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Investigating the Applicability of the McGill Thyroid Nodule Score (MTNS) in Patients Undergoing Surgery for Thyroid Nodules: A Comparison Between Patients with and Without Papillary Thyroid Cancer

Yiğit Keleşoğlu,[1] Yunushan Furkan Aydoğdu,[2] Çağrı Büyükkasap,[3] Hasan Bostancı,[3] Bülent Aytaç[3]

[1]Department of General Surgery, Kayseri City Hospital, Kayseri, Türkiye
[2]Department of General Surgery, Bandirma Training and Research Hospital, Balikesir, Türkiye
[3]Department of General Surgery, Gazi University Faculty of Medicine, Ankara, Türkiye

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Address for correspondence:
Yunushan Furkan Aydoğdu. Department of General Surgery, Bandirma Training and Research Hospital, Balikesir, Türkiye
Phone: +90 537 561 66 81
E-mail:
yfaydogdu92@gmail.com

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ABSTRACT

Objective: Various algorithms are currently used to evaluate patients with thyroid nodules. Thyroid fine needle aspiration biopsy (FNAB) is the most valuable method for assessment, but it yields 5–10% false negative results. Therefore, the McGill Thyroid Nodule Score (MTNS), which consists of 22 parameters, was developed for use in the preoperative period. In this study, we investigated the applicability of MTNS in patients with indeterminate FNAB results by comparing patients diagnosed with papillary thyroid cancer to those with benign outcomes according to the specimen result.

Materials and Methods: Between January 2016 and August 2017, 382 patients who underwent thyroidectomy at our clinic were evaluated. A total of 140 patients categorized as Bethesda III- IV-V were included in the study. The MTNS was calculated and compared between the malignant and benign groups. Subsequently, patients were divided into four groups based on nodule diameter to evaluate their MTNS.

Results: The median MTNS was 6 (range 1–16) in the benign group and 12 (range 3–23) in the malignant group. To determine the cut-off for MTNS, Receiver Operating Characteristic (ROC) analysis was conducted using the pathology result as the primary endpoint. The cut-off value was determined to be 8.5. Statistical analysis revealed that the sensitivity and specificity of MTNS were 83.0% and 85.5%, respectively.

Conclusion: Ultrasonography (USG) and FNAB are currently preferred methods for approaching patients with thyroid nodules. In cases where FNAB results are inconclusive, MTNS can be safely applied clinically to identify high-risk patients.

Keywords: Thyroid, papillary thyroid carcinoma, nodule, cancer, McGill Thyroid Nodule Score.

INTRODUCTION

Although the prevalence of thyroid nodules is increasing, most of these nodules are benign. Ultrasonography detects that 5–10% of nodules are malignant.[1] Thyroid fine needle aspiration biopsy (FNAB) is a safe, cost-effective, and highly accurate method for differentiating between benign and malignant thyroid nodules.[2–5] Although FNAB provides valuable information about the characteristics of the thyroid nodule, it may yield false negative results in 5% of cases.[6,7] Misclassifications, such as deeming malignant thyroid nodules benign, may lead to undesirable outcomes. When identifying patients in need of surgery, it is important to identify those who are clinically high-risk.[8]

Studies have shown that the McGill Thyroid Nodule Score (MTNS) is useful in identifying a clinically high-risk patient population. The MTNS is a scoring system that consists of 22 parameters correlated with the pathology results. It includes risk factors such as age, gender, echogenicity of the nodule (hypoechoic, isoechoic, hyperechoic), increased vascularity, calcification status, nodule size, and determines the patient's risk percentage for malignancy.[8–11]

In our study, the applicability of the MTNS was investigated by comparing patients diagnosed with papillary thyroid cancer and those with benign nodular disease in the postoperative period to the preoperative period.

MATERIALS AND METHODS

The data of 382 patients who underwent thyroidectomy at the general surgery clinic of our tertiary care hospital between January 2016 and August 2017 were analyzed. Approval for the study was obtained from the Ethics Committee of Gazi University Faculty of Medicine (10/10/2017- 08). The data were evaluated retrospectively.

Inclusion criteria were defined as patients with indeterminate character on FNAB (Bethesda III, IV, V) (n=183). In this evaluation, dominant nodules were considered as index nodules. Initially, the MTSNs of the patients were calculated. Patients with missing thyroid imaging, blood parameters, and FNAB results required for MTSN calculation were excluded from the study (n=12). Patients with diagnoses other than thyroid papillary carcinoma and benign diseases, such as follicular carcinoma, Hürthle cell neoplasia, and medullary carcinoma, were also excluded (n=31). As a result, a total of 140 patients were evaluated in the study. Due to the retrospective nature of the study, informed consent was not obtained from the patients.

The parameters required to calculate the MTNS for patients who met the necessary criteria were first calculated. Demographic data, postoperative and preoperative specimen diagnoses, and nodule diameters were then evaluated. The MTNS was assessed in two groups: benign (n=69) and malignant (n=71) (Fig. 1). Documentation of the FNAB site ensured correct malignancy assignment to the same site as the biopsied nodule, thus avoiding incorrect assignment of malignancy to benign nodules in patients with multinodular thyroid glands. After this evaluation, the dominant nodules were divided into four groups according to their diameters for MTNS calculation: less than 2 cm, 2–3 cm, 3–4 cm, and greater than 4 cm).

KEY MESSAGES

- The McGill Thyroid Nodule Score (MTNS) demonstrated high sensitivity (83.0%) and specificity (85.5%), making it a reliable tool for identifying high-risk patients with indeterminate Fine Needle Aspiration Biopsy (FNAB) results.
- MTNS is valuable when FNAB and ultrasonography (USG) results are inconclusive, providing a preoperative scoring system to assess malignancy risk in thyroid nodules.
- MTNS is effective in preoperative evaluations, helping to prioritize treatment for patients with indeterminate thyroid nodules.

Statistical Analysis

IBM SPSS version 26.0 (IBM Co., Armonk, NY, USA) was utilized for all statistical analyses in this study. Continuous data were analyzed using mean, median, standard deviation, and 95% confidence intervals (CIs), with statistical significance set at $p<0.05$. Comparative analysis of categorical data was conducted using the Chi-square test. To assess the normal distribution of numerical variables, the Kolmogorov-Smirnov test, histogram analysis, and skewness/kurtosis data were employed. For parameters lacking normal distribution characteristics, the Mann-Whitney U test was used for comparing two independent groups, while the Kruskal-Wallis test was used for multiple independent groups. The Analysis of Variance (ANOVA) test was applied for the comparative analysis of quantitative data. The cut-off for MTNS was determined through Receiver Operating Characteristic (ROC) analysis, considering the pathology result as the primary endpoint. The resulting cut-off value's sensitivity, specificity, and Area Under the Curve (AUC) values were provided. The score was then categorized as benign or malignant based on the cut-off, and sensitivity and specificity were calculated accordingly.

RESULTS

In our investigation, a total of 140 patients participated, comprising 40 (28.6%) males and 100 (71.4%) females during the initial assessment. Among these patients, 71 received a histopathological diagnosis of thyroid papillary cancer, while 69 were

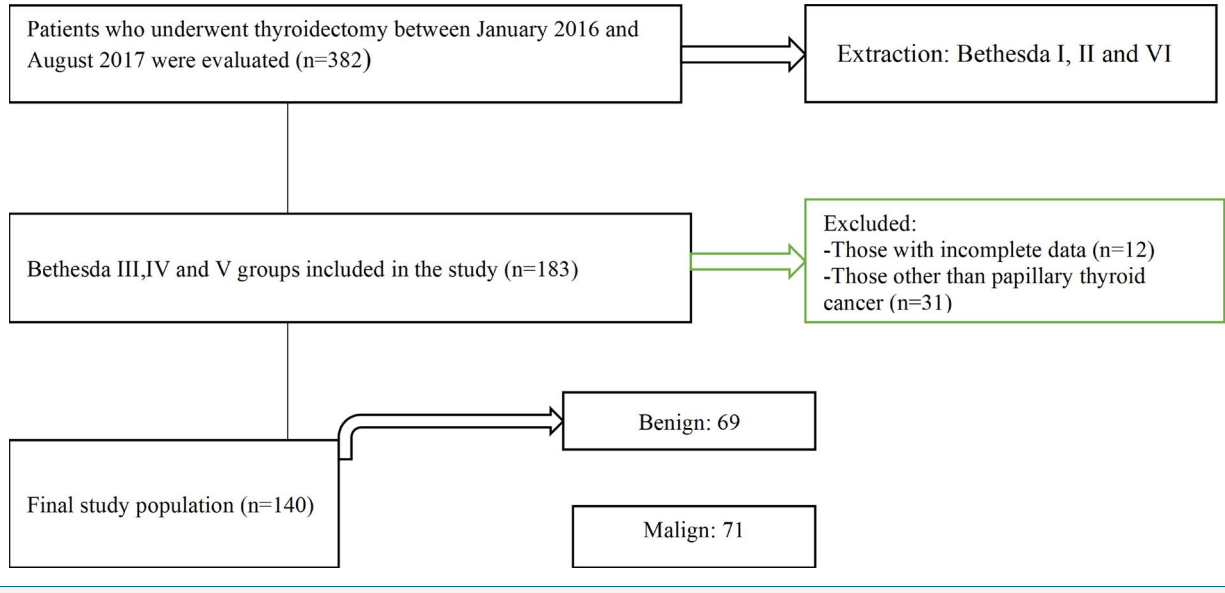

Figure 1. Sample collection scheme.

Table 1. Distribution of demographic data and nodule characteristics of benign and malignant nodules

	Benign	Malign (PTC)	Total
Age (median), (range), year	53 (20–79)	43 (19–75)	48 (19–79)
Sex, n (%)			
Male	19 (28.6%)	21 (28.6%)	40 (28.6%)
Female	50 (71.4%)	50 (71.4%)	100 (71.4%)
Nodule diameter (mean±SD), cm	2.5±1.2	1.9±1.3	2.2±1.2
Nodule diameter group (cm), n (%)			
<2 cm group	21 (30.4%)	43 (60.5%)	64 (45.7%)
2–2.9 cm group	26 (37.6%)	13 (18.3%)	39 (27.8%)
3–3.9 cm group	12 (17.3%)	8 (11.2%)	20 (14.2%)
>4 cm group	10 (14.4%)	7 (5.0%)	17 (12.1%)
MTNS (median), (range)	6 (1–16)	12 (3–23)	9 (1–23)

PTC: Papillary thyroid cancer; n: Number; SD: Standard deviation; cm: Centimeter; MTSN: McGill Thyroid Nodule Score.

diagnosed with benign nodular disease. The age range of the participants varied from 19 to 79 years, with a median age of 48 years. The average diameter of the dominant nodule observed in thyroid imaging studies was 2.2±1.2 cm. The median MTNS among the patients was 9 (minimum: 1 – maximum: 23). Within the malignant group, consisting of 71 patients, the median age was 43 years (ranging from 19 to 75). In the benign group, the median age of the patients was 51 years (ranging from 20 to 79). The mean nodule diameter in the malignant group was 1.9±1.3 cm, whereas in the benign group, it measured 2.5±1.2 cm. Patients were categorized into four groups based on nodule diameter. In the <2 cm group, 21 (30.4%) patients belonged to the benign group, while 43 (60.5%) were in the malignant group. In the 2–2.9 cm group, 26 (37.6%) patients were in the benign group, and 13 (18.3%) were in the malignant group. In the 3–3.9 cm group, 12 (17.3%) patients were in the benign group, and 8 (11.2%) were in the malignant group. In the >4 cm group, 10 (14.4%) patients were in the benign group, and 7 (5%) were in the malignant group. The median MTNS was 6 (1–16) in the benign group and 12 (3–23) in the malignant group (Table 1).

Table 2. Distribution of demographic data and McGill Thyroid Nodule Score parameters of nodule diameter subgroups

Nodule diameter group, n	<2 cm (n=64)	2–2.9 cm (n=39)	3–3.9 cm (n=20)	≥4 cm (n=17)	p
Age (median), (range), year	46 (19–73)	43 (20–79)	55 (30–74)	57 (29–75)	0.013
Sex, n (%)					0.018
Male	14 (21.9%)	9 (23.1%)	7 (35%)	10 (58.8%)	
Female	50 (78.1%)	30 (76.9%)	13 (65%)	7 (41.2%)	
Specimen diagnosis, n (%)					0.008
Benign	21 (32.8%)	26 (66.6%)	12 (60.0%)	10 (58.8%)	
Malign	43 (67.1%)	13 (33.3%)	8 (40%)	7 (41.2%)	
MTNS	9 (1–21)	7 (2–23)	10 (4–17)	9 (6–23)	0.007

n: Number; cm: Centimeter; MTSN: McGill Thyroid Nodule Score.

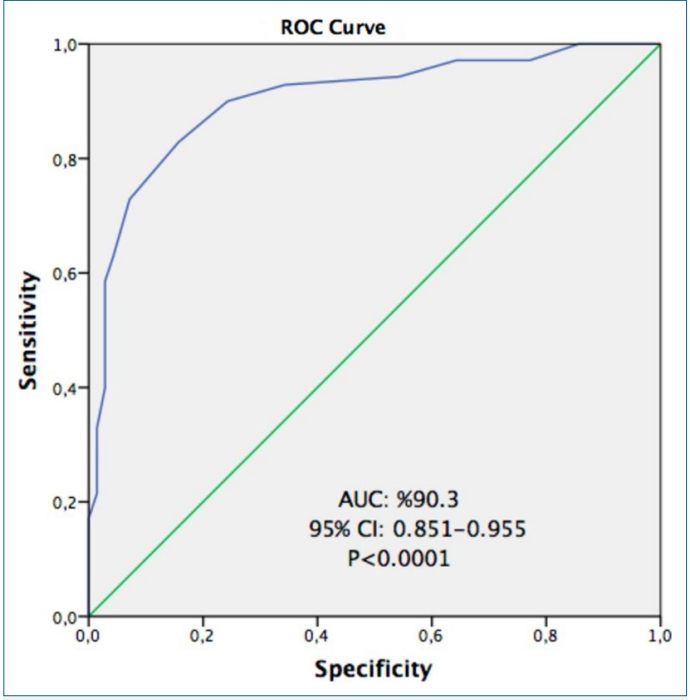

Figure 2. Receiver operating characteristic (ROC) analysis of McGill Thyroid Nodule Score.

In the nodule diameter subgroups, there were 64 patients, 14 (21.9%) males and 50 (78.1%) females, in the <2 cm group. The median age of patients in this group was 46 years (range 19–73). The median MTNS of patients in this group was 9 (range 1–21). There were 9 (23.1%) male and 30 (76.9%) female patients in the 2–2.9 cm group. The median age was 43 years (range 20–79). The median MTNS of patients in this group was 7 (range 2–23). In the 3–3.9 cm group, there were 20 patients, 7 (35%) male and 13 (65%) female. The median age was 55 years (range 30–74). The median MTNS of patients in this group was 10 (range 4–17). In the group with nodules >4 cm, 10 (58.8%) of 17 patients were male and 7 (41.2%) were female. The median age of patients in this group was 55 years (range 30–74). The median MTNS of patients in this group was 9 (range 6–23). In the <2 cm group, 21 (32.8%) of 64 patients had benign pathology, while 42 (67.1%) had malignant pathology. There were 39 patients in the 2–2.9 cm group, of which 26 (66.6%) had benign pathology and 13 (33.3%) had malignant pathology. The nodule diameter of 20 patients in the study ranged from 3–3.9 cm, with 12 (60%) in the benign group and 8 (40%) in the malignant group. Of the 17 patients in the >4 cm group, 10 (58.8%) were benign and 7 (41.2%) had malignant pathology.

When nodule diameter subgroups were compared in terms of age (p=0.013) and MTNS (p=0.007), the difference between the groups was statistically significant. The difference was due to the group with tumor diameter >4 cm (Table 2). To determine the cut-off for the MTNS, the pathology result was taken as the primary endpoint and ROC analysis was performed. According to ROC analysis, the sensitivity and specificity of the MTNS were 83.0% and 85.5%, respectively (AUC: 90.3%, 95% CI [0.851, 0.955]). The cut-off for the MTNS value was calculated as 8.5 (Fig. 2).

Patients were divided into benign and malignant groups with a cut-off of 8.5 according to MTNS. Accordingly, there were a total of 69 patients with MTNS 9 and above. Of these, 59 patients were histopathologically diagnosed with thyroid papillary cancer and 10 patients were histopathologically diagnosed with benign nodular disease. Of the 71 patients with MTNS ≤8, 59 were in the benign group and 12 were in the malignant group. The analysis showed a significant difference between the groups (p=0.019). With a cut-off value of 8.5, the sensitivity of the MTNS was 83.0%, and the specificity was 85.5% (Table 3).

Table 3. Distribution of demographic data and McGill Thyroid Nodule Score parameters of nodule diameter subgroups

Malignant	Benign	p
MTNS ≥9 group, n	59	10
MTNS ≤8 group, n	12	59

n: Number; MTSN: McGill Thyroid Nodule Score.

DISCUSSION

Thyroid nodules are a common health problem worldwide. Anamnesis, physical examination, imaging tests, and thyroid FNAB are commonly used in the approach to thyroid nodules. Differentiating whether the nodule is benign or malignant is important in choosing the treatment approach for the patient.[1,12] In the last decades, ultrasonography (USG) has increasingly demonstrated the ability to detect smaller thyroid nodules. As a result of this development and a series of studies triggered by it, it has been demonstrated that a significant percentage of asymptomatic individuals have thyroid nodules, and the frequency of malignancy in these nodules is not different from that of palpated nodules.[13] USG, which reveals the presence of nodules in approximately half of the population, cannot differentiate these nodules as benign or malignant with the same success. The presence of malignancy in the nodules detected by USG with a rate ranging from 5–13% is not only a major problem for clinicians but also a major problem in terms of health economics. Studies to date have shown that no single ultrasonographic nodule feature alone can make a complete and reliable distinction between malignant and benign. However, the use of some features alone or in combination with others can provide a relatively high characterization success. These features include a predominantly solid nodule, irregular borders, hypoechogenicity, anteroposterior diameter greater than the transverse diameter, presence of calcification, centrally predominant intranodular blood supply, and the presence of surrounding suspicious lymph nodes.[13–17]

Thyroid FNAB is performed on nodules found to be suspicious on USG. Thyroid FNAB is a simple, non-hazardous, reproducible approach with a high diagnostic value in the context of cancer.[14] Nondiagnostic aspiration in thyroid FNAB occurs in 7–25% of cases. False negativity with a rate of 5–15% has also been reported in benign nodules. In malignant cytology, sensitivity is around 98–99%. Intermediate cytology is difficult to evaluate, and 70–90% of these cases are essentially benign. The remaining 10–30% are adenomatous hyperplasia or neoplasms.[6,18–20]

Even with the use of USG and thyroid FNAB alone or in combination, some thyroid nodules remain ambiguous in terms of patient management, leading to delays in treatment and increased costs due to repeated examinations. Therefore, the MTNS, an evidence-based preoperative scoring system, is becoming important in the preoperative evaluation of thyroid nodules and in determining the treatment approach.[8] Although MTNS is an evidence-based scoring system, there are not many studies on this system in the literature. The lack of a precise cut-off value for MTNS is another challenge. To clarify these uncertainties, the relationship between clinicopathological variables and MTNS was evaluated in our study, which assessed the data of 140 patients operated on for nodules in the thyroid, to add to the reports from various centers around the world and to contribute to the literature.

In our study, according to the results of multivariate analysis, the cut-off value for MTNS was found to be 8.5. When the patients were re-categorized according to MTNS with a cut-off value of 8.5, the sensitivity and specificity of MTNS were found to be 83.0% and 85.5%, respectively. Additionally, a statistical relationship was found between age, MTNS, and nodule diameter in the comparison of nodule diameter subgroups. In light of these results, we suggest that preoperative MTNS is an easily applicable and safe method to determine the risk of malignancy in high-risk patient groups with thyroid nodules, especially in patients for whom FNAB is not helpful and USG findings are inconclusive. Varshney R et al.,[10] in a study of 437 patients, found a significant correlation between MTNS and malignancy but did not specify a cut-off value for MTNS. Khalife S et al.,[8] found similar results in a study of 101 patients, but they also did not specify a cut-off value. Al-Hakami HA et al.,[21] found a statistically significant difference (p=0.002) when divided into two groups as MTNS <8 and MTNS >11. Sands NB et al.,[11] calculated MTNS score in[11] patient populations. They statistically calculated the risk of MTNS less than 8 and greater than 19. However, they did not specify a cut-off value. They predicted a malignancy risk of 86% at MTNS less than 8. In our study, we found a significant correlation (p=0.019) in our analysis with the determination of our own cut-off value (8.5). Colombo et al.[22] calculated a thyroid risk score for indeterminate nodules with a sensitivity of 72.0% and a specificity of 80.0%. According to our study, MTNS (cut-off=8.5) had better sensitivity and specificity. Gomes-Lima CJ et al.[23] found sensitivity at 80.7% and specificity at 84.6% in their risk scoring in indeterminate nodules. According to our cut-off value, MTNS had better sensitivity and specificity.

CONCLUSION

MTNS can be considered as an easily applicable and safe method for determining the risk of malignancy in the preoperative period in high-risk patient groups with thyroid nodules in whom FNAB is not helpful according to USG findings. Especially in the indeterminate group, when we take the cut-off value as 8.5, it is evident that more care should be taken in evaluating the potential for malignancy.

Ethics Committee Approval: The Gazi University Clinical Research Ethics Committee granted approval for this study (date: 10.10.2017, number: 08).

Author Contributions: Concept – YK; Design – YK, YFA; Supervision – ÇB; Resource – ÇB, BA; Materials – YFA, YK, ÇB; Data Collection and/or Processing – YK, YFA; Analysis and/or Interpretation – YFA, ÇB, BA; Literature Search – HB, ÇB; Writing – YFA, YK; Critical Reviews – BA, ÇB.

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