

ORIGINAL RESEARCH

Impact of Modified Thoracic Breast Approach Lumpectomy on Prognosis of Recurrence in Radical Thyroid Carcinoma Patients

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ABSTRACT

Objective • This study aimed to compare the efficacy and safety of endoscopic radical thyroidectomy (ERT) via modified breast approach (MBA) with conventional open thyroidectomy in treating thyroid carcinoma (TC).

Methods • One hundred patients with TC were randomized into a research group (treated with modified thoracic breast approach lumpectomy) and a control group (treated with traditional open surgery). Clinical efficacy, adverse effects, operative time, intraoperative bleeding, postoperative drainage, and length of stay (LOS) were compared between the groups. Serum calcium and parathyroid hormone levels were measured preoperatively and on postoperative days 1 and 5. Patients were followed up for 1-year prognosis, including prognostic survival, TC recurrence rate, and factors affecting their prognosis.

Results • There was no difference in total treatment efficiency between the groups, but the incidence of adverse

effects, intraoperative bleeding, postoperative drainage, and LOS were lower in the research group, while the operative time was higher in the control group. Serum calcium and parathyroid hormone were insufficient in both groups on postoperative day 1 compared to preoperative levels, with higher levels in the research group. On postoperative day 5, there was no difference between the groups. TC recurrence was lower in the research group, and logistic regression analysis showed that age and surgical method were independent factors affecting prognostic recurrence in TC patients.

Conclusion • Modified thoracic breast approach lumpectomy for radical TC is a safe and effective technique that can improve patients' prognosis of recurrence. It is recommended for clinical practice. (*Altern Ther Health Med.* 2023;29(5):210-215).

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INTRODUCTION

Thyroid carcinoma (TC) is a highly prevalent endocrine malignancy worldwide, encompassing various carcinomas with distinct biological behaviors and pathological types. Its incidence has been steadily increasing in recent years.¹ Globally, it is estimated that about 200 000-300 000 new cases of TC occur each year, with an annual increase rate of 20%.² Although TC predominantly affects middle-aged women, recent studies have shown an apparent trend of younger age among those diagnosed with the disease.³ TC exhibits a slow-growing, highly insidious pathology that may remain

confined to the thyroid gland for several years. However, the lesions may spread to other parts of the gland and the cervical lymph nodes through intraglandular lymphatics.⁴ Once the tumor develops, it usually invades both the left and right lobes, significantly impacting the patient's body function with a poor prognosis.⁵ Surveys have demonstrated that the 3-year prognostic mortality rate of patients with mid to late-stage TC exceeds 40%, posing a substantial threat to patients.⁶

The primary clinical treatment for TC remains surgical, achieved through complete resection of primary tumors and affected lymph nodes.⁷ However, traditional open surgery can result in large incision scars at the thyroid gland, significantly affecting patients' appearance and leading to paresthesia.⁸ Moreover, the incidence of postoperative complications is also substantially increased due to significant stress response.⁹ Therefore, multiple access lumpectomies have been developed to ensure efficacy while reducing patient body trauma and meeting aesthetic needs.¹⁰ The thoracic breast approach lumpectomy for radical TC has shown excellent results among these. However, previous

studies have primarily focused on clinical outcomes and ignored the prognosis of TC.¹¹ Therefore, this study aims to investigate the effect of modified thoracic breast approach lumpectomy for radical TC and extend the experimental period to follow up on patients' prognosis, providing a more reliable and comprehensive reference for future clinical treatment.

MATERIALS AND METHODS

Study Design

This randomized controlled trial aims to compare the effects of a modified thoracic breast approach lumpectomy with conventional open thyroidectomy in treating thyroid carcinoma. The study will enrol 100 patients with thyroid carcinoma and follow them for a 1-year prognosis to evaluate the efficacy and safety of the two surgical methods. The study will measure several clinical outcomes, including operative time, intraoperative bleeding, postoperative drainage, and length of stay.

Patient Selection

Patient Selection One hundred patients diagnosed with TC and admitted to Zhou Shan Hospital between February 2018 to December 2020 were randomly allocated into two groups using a random number table method—the research group (n=50) and the control group (n=50). All participants provided written informed consent before being included in the study.

Inclusion and Exclusion Criteria

Inclusion Criteria. Patients over 18 years old, diagnosed with TC by the pathology department according to the guidelines of the European Society for Medical Oncology,¹² had a single lesion, 1-3 cm in diameter, and a unilateral glandular lobe lesion requiring radical surgery.

Exclusion Criteria. Patients with a history of radiotherapy or chemotherapy within six months prior to admission, abnormal liver and kidney function and disorders, other combined cardiovascular and cerebrovascular diseases, neck trauma, autoimmune defects, and pregnant and lactating patients were excluded from the study.

Surgery Methods

Patients were supine with an immobilized head and conventional general anesthesia with tracheal intubation. Control group: Traditional open surgery was performed by making a collar transverse incision on the sternal notch, two transverse fingers in the direction of the skin line, and the two ends reached the lateral edge of the sternocleidomastoid muscle to expose the thyroid tissue fully. The patient's ipsilateral or contralateral thyroid was removed, silk ligated to stop bleeding, drainage placed, and the incision closed. Research group: Modified lumpectomy TC radical surgery was performed. After anesthesia, an incision (approximately 1 cm in length) was made 10 cm above the intersection of the midline of both nipples and the right parasternal line, deep to

the deep fascia, and 80 mL of expansion fluid was injected. At the same time, an incision (approximately 5 mm in length) was made 10 cm above each side of the areola to place the Trocar tube. The ultrasonic knife was used to separate the upper edge of the flap from the thyroid cartilage to expose the thyroid gland fully. A total lobectomy was performed on the affected side, the central lymph nodes were swept, and drainage was placed after hemostasis.

Sample Collection

Three milliliters (3 ml) of fasting venous blood were collected from both groups at three-time points: preoperative (T₀), postoperative 1st day (T₁), and postoperative 5th day (T₂). The blood was then centrifuged for 10 minutes at 2500 × g and 4°C after being kept at room temperature for 30 minutes to obtain serum. Serum calcium and parathyroid hormone levels were measured using a fully automated biochemical analyzer (Beckman Coulter, BC5800, Brea, CA, USA).

Efficacy Evaluation Criteria

Markedly Effective. complete disappearance of clinical symptoms, complete separation of thyroid nodules, and no symptoms of infection.

Effective. significant improvement in clinical symptoms and basic resection of thyroid nodules.

Ineffective. no improvement in clinical symptoms and the presence of infection after the operation.

Total Effective Rate = (Markedly Effective + Effective) / Total × 100%.¹³

Psychological Status Assessment

The Self-Assessment Scale for Depression (SAS) and the Self-Assessment Scale for Anxiety (SDS)¹⁴ were used to assess patients' psychological status before surgery (pre-treatment) and at the time of patient discharge (post-treatment). The scores of the individual questions were added together as the crude score, and the crude score was multiplied by 1.25 and rounded to the nearest whole number to obtain the standard score (up to 100), with higher scores indicating more severe depression and anxiety in patients.

Prognostic Follow-Up

A 1-year follow-up was conducted through regular hospital reviews to record the prognostic TC recurrence rate and survival in both groups. Survival curves were plotted for further analysis.

Outcome Measures

The main outcome measures were clinical efficacy, safety (incidence of adverse events), operative status (operative time, intraoperative bleeding, postoperative drainage, length of stay), thyroid function (serum calcium, parathyroid hormone), prognostic survival, and related factors affecting patient prognosis.

Statistical Methods

Data analysis was performed using SPSS 24.0 software, and statistical significance was set at $P < .05$. The frequency of categorical data was presented as [n (%)] and compared using the chi-square test. Continuous data were expressed as mean $\pm$ standard deviation (SD) and compared using independent samples t test, one-way ANOVA, and LSD post hoc test. Kaplan-Meier method was used to calculate survival rates, and the log-rank test was used to compare survival

rates. Logistic regression analysis was used to identify factors associated with prognostic recurrence.

RESULTS

Comparison of Clinical Baseline Data

To ensure the reliability of the experimental results, we compared the clinical baseline data of both groups of patients. It was found that there were no statistically significant differences in age and gender between groups ($P > .05$, Table 1), suggesting that both groups were comparable.

Comparison of Clinical Efficacy

In the research group, 60.00% of patients were classified as markedly effective, 20.00% were effective, and 14.00% were ineffective, resulting in a total treatment efficacy of 92.00%. The total effective rate of the control group was 86.00%. There was no statistically significant difference between the groups' total effective rate of other clinical efficacy ($P > .05$, Table 2).

Comparison of Safety

During the treatment of patients in the control group, adverse reactions such as hoarseness, dysphagia, dyspnea, nerve damage, and numbness in the hands and feet occurred, with an overall incidence of 30.00%. In contrast, only two patients in the research group experienced dysphagia, and 1 case each of hoarseness, dyspnea, and numbness in the hands and feet, resulting in an overall incidence of 12.00%. The incidence of adverse reactions was significantly lower in the research group than in the control group ($P < .05$, Table 3).

Comparison of Surgical Outcomes

The research group had a longer operative time of 118.52 ± 17.45 min compared to 86.04 ± 8.67 min in the control group ($P < .05$, Figure 1A). However, the research group had lower levels of intraoperative bleeding and postoperative drainage, and length of stay, with values of 82.36 ± 9.32 mL, 16.94 ± 4.89 mL, and 6.28 ± 1.31 d, respectively, compared to the control group ($P < .05$, Figure 1B-D).

Comparison of Mental States

There was no statistically significant difference in SAS and SDS scores between the two groups before treatment ($P > .05$). After treatment, the scores decreased in both groups ($P < .05$). The SAS and SDS scores in the research group were 30.24 ± 5.73 and 29.60 ± 8.95 , respectively, showing more significant reductions compared to the control group ($P < .05$, Figure 2A and B).

Table 1. Comparison of Clinical Baseline Data

	Control group (n=50)	Research group (n=50)	t or χ^2	P value
Age	51.44 $\pm$ 6.39	50.14 $\pm$ 8.49	0.901	0.373
Tumor Diameter (cm)	1.67 $\pm$ 0.30	1.72 $\pm$ 0.26	0.582	0.564
BMI (kg/m ²)	22.22 $\pm$ 4.01	22.52 $\pm$ 3.65	0.572	0.570
Gender			-	-
Male	4 (8.00)	8 (10.00)		
Female	42 (90.00)	42 (90.00)		
Tumor Type			1.042	.307
Papillary	47 (94.00)	49 (98.00)		
Follicular	3 (6.00)	2 (2.00)		
Pathological Stage			1.010	.315
Stage I-II	49 (95.00)	50 (100.00)		
Stage III-IV	1 (5.00)	0 (0.0)		
Degree of Differentiation			-	-
Low Differentiation	0 (0.0)	0 (0.0)		
Moderately/Highly Differentiated	50 (100.00)	50 (100.00)		
Lymph Node Metastasis			0.508	.476
Yes	5 (10.00)	6 (12.00)		
No	45 (90.00)	44 (88.00)		
Smoking			1.099	.295
Yes	3 (6.00)	6 (12.00)		
No	47 (94.00)	44 (88.00)		
Family History of Disease			0.102	.749
Yes	6 (12.00)	5 (10.00)		
No	44 (88.00)	45 (90.00)		
Place of Residence			0.480	.488
Urban	39 (78.00)	36 (72.00)		
Rural	11 (22.00)	14 (28.00)		
Ethnicity			3.093	.079
Han Chinese	47 (94.00)	50 (100.00)		
Ethnic Minority	3 (6.00)	0 (0.0)		

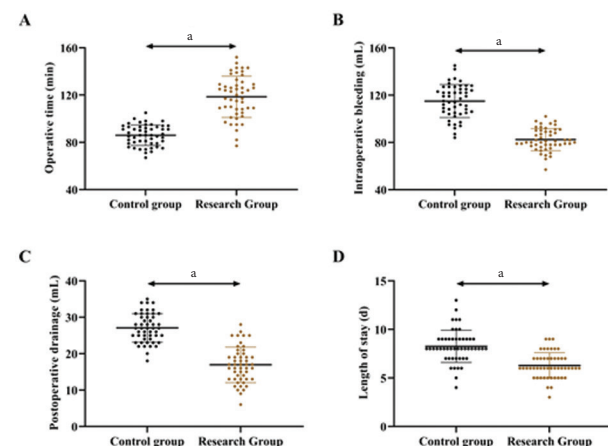
Table 2. Clinical Efficacy of Patients in Both Groups

	Clinically effective	Effective	Ineffective	Total Effective Rate (%)
Control group (n = 50)	36 (72.00)	10 (20.00)	4 (8.00)	86.00
Research group (n = 50)	30 (60.00)	13 (26.00)	7 (14.00)	92.00
χ^2				0.919
P value				.338

Table 3. Incidence of Adverse Reactions in Both Groups

	Hoarseness	Dysphagia	Dyspnea	Nerve Damage	Numbness	An overall incidence (%)
Control group (n = 50)	4 (8.00)	4 (8.00)	2 (4.00)	3 (6.00)	2 (4.00)	30.00
Research group (n = 50)	1 (2.00)	2 (4.00)	1 (2.00)	0 (0.0)	1 (2.00)	12.00
χ^2						4.882
P value						.027

Figure 1. Comparison of surgical situations. (A) comparison of operative time between the two groups. (B) comparison of intraoperative bleeding between the two groups. (C) comparison of postoperative drainage between the two groups. (D) Comparison of length of stay between the two groups.



^a $P < .05$

Comparison of Parathyroid Function and Serum Calcium

There were no statistically significant differences in serum calcium and parathyroid hormone levels between the two groups at T_0 and T_2 ($P > .05$). However, at T_1 , the results of serum calcium and parathyroid hormone tests in the research group were 0.98 ± 0.08 mmol/L and 8.20 ± 0.34 mmol/L, respectively, which were higher than those in the control group ($P < .05$). Additionally, both groups showed lower serum calcium and parathyroid hormone levels at T_1 and higher levels at T_2 than T_0 ($P < .05$, Figure 3A and B).

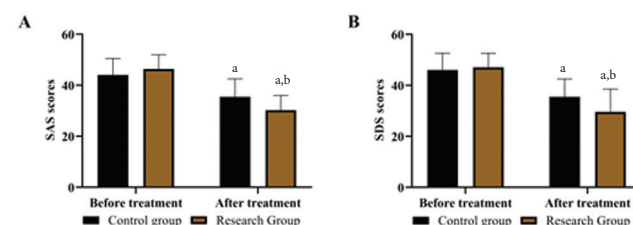
Comparison of Prognosis

At the prognostic follow-up, 47 cases in the research group and 45 in the control group were successfully followed up. The recurrence rate in the control group was 11.11%, which was higher than that in the research group (1.0%) ($P < .05$, Figure 4A). However, the overall survival rate of 90% in the research group was not significantly different from that in the control group ($P > .05$, Figure 4B) during the follow-up period.

Analysis of Factors Associated with Patient Prognosis for Recurrence

A logistic regression analysis was conducted with the prognostic recurrence of patients as covariates and the other observed indicators mentioned above as dependent variables for both groups of patients. The analysis revealed that information such as BMI, gender, and smoking were not independent factors affecting prognostic recurrence. However, age and surgical modality were independent factors affecting the prognosis of recurrence in TC patients ($P < .05$, Table 4).

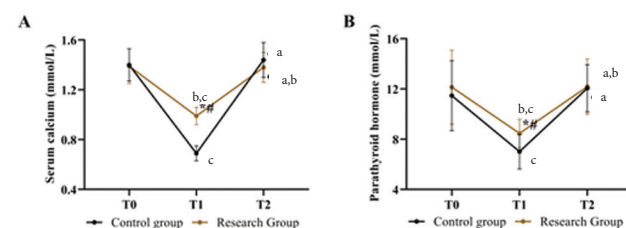
Figure 2. Comparison of mental states. (A) comparison of SAS scores. (B) comparison of SDS scores.



^aIndicates comparison with before treatment $P < .05$

^bIndicates comparison with control group $P < .05$

Figure 3. Comparison of parathyroid function and serum calcium. (A) comparison of serum calcium. (B) comparison of parathyroid hormone.



^aIndicates comparison with T_0 $P < .05$

^bIndicates comparison with T_2 $P < .05$

^cIndicates comparison with control group $P < .05$

Figure 4. Comparison of prognosis. (A) comparison of recurrence rate. (B) comparison of overall survival rate.

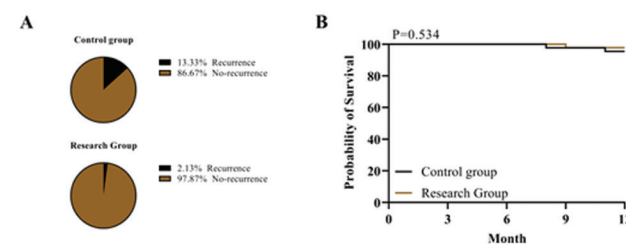


Table 4. Analysis of Factors Associated with Patient Prognosis for Recurrence.

	Single Factor Analysis			Multi-factor analysis		
	HR	95%CI	P value	OR	95%CI	P value
Age	1.19	1.34-4.74	.027	1.27	0.77-2.14	.486
Tumor Diameter	0.44	0.07-2.72	.012	1.46	0.34-2.81	.087
Bmi	1.44	0.62-4.16	.634	-	-	-
Gender	1.84	0.89-41.06	.255	-	-	-
Tumor Type	2.18	1.87-12.63	.004	2.41	1.64-10.62	.134
Pathological Stage	2.77	0.94-4.62	<.001	1.58	0.44-3.60	<.001
Degree Of Differentiation	0.54	0.24-2.86	.012	0.84	0.31-3.59	<.001
Lymph Node Metastasis	1.54	0.06-4.63	<.001	1.30	0.70-2.62	<.001
Smoking	5.42	1.76-45.63	.642	-	-	-
Family History Of Disease	1.69	0.44-4.24	.421	-	-	-
Place Of Residence	0.64	0.14-0.62	.241	-	-	-
Ethnicity	2.84	0.98-8.11	.527	-	-	-
Surgical Method	4.16	3.84-11.89	.012	2.66	1.13-10.42	.012

DISCUSSION

TC is a common malignancy that threatens patients' lives and health, and timely, effective, and accurate treatment is crucial for protecting their prognosis.¹⁵ TC radical surgery is the most direct and effective method for treating TC in clinical practice, and it has long been a focus of clinical research.¹⁵ Since patients' prognosis is closely related to the procedure, the continuous optimization and adjustment of the radical surgery process and protocol is one of the key aspects determining the procedure's outcome.¹⁵ Currently, the effectiveness of lumpectomy radical surgery with a thoracic breast approach in TC has been demonstrated,¹⁶ and the resection of tumor lesions by an ultrasonic knife can theoretically further enhance the effectiveness of tumor resection and hemostasis.¹⁷ Therefore, this study analyzed the treatment effects of lumpectomy radical surgery with a modified thoracic breast approach versus conventional radical surgery for TC and investigated the relevant factors affecting patients' survival prognosis, which will help future clinics better understand TC and optimize treatment services to improve patients' prognosis.

In this study, we compared the clinical efficacy and safety of both groups of patients. The results showed no significant difference in the treatment efficiency between the two groups, indicating that our modified thoracic breast approach lumpectomy and open radical surgery have similar treatment outcomes for TC. However, the incidence of adverse events was lower in the research group than in the control group, indicating that our modified thoracic breast access lumpectomy has a higher safety profile. Thyroid lumpectomy is currently one of the mainstream options for TC treatment, with advantages such as facilitating postoperative recovery and suppressing adverse effects.^{18,19} Traditional open surgery can leave a significant scar on patients' necks after radical TC surgery, which can negatively impact their psychology, especially for female patients.²⁰

The modified thoracic breast approach lumpectomy can improve patients' postoperative psychology by reducing the area of the free flap and shortening their recovery period through less surgical trauma. The subsequent comparison of intraoperative bleeding, postoperative drainage, LOS, and SAS and SDS scores in the two groups confirmed it. Previous studies have indicated that thoracic breast approach lumpectomy is less damaging to the superficial subcutaneous nerves and allows the treating surgeon greater operative space.²¹ The use of an ultrasonic knife can achieve rapid hemostasis when cutting vascular tissue, reduce damage to nerves and muscles, and further improve surgery safety.²² Jie L et al. noted that thoracic breast approach lumpectomy has a higher safety profile for treating TC,²³ which supports the results of our study. However, the longer operative time in the research group than in the control group may be due to the more complex surgical procedure of the thoracic breast approach lumpectomy.

The decrease in parathyroid hormone and serum calcium levels before and after treatment indicated that the invasive

surgical operation significantly damaged the thyroid function in both groups after treatment.²⁴ However, the fact that the levels of parathyroid hormone and serum calcium were higher in the research group than in the control group further suggests that our modified thoracic breast approach lumpectomy caused less damage to the parathyroid function in TC patients. Additionally, the levels at T₂ were again elevated in both groups, indicating that the postoperative stress trauma of thyroid function had largely stabilized in both groups, showing a trend consistent with the preoperative period.

We found no difference in prognostic survival between the two groups during the prognostic follow-up. However, the patients in the research group had a lower prognostic recurrence rate, tentatively suggesting that our two surgical approaches have more stable results and that the modified thoracic breast approach lumpectomy for radical TC has a more reliable prognosis for patients. Logistic regression analysis found that the surgical approach was an independent factor affecting the prognostic recurrence of patients, further illustrating the positive effect of modified thoracic breast approach lumpectomy for radical TC on their prognosis. The reason for this finding may also be related to our belief that modified thoracic breast approach lumpectomy for radical TC is less invasive and more complete for patients.

In this study, it was observed that factors closely related to TC progression, such as pathological stage, degree of differentiation, and lymph node metastasis, were not factors affecting the prognosis of patients with recurrence, which is inconsistent with the results of previous studies.^{25,26} We speculate that this may be due to statistical analysis chance caused by the small number of cases included in this study and all early-stage patients. Therefore, we plan to expand the number of study cases for confirmatory analysis as soon as possible.

It is important to note that there are currently no established clinical guidelines for lumpectomy radical surgery with a modified thoracic breast approach; there remains the potential for further refinement in the specific implementation steps of the procedure. Therefore, it is imperative for clinical staff to continually review and analyze their surgical experience to optimize the process. Additionally, as previously stated, there is a need to increase the study's sample size and extend the trial's duration to evaluate the efficacy of modified thoracic breast approach lumpectomy more thoroughly in treating TC patients. Furthermore, we plan to compare the clinical application effects of lumpectomy radical surgery for various surgical approaches to determine the most suitable protocol for TC treatment and provide a comprehensive and detailed clinical reference for practitioners.

Study Limitations

It is important to note that this study has some limitations. Firstly, the sample size was relatively small, which may affect the generalizability of the results.

Additionally, there was a lack of long-term follow-up data, and the study only included patients with early-stage TC. Finally, as with any surgical technique, there is a learning curve for surgeons, and the results may vary depending on their level of expertise.

CONCLUSION

The modified thoracic approach lumpectomy represents an upgrade from the traditional thoracic approach lumpectomy, requiring a smaller operating space and higher technical proficiency from the operator. Despite its technical challenges, the modified approach reduces trauma and faster patient postoperative recovery, making it a promising technique for treating TC. Furthermore, its safety profile ensures that patients' thyroid function is effectively preserved and the possibility of recurrence in their prognosis is reduced. Therefore, we recommend the promotion of this flap in clinical practice, given its significant potential to improve the treatment of TC patients.

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CONFLICT OF INTEREST

The authors reported no potential conflict of interest.

REFERENCES

1. Baloch ZW, Asa SL, Barletta JA, et al. Overview of the 2022 WHO Classification of Thyroid Neoplasms. *Endocr Pathol*. 2022;33(1):27-63. doi:10.1007/s12022-022-09707-3
2. Ibrahimipasic T, Ghossein R, Shah JR, Ganly L. Poorly Differentiated Carcinoma of the Thyroid Gland: Current Status and Future Prospects. *Thyroid*. 2019;29(3):311-321. doi:10.1089/thy.2018.0509
3. Kim M, Kim BH. Current Guidelines for Management of Medullary Thyroid Carcinoma. *Endocrinol Metab (Seoul)*. 2021;36(3):514-524. doi:10.3803/EnM.2021.1082
4. Hirokawa M, Higuchi M, Suzuki A, Hayashi T, Kuma S, Miyauchi A. Papillary Thyroid Carcinoma with Honeycomb-Like Growth: Clinicopathological Characteristics and Diagnostic Significance as a Novel Variant. *Pathobiology*. 2022;89(2):107-115. doi:10.1159/000520165
5. Araque KA, Gubbi S, Klubo-Gwiedzinska J. Updates on the Management of Thyroid Cancer. *Horm Metab Res*. 2020;52(8):562-577. doi:10.1055/a-1089-7870
6. Deeken-Draisey A, Yang GY, Gao J, Alexiev BA. Anaplastic thyroid carcinoma: an epidemiologic, histologic, immunohistochemical, and molecular single-institution study. *Hum Pathol*. 2018;82:140-148. doi:10.1016/j.humpath.2018.07.027
7. Sanabria A, Pinillos P, Lira RB, et al. Current therapeutic options for low-risk papillary thyroid carcinoma: scoping evidence review. *Head Neck*. 2022;44(1):226-237. doi:10.1002/hed.26883
8. Seib CD, Sosa JA. Evolving Understanding of the Epidemiology of Thyroid Cancer. *Endocrinol Metab Clin North Am*. 2019;48(1):23-35. doi:10.1016/j.eccl.2018.10.002
9. Filho JG, Kowalski LP. Postoperative complications of thyroidectomy for differentiated thyroid carcinoma. *Am J Otolaryngol*. 2004;25(4):225-230. doi:10.1016/j.amjoto.2004.02.001
10. Sun JL, Xing SY. Short-term outcome of laparoscopic surgery versus open surgery on colon carcinoma: A meta-analysis. *Math Biosci Eng*. 2019;16(5):4645-4659. doi:10.3934/mbe.2019233
11. Bible KC, Kebebew E, Brierley J, et al. 2021 American Thyroid Association Guidelines for Management of Patients with Anaplastic Thyroid Cancer. *Thyroid*. 2021;31(3):337-386. doi:10.1089/thy.2020.0944
12. Filetti S, Durante C, Hartl D, et al; ESMO Guidelines Committee. Electronic address: clinicalguidelines@esmo.org. Thyroid cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol*. 2019;30(12):1856-1883. doi:10.1093/annonc/mdz400
13. Nabhan F, Dedhia PH, Ringel MD. Thyroid cancer, recent advances in diagnosis and therapy. *Int J Cancer*. 2021;149(5):984-992. doi:10.1002/ijc.33690
14. Lv J, Zhu L, Wu X, Yue H, Cui X. Study on the correlation between postoperative mental flexibility, negative emotions, and quality of life in patients with thyroid cancer. *Gland Surg*. 2021;10(8):2471-2476. doi:10.21037/gs-21-424
15. Asa SL. The Current Histologic Classification of Thyroid Cancer. *Endocrinol Metab Clin North Am*. 2019;48(1):1-22. doi:10.1016/j.eccl.2018.10.001
16. Fei Y, Li Y, Chen F, Tian W. Intraoperative neuromonitoring of the recurrent laryngeal nerve is indispensable during complete endoscopic radical resection of thyroid cancer: A retrospective study. *Laryngoscope Invest Otolaryngol*. 2022;7(4):1217-1223. doi:10.1002/lio2.822
17. Fraga TS, Köhler HF, Chulam TC, Kowalski LP. Impact of scalp type on operative time and acute complications in thyroidectomies. *Rev Bras Otorrinolaringol (Engl Ed)*. 2021;87(2):205-209.
18. Chen Z, Dong HH, Ye Z. [The influence on the function of parathyroid after different thyroid cancer radical operation]. *Lin Chuang Er Bi Yan Hou Tou Jing Wai Ke Za Zhi*. 2016;30(15):1232-1235.
19. Hermann M, Gschwandtner E, Schneider M, Handgriff L, Prommegger R. [Modern thyroid surgery - the surgeon's endocrine-surgical understanding and his responsibility for the extent of surgery and complication rate]. *Wien Med Wochenschr*. 2020;170(15-16):379-391. doi:10.1007/s10354-020-00750-5
20. Noto B, Asmus I, Schäfers M, Görlich D, Riemann B. Predictors of Anxiety and Depression in Differentiated Thyroid Cancer Survivors: Results of a Cross-Sectional Study. *Thyroid*. 2022;32(9):1077-1085. doi:10.1089/thy.2022.0067

21. Liu P, Zhang Y, Qi X, et al. Unilateral Axilla-Bilateral Areola Approach for Thyroidectomy by da Vinci Robot: 500 Cases Treated by the Same Surgeon. *J Cancer*. 2019;10(16):3851-3859. doi:10.7150/jca.31463
22. De Palma M, Rosato L, Zingone F, et al. Post-thyroidectomy complications. The role of the device: bipolar vs ultrasonic device: Collection of data from 1,846 consecutive patients undergoing thyroidectomy. *Am J Surg*. 2016;212(1):116-121. doi:10.1016/j.amjsurg.2015.05.024
23. Jie L, Meng W. Thoracoscopy-assisted treatment for mediastinal metastasis of thyroid cancer: a case report. *J Int Med Res*. 2022;50(3):3000605221078409. doi:10.1177/03000605221078409
24. Kawai H, Sugimoto R, Iga N, et al. [A Case of Mediastinal Dissection by Video-Assisted Thoracoscopic Surgery (VATS) in a Patient with Mediastinal Nodal Recurrence from Thyroid Carcinoma after Primary Surgery via Median Sternotomy]. *Gan To Kagaku Ryoho*. 2016;43(12):2130-2132.
25. Grønlund MP, Jensen JS, Hahn CH, Grønhoj C, Buchwald CV. Risk Factors for Recurrence of Follicular Thyroid Cancer: A Systematic Review. *Thyroid*. 2021;31(10):1523-1530. doi:10.1089/thy.2020.0921
26. Nieto HR, Thornton CEM, Brookes K, et al. Recurrence of Papillary Thyroid Cancer: A Systematic Appraisal of Risk Factors. *J Clin Endocrinol Metab*. 2022;107(5):1392-1406. doi:10.1210/clinem/dgab836