with Hashimoto's thyroiditis	2	1.0
Follicular carcinoma	2	1.0
Hürthle cell carcinoma	1	0.5
Total	20	10.0

DISCUSSION

The present study highlights the clinical and pathological spectrum of multi-nodular goiter (MNG) in a cohort of 200 patients who underwent surgical management. [17] The findings emphasize the necessity for a structured approach in evaluating and treating MNG, given its diverse presentation and potential for malignancy.

Diagnostic Insights

Routine and specialized investigations played a pivotal role in identifying the underlying pathology and determining surgical indications. [18] Ultrasonography, a non-invasive and widely available tool, proved essential in assessing nodule size, composition, and features, while fine-needle aspiration (FNA) guided the diagnosis of malignancy in suspicious cases. However, the limitations of FNA in differentiating follicular adenomas from carcinomas underscore the importance of histopathological examination post-surgery. [19-24] The use of iodine scintigraphy and advanced imaging modalities such as CT or MRI helped address cases with compressive symptoms or intrathoracic extension, reinforcing their value in preoperative planning.

Indications for Surgery

The primary indications for surgical intervention reflected the complexity of MNG management. Pressure effects on cervical structures were the most common

indication, aligning with the clinical relevance of tracheal deviation or compression. [20] Thyrotoxicosis, observed in a significant proportion of patients, underscores the need for addressing the functional aspects of the disease alongside structural abnormalities. Intrathoracic extension and suspected malignancy accounted for a notable portion of cases, highlighting the multi-faceted nature of MNG and the necessity for individualized treatment strategies. [25-29]

Pathological Spectrum

Histopathological analysis revealed a predominance of benign pathology, with adenomas and colloid goiters being the most frequently observed conditions. Toxic multi-nodular goiter was the second most common benign condition. [22-30] These findings underscore the largely non-malignant nature of MNG; however, the identification of malignancy in a subset of cases warrants attention. Papillary carcinoma was the most frequently encountered malignancy, consistent with its known prevalence in thyroid cancers. The presence of aggressive histological types, such as undifferentiated (anaplastic) carcinoma and medullary carcinoma, albeit rare, reinforces the need for thorough preoperative evaluation and tailored surgical approaches. [31-33]

Clinical Implications

The results of this study underscore the importance of integrating clinical, radiological, and pathological findings in the management of MNG. [34] While most cases were benign, the identification of malignancies in a proportion of patients highlights the need for vigilance in surgical planning and follow-up. The use of near-total thyroidectomy as the primary surgical approach allowed for effective disease management while minimizing the risk of recurrence. [35] However, the necessity of leaving residual thyroid tissue to preserve parathyroid function and prevent complications like hypoparathyroidism was evident.

CONCLUSION

This study provides a comprehensive evaluation of the clinical, diagnostic, and pathological aspects of multinodular goiter (MNG) in a cohort of 200 patients undergoing surgical management. The findings emphasize the largely benign nature of MNG, with adenomas and colloid goiters predominating; however, the presence of malignancies in 10% of cases highlights the critical need for meticulous preoperative evaluation and appropriate surgical intervention. Near-total thyroidectomy proved to be an effective approach for managing MNG, balancing disease control with the preservation of parathyroid function.

The study underscores the value of combining clinical, radiological, and pathological findings for individualized treatment strategies. Further research is recommended to refine diagnostic accuracy, optimize surgical techniques, and investigate long-term outcomes, particularly in cases with malignant pathology.

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