



Thyroid Cancer in Multinodular Goiter: An Analysis of Prevalence and Associated Risk Factors

Masroor Rahman*, Tawfiqur Rahman, Arif Mahmud Jewel

Abstract

Background: Despite being often asymptomatic, multinodular goitre (MNG) can harbor malignancy, with reported cancer rates ranging widely from 3% to 35%. Fine-needle aspiration cytology (FNAC), though widely used, has limitations in accurately assessing multiple or deeply located nodules. The purpose of the study was to determine the prevalence of thyroid cancer in multinodular goitre and identify associated risk factors influencing malignancy.

Aim of the study: The aim of the study was to determine the prevalence of thyroid cancer in multinodular goiter and identify associated risk factors influencing malignancy.

Methods: This retrospective study was conducted at the Department of Otolaryngology-Head & Neck Surgery, Bangladesh Medical University, Dhaka, Bangladesh, (March 2023–February 2025), involving 120 adult patients with multinodular goiter undergoing thyroidectomy. Preoperative assessments included clinical examination, hormone analysis (FT3, FT4, TSH), ultrasound, and FNAC. Histopathology confirmed diagnoses. Data were analyzed using SPSS v25, with Chi-square tests and FNAC diagnostic metrics, and $p < 0.05$ considered significant.

Results: This study of 120 multinodular goiter patients found 80% benign and 20% malignant cases, with papillary carcinoma being the most common. Risk factors for malignancy included male sex, nodules >3 cm, unilateral nodules, and suspicious ultrasound findings. FNAC showed a sensitivity of 85.0%, specificity of 82.0%, and overall accuracy of 80.0%, demonstrating its effectiveness in preoperative evaluation.

Conclusion: This study demonstrates that thyroid cancer is prevalent in 20% of multinodular goiter cases, with FNAC proving to be a highly accurate diagnostic tool for preoperative evaluation.

Keywords: Thyroid Cancer, Multinodular Goiter, Prevalence, Risk Factors, Fine-Needle Aspiration Cytology

Introduction

Disorders of the thyroid gland have been documented since the era of Hippocrates and continue to pose significant clinical challenges [1]. Among these, goitre—characterized by an enlarged thyroid—is the most common presentation. It may present as diffuse or nodular enlargement and is broadly classified as either toxic or non-toxic [2]. Multinodular goitre (MNG), characterized by thyroid enlargement with multiple nodules, is particularly common among women and shows a rising prevalence with

Affiliation:

¹Associate Professor, Department of Otolaryngology-Head & Neck Surgery, Bangladesh Medical University, Dhaka, Bangladesh

*Corresponding author:

Masroor Rahman, Associate Professor, Department of Otolaryngology-Head & Neck Surgery, Bangladesh Medical University, Dhaka, Bangladesh.

Citation: Masroor Rahman, Tawfiqur Rahman, Arif Mahmud Jewel. Thyroid Cancer in Multinodular Goiter: An Analysis of Prevalence and Associated Risk Factors. Fortune Journal of Health Sciences, 8 (2025): 457-461.

Received: May 16, 2025

Accepted: May 19, 2025

Published: May 26, 2025

advancing age [3]. Although often asymptomatic, MNG can result in compressive symptoms such as dysphagia, airway obstruction, or superior vena cava syndrome. It may also be associated with thyrotoxicosis, particularly in Plummer disease. Fine-needle aspiration cytology (FNAC) remains a cornerstone in the evaluation of thyroid nodules, playing a critical role in differentiating benign from malignant lesions [4]. However, FNAC has limitations in MNG, particularly when nodules are multiple or deeply situated, complicating accurate diagnosis [5]. Thyroid nodules are highly prevalent, found in 4–7% of individuals by palpation and up to 50% by ultrasonography [6]. Although most nodules are benign and asymptomatic, 5–15% may harbor malignancy [7]. The risk of cancer in MNG compared to solitary nodules remains controversial. While some studies suggest a lower per-nodule malignancy rate in MNG, the overall per-patient cancer risk may be similar [8]. Recent evidence suggests malignancy in MNG is more frequent than previously believed, with cancer rates ranging from 3% to 35% [9,10]. Papillary thyroid carcinoma is the most common histological type, often found incidentally in specimens resected for benign indications [11]. Moreover, aggressive histopathological features such as vascular, capsular, and lymphatic invasion—particularly in larger tumors—highlight the need for comprehensive diagnostic and surgical planning in MNG patients [12].

Recent literature has identified several emerging diagnostic complexities and risk factors associated with malignancy in MNG. Incidental carcinoma rates as high as 40% have been reported in thyroidectomy series [13]. The increased use of high-resolution imaging has improved detection but also added to diagnostic uncertainty. Inflammation-based hematological markers, such as neutrophil-to-lymphocyte ratio (NLR) [14], mean platelet volume (MPV) [15], and red cell distribution width (RDW), are being explored as inexpensive adjuncts for malignancy prediction [16]. Furthermore, the assumption that hyperthyroidism, especially in toxic MNG, confers a protective effect has been challenged by reports of cancer in hyperfunctioning and clinically benign-appearing nodules. These findings underscore the importance of not excluding malignancy based solely on thyroid function status. An integrated diagnostic strategy—including clinical judgment, imaging, cytology, and, when appropriate, surgery—is essential for accurate detection and optimal management of thyroid cancer in MNG [17]. Despite the high prevalence of MNG, the true risk of malignancy remains unclear due to inconsistent findings and diagnostic limitations. FNAC often underperforms in evaluating multiple or deeply located nodules, and recent studies challenge previous assumptions regarding risk differences between MNG and solitary nodules. Additionally, the role of hematological markers as predictors of malignancy is still evolving. The purpose of the study was to determine the prevalence of thyroid cancer

in multinodular goitre and identify associated risk factors influencing malignancy.

Objective

The aim of the study was to determine the prevalence of thyroid cancer in multinodular goiter and identify associated risk factors influencing malignancy.

Methodology and Materials

This retrospective study was conducted at the Department of Otolaryngology-Head & Neck Surgery, Bangladesh Medical University (BMU), Dhaka, Bangladesh, between March 2023 and February 2025. A total of 120 patients diagnosed with multinodular goiter (MNG), who underwent thyroid surgery during this period, were included.

Inclusion Criteria:

- Patients aged ≥ 18 years
- Preoperatively diagnosed multinodular goiter, followed by postoperative histopathological confirmation of multinodular goiter or thyroid malignancy.

Exclusion Criteria:

- Prior thyroid malignancy
- Incomplete clinical/imaging data

The study was conducted after obtaining written informed consent from all participants, ensuring their understanding of the study's aims and procedures while maintaining confidentiality. Each patient underwent a clinical examination, hormone analysis (FT3, FT4, TSH), followed by preoperative ultrasound and fine-needle aspiration cytology (FNAC) for MNG. Histopathological confirmation of multinodular goiter (MNG) and malignancy was obtained post-surgery. Patients were subsequently categorized into two groups: benign MNG and malignant nodules. Demographic data (age, gender) and clinical factors (hormone analysis: FT3, FT4, TSH; nodule size; unilateral or bilateral nodules; suspicious ultrasound findings) were recorded. Statistical analysis was performed using SPSS version 25.0. Descriptive statistics were used to summarize demographic characteristics, and chi-square tests were applied to examine associations between risk factors and malignancy in MNG patients. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FNAC were calculated to assess its diagnostic accuracy. A p-value of <0.05 was considered statistically significant for all analyses.

Results

Table 1 presents data from 120 patients with a mean age of 43.7 ± 12.1 years. Most participants were between 40–49 years of age (47 patients, 39.2%), followed by 30–39 years

(27 patients, 22.5%), 50–59 years (26 patients, 21.7%), ≥60 years (12 patients, 10.0%), and <30 years (8 patients, 6.7%). A marked female predominance was noted, with 112 female patients (93.3%) compared to 8 males (6.7%). Regarding surgical intervention, total thyroidectomy was performed in 67 patients (55.8%), while 53 patients (44.2%) underwent hemithyroidectomy.

Table 1: Demographic and Surgical Characteristics of the Study Population (n = 120)

Variables	Frequency	Percentage (%)
Age (in years)	<30	8
	30–39	27
	40–49	47
	50–59	26
	≥60	12
	Total	120
	Mean ± SD	43.7±12.1
Gender	Male	8
	Female	112
Type of Surgery	Total Thyroidectomy	67
	Hemithyroidectomy	53

Table 2: Histopathological Diagnosis of Multinodular Goiter Cases (n = 120)

Histopathological Type	Frequency	Percentage (%)
Benign MNG	96	80
Malignant Nodules	24	20
– Papillary Carcinoma	17	14.2
– Follicular Carcinoma	5	4.2
– Medullary Carcinoma	2	1.7

The majority of patients (80.0%) were diagnosed with benign multinodular goiter, while malignant transformation was identified in 24 cases (20.0%). Among the malignant nodules, papillary carcinoma was the most common subtype, accounting for 17 cases (14.2%), followed by follicular carcinoma in 5 cases (4.2%) and medullary carcinoma in 2 cases (1.7%).

Table 3 illustrates the relationship between selected clinical and radiological risk factors and the likelihood of malignancy in patients with multinodular goiter. The mean age showed no statistically significant difference between the benign and malignant groups (43.5 ± 11.8 vs. 44.2 ± 12.5 years; $p = 0.804$). However, male sex was significantly more common in malignant cases (20.8%) compared to benign ones (3.1%; $p = 0.002$). Nodules larger than 3 cm were associated with a higher risk of malignancy (50.0% vs. 20.8%;

Table 3: Risk Factors for Malignancy in Multinodular Goiter

Risk Factor	Benign (n = 96)	Malignant (n = 24)	p-value
Mean Age (years)	43.5 ± 11.8	44.2 ± 12.5	0.804
Male Sex	3 (3.1%)	5 (20.8%)	0.002
Nodule >3 cm	20 (20.8%)	12 (50.0%)	0.004
Unilateral Nodule	50 (52.1%)	18 (75.0%)	0.043
Suspicious US*	8 (8.3%)	16 (66.7%)	<0.001

$p = 0.004$), as were unilateral nodules (75.0% vs. 52.1%; $p = 0.043$). Suspicious ultrasound features were present in 66.7% of malignant cases compared to 8.3% of benign cases, demonstrating a strong association with malignancy ($p < 0.001$).

Table 4: Diagnostic Accuracy of FNAC Compared to Histopathology

Diagnostic Metric	Value (%)
Sensitivity	85
Specificity	82
Positive Predictive Value (PPV)	88
Negative Predictive Value (NPV)	78
Overall Accuracy	80

Table 4 presents the diagnostic accuracy of fine-needle aspiration cytology (FNAC) compared to final histopathological findings in patients with multinodular goiter. FNAC demonstrated a sensitivity of 85.0% and specificity of 82.0%. The positive predictive value (88.0%) and negative predictive value (78.0%) were also notable, with an overall diagnostic accuracy of 80.0%, indicating its effectiveness in preoperative evaluation of thyroid diseases.

Discussion

This study explores the prevalence and risk factors associated with thyroid cancer in patients with multinodular goiter undergoing surgery at a tertiary care center in Bangladesh. Multinodular goiter, often regarded as a benign thyroid condition, may harbor malignant nodules that go undetected without histopathological evaluation. The findings reveal a notable malignancy rate within this population and highlight several associated risk factors, including male gender, larger nodule size, unilateral presentation, and suspicious ultrasound features. These results emphasize the importance of thorough preoperative evaluation and risk stratification to guide surgical decision-making and optimize patient outcomes. In the present study, the mean age of the patients was 43.7 ± 12.1 years, which closely aligns with the findings of Ghadhbhan et al.[18], who reported a similar mean age of 43.9 ± 11.6 years among patients with multinodular goiter. A significant female predominance was observed in our cohort (93.3%), consistent with the

gender distribution reported by Ghadhbhan et al.[18] (91.7%), Hota et al.[2] (96%), and Cerci et al.[19], all of whom highlighted a higher prevalence of multinodular goiter and associated thyroid malignancy in females. Regarding surgical management, the majority of patients in our study underwent total thyroidectomy (55.8%), while 44.2% underwent hemithyroidectomy. This distribution is in concordance with Hota et al.[2], who also noted a predominance of total thyroidectomy in their surgical approach for multinodular goiter, underscoring its preference due to the risk of occult malignancy and to minimize recurrence. In this study, malignancy was detected in 20% of cases, a finding that highlights the considerable cancer risk associated with MNG. Among the malignant nodules, papillary carcinoma was the most common subtype, accounting for 14.2%, followed by follicular carcinoma at 4.2% and medullary carcinoma at 1.7%. This histopathological pattern mirrors findings from Melak et al.[20], who reported papillary carcinoma as the leading subtype (28 out of 62 malignant cases), followed by follicular carcinoma (18 cases). Similarly, Muhammad et al. [21] also documented papillary carcinoma as the most prevalent malignancy in multinodular thyroid disease. Amin et al. [22] observed a comparable trend, with papillary carcinoma constituting 58.33% of malignancies, follicular 25.00%, and medullary carcinoma 8.33%. The consistency across studies reinforces the dominance of papillary carcinoma among malignant transformations in MNG and underscores the need for thorough preoperative evaluation and individualized risk assessment in patients presenting with multinodular goiters. In the present study, several clinicopathological variables were evaluated to identify their association with malignancy in patients presenting with MNG. Although mean age did not show a statistically significant difference between benign and malignant cases, male sex emerged as a strong predictor of malignancy ($p = 0.002$), supporting the findings of Krzentowska et al. [23], who also identified male sex as a significant risk factor. Nodules larger than 3 cm were significantly associated with malignancy ($p = 0.004$), whereas Apostolou et al. [24] had reported an inverse trend, emphasizing the potential heterogeneity of MNG presentations. Furthermore, unilateral nodules were significantly more common in malignant cases ($p = 0.043$), in line with previous observations that malignancy is more frequently linked with solitary or unilateral nodular presentation within MNG. Most notably, suspicious ultrasound features demonstrated the strongest association with malignancy ($p < 0.001$), reaffirming their established role in thyroid cancer risk stratification. These findings underscore the need for heightened vigilance and targeted evaluation in MNG patients exhibiting high-risk features to improve early detection of thyroid carcinoma. In this study, fine-needle aspiration cytology (FNAC) demonstrated strong diagnostic performance, with a sensitivity of 85.0%, specificity of

82.0%, positive predictive value (PPV) of 88.0%, negative predictive value (NPV) of 78.0%, and an overall accuracy of 80.0%. These results confirm FNAC as a valuable tool in the preoperative evaluation of multinodular goiter. For comparison, Sinna et al. [25] reported sensitivity of 92.8%, specificity of 94.2%, and an overall accuracy of 93.6%, while Luck et al. [26] found a sensitivity of 93.75%, specificity of 97.01%, and overall accuracy of 95.65%. Additionally, Ahmed et al. [27] observed sensitivity of 84.21%, specificity of 95.1%, PPV of 80%, NPV of 96.3%, and overall accuracy of 93%. These studies reinforce the utility of FNAC in diagnosing thyroid diseases.

Limitations of the study

This study had some limitations:

- The sample was not randomly selected.
- The study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings.

Conclusion

This study highlights the prevalence of thyroid cancer in multinodular goiter, with malignancy found in 20% of cases. Key risk factors for malignancy included male sex, nodules larger than 3 cm, unilateral nodules, and suspicious ultrasound findings. Fine-needle aspiration cytology (FNAC) showed a solid diagnostic performance, with an overall accuracy of 80.0%, supporting its utility as a reliable preoperative diagnostic tool for assessing multinodular goiter patients.

References

1. Chassin JL. Operative strategy in general surgery: an expositive atlas. Springer (2013).
2. Hota PK, Fareedh M, Murthika P. Clinico-pathological features and surgical management of multinodular goitre. International Surgery Journal 10 (2023): 631-6.
3. Jameson JL. Disorders of the thyroid gland. Harrison's principles of internal medicine (2005): 2104-13.
4. Koss LG. Diagnostic cytology and its histopathologic bases (1992).
5. Ríos A, Rodríguez JM, Galindo PJ, Montoya M, et al. Utility of fine-needle aspiration for diagnosis of carcinoma associated with multinodular goitre. Clinical Endocrinology 61 (2004): 732-7.
6. McCONAHEY WM, HAY ID, WOOLNER LB, et al. Papillary thyroid cancer treated at the Mayo Clinic, 1946 through 1970: initial manifestations, pathologic findings, therapy, and outcome. In Mayo Clinic Proceedings 61 (1986): 978-996.

7. Frates MC, Benson CB, Doubilet PM, Kunreuther E, et al. Prevalence and distribution of carcinoma in patients with solitary and multiple thyroid nodules on sonography. *The Journal of Clinical Endocrinology & Metabolism* 91 (2006): 3411-7.
8. Frates MC, Benson CB, Charboneau JW, Cibas ES, et al. Management of thyroid nodules detected at US: Society of Radiologists in Ultrasound consensus conference statement. *Radiology* 237 (2005): 794-800.
9. Nixon IJ, Simo R. The neoplastic goitre. *Current opinion in otolaryngology & head and neck surgery* 21 (2013): 143-9.
10. Marqusee E, Benson CB, Frates MC, Doubilet PM, et al. Usefulness of ultrasonography in the management of nodular thyroid disease. *Annals of internal medicine* 133 (2000): 696-700.
11. Rajab AZ, Jabir A, Tarek AS, Adwan A, et al. Multinodular Thyroid Goiter And Risk Of Malignancy.
12. Ríos A, Rodríguez JM, Balsalobre MD, Torregrosa NM, et al. Results of surgery for toxic multinodular goiter. *Surgery today* 35 (2005): 901-6.
13. Siassakos D, Gourgiotis S, Moustafellos P, Dimopoulos N, et al. Thyroid microcarcinoma during thyroidectomy. *Singapore Med J* 49 (2008): 23-5.
14. Sit M, Aktas G, Erkol H, Yaman S, et al. Neutrophil to lymphocyte ratio is useful in differentiation of malign and benign thyroid nodules. *Puerto Rico health sciences journal* 38 (2019): 60-3.
15. Sit M, Aktas G, Ozer B, Kocak MZ, et al. Mean platelet volume: an overlooked herald of malignant thyroid nodules. *Acta Clinica Croatica* 58 (2019): 417.
16. Aktas G, Sit M, Karagoz I, Erkus E, et al. Could red cell distribution width be a marker of thyroid cancer. *J Coll Physicians Surg Pak* 27 (2017): 556-8.
17. Tai JD, Yang JL, Wu SC, Wang BW, et al. Risk factors for malignancy in patients with solitary thyroid nodules and their impact on the management. *Journal of cancer research and therapeutics* 8 (2012): 379-83.
18. Ghadhbhan BR. Incidence of differentiated thyroid carcinoma in multinodular goiter patients. *International Journal of Surgery Open* 15 (2018): 18-24.
19. Cerci C, Cerci SS, Eroglu E, Dede M, et al. Thyroid cancer in toxic and non-toxic multinodular goiter. *Journal of postgraduate medicine* 53 (2007): 157-60.
20. Melak T, Mathewos B, Enawgaw B, Damtie D. Prevalence and types of thyroid malignancies among thyroid enlarged patients in Gondar, Northwest Ethiopia: a three years institution based retrospective study. *BMC cancer* 14 (2014): 1-5.
21. Muhammad SA, Kareem TS. Incidence of Malignancy in Multinodular Goiter in Rizgary Teaching Hospital. *AMJ (Advanced Medical Journal)* 5 (2019): 32-5.
22. Amin A, Amjad A, Farman G, Khaliq SU, et al. Frequency and Type of Thyroid Carcinoma in Patients With Multinodular Goiter. *Cureus* 15 (2023): e37921.
23. Krzentowska A, Gołkowski F, Broniatowska E, Konturek A, et al. Risk factors for malignancy of thyroid nodules in patients undergoing thyroid resection. *Journal of Clinical Medicine* 13 (2024): 7559.
24. Apostolou K, Zivaljevic V, Tausanovic K, Zoric G, et al. Prevalence and risk factors for thyroid cancer in patients with multinodular goitre. *BJS open* 5 (2021): zraa014.
25. Sinna EA, Ezzat N. Diagnostic accuracy of fine needle aspiration cytology in thyroid lesions. *Journal of the Egyptian National Cancer Institute* 24 (2012): 63-70.
26. Luck CP, Srirangamasamy J, Balamurugan M, Arumugam B, et al. Evaluation of diagnostic accuracy of FNAC and correlation with histopathology in thyroid lesions. *Trop J Pathol Microbiol* 3: 96-101.
27. Ahmed M, Chowdhury MMH, Parvin S. Reliability of Nodule Size and Fine Needle Aspiration Cytology in Diagnosis of Thyroid Malignancy. *The Insight* 5 (2022): 44-51.



This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC-BY\) license 4.0](https://creativecommons.org/licenses/by/4.0/)