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Comparison of endoscopic and open surgical approaches in reoperative thyroid surgery

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Abstract: *To investigate the feasibility and efficacy of endoscopic surgery in reoperative thyroid surgery. A retrospective analysis was conducted on the clinical data of 94 patients who underwent reoperative thyroid surgery at our hospital and the First Affiliated Hospital of Jinan University from January 2018 to June 2023. Among them, 41 patients underwent endoscopic surgery via a complete areola approach, and 53 patients underwent open surgery. The two groups were compared in terms of operative time, intraoperative blood loss, drainage volume, drainage time, hospital stay, pain scores, cosmetic satisfaction, and complications. Compared with the open surgery group, the endoscopic group had less intraoperative blood loss [(5.9 ± 2.3) ml vs. (16.5 ± 9.4) ml, t = -7.90, P = 0.000] and higher postoperative cosmetic satisfaction [(2.9 ±0.4) points vs. (1.8 ±0.8) points, t = -7.802, P = 0.000]. The two groups were followed up for (31.4 ±8.5) months and (32.5 ±10.9) months, respectively (t = 0.526, P = 0.600). There were no significant differences in operative time, drainage volume, drainage time, hospital stay, or pain scores between the two groups [(112.1 ± 24.3) min vs. (120.9 ± 26.0) min, t = -1.680, P = 0.096; (91.8 ±16.6) ml vs. (97.4 ±17.0) ml, t = -1.610, P = 0.111; (69.2 ±19.0) h vs. (75.8 ±20.4) h, t = -1.604, P = 0.112; (5.7 ±1.8) d vs. (6.0 ±1.7) d, t = -0.869, P = 0.387; (3.8 ±2.2) points vs. (4.4 ±2.0) points, t = -1.352, P = 0.180]. Endoscopic surgery is a safe and effective approach for reoperative thyroid surgery. Compared with open surgery, it offers better cosmetic outcomes and reduces intraoperative blood loss.*

Keywords: *Reoperative thyroid surgery; Complete areola approach; Endoscopic surgery; Open surgery*

1. Introduction

The incidence of thyroid cancer has been increasing year by year, with differentiated thyroid cancer being the most common type. Surgery remains the primary treatment method [1, 2]. Whether to perform surgery for benign thyroid diseases depends mainly on the characteristics of the disease itself, and there is controversy regarding the extent of surgery. Irregularities in thyroid surgery or diagnostic deviations inevitably lead to disease recurrence or persistence, and some patients require reoperation. Reoperative thyroid surgery not only increases the difficulty of the operation but also raises the risk of postoperative complications, mainly due to scarring, edema, and anatomical changes caused by the initial surgery [3, 4]. In the choice of surgical approach for reoperative thyroid surgery, most centers still prefer open surgery, while endoscopic surgery is considered relatively or absolutely contraindicated. With the development of endoscopic instruments and the accumulation of experience in endoscopic surgery, it is worth exploring whether endoscopic techniques can achieve the same efficacy as open surgery in reoperative thyroid surgery. This study retrospectively analyzed the clinical data of 94 cases of reoperative thyroid surgery at our hospital and the First Affiliated Hospital of Jinan University from January 2018 to June 2023, including 41 cases of endoscopic surgery and 53 cases of open surgery, to explore the feasibility and efficacy of endoscopic surgery in reoperative thyroid surgery.

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2. Clinical Data and Methods

2.1 General Data

Patients who underwent reoperative thyroid surgery between January 2018 and June 2023 were selected as the study subjects. All patients were confirmed to have recurrent or persistent thyroid disease by ultrasound or CT before surgery. Inclusion criteria: ① Voluntary choice of endoscopic surgery with no or only mild neck scarring; ② Recurrent or persistent benign thyroid nodules with a diameter of 2-4 cm; ③ Recurrent or persistent differentiated thyroid cancer without cervical lymph node metastasis; ④ Recurrent or persistent hyperthyroidism < grade II; ⑤ Preoperative assessment indicating clear boundaries and mild adhesion of residual thyroid tissue. Exclusion criteria: ① Significant neck scarring; ② Benign thyroid nodules with a diameter > 4 cm; ③ Differentiated thyroid cancer with cervical lymph node metastasis; ④ Grade III hyperthyroidism; ⑤ Substernal goiter; ⑥ Preoperative assessment indicating unclear boundaries and severe adhesion of residual thyroid tissue; ⑦ Severe cardiovascular or pulmonary diseases and coagulation disorders. A total of 94 cases meeting the criteria were included and divided into two groups: 41 cases in the endoscopic group and 53 cases in the open group. There were no significant differences in general data and surgical approach between the two groups (P > 0.05), as shown in Table 1-2.

Table 1 Comparison of General Data Between the Two Groups

Group	Age (years)	Gender		Nodule Diameter (cm)	Disease Duration (months)	Comorbidities
		Male	Female			
Endoscopic Group (n=41)	49.8 ±9.1	5	36	2.4 ±0.43	113.9 ±52.2	6
Open Surgery Group (n=53)	50.8 ±8.2	4	49	2.5 ±0.38	123.8 ±41.2	8
t(χ2)	*T*=−0.59	χ2=0.165		*t*=−0.59	t=-1.23	χ2=0.000
P value	0.559	0.690		0.358	0.221	1.000

Table 2 Comparison of Surgical Approach Between the Two Groups

Group	Surgical Approach				
	Subtotal Resection	Near-Total Resection	lobectomy	Total Resection	Total Resection + Central Lymph Node Dissection
Endoscopic Group (n=41)	10	15	7	6	3
Open Surgery Group (n=53)	14	18	9	8	4
χ2 value			χ2=0.087		
P value			0.999		

Comorbidities include hypertension, diabetes, coronary heart disease, emphysema, etc.

2.2 Methods

2.2.1 Endoscopic Group

General anesthesia with tracheal intubation was administered. The patient was placed in a supine position with legs apart and the head slightly tilted back. The monitor was placed on the left side of the patient's head, and the surgeon stood between the patient's legs. A complete areola approach was used for endoscopic surgery, with the method and extent of anterior cervical flap separation consistent with previous reports [5]. The ultrasonic scalpel was used to make a longitudinal incision 1-2 cm below the original cervical midline incision. A combination of blunt and sharp dissection was used to separate the adhesions between the residual gland and the infrahyoid muscles. The sternohyoid muscle was suspended and retracted with sutures. If the thyroid isthmus was present, it was transected at the middle of the trachea. Then, the residual gland was separated using forceps or a suction device, following the principle of separating lightly adhered areas first and then heavily adhered areas. Depending on whether the residual gland had blood vessels, they were coagulated and cut using the ultrasonic scalpel. Throughout the procedure, the decision to expose the recurrent laryngeal nerve was based on the patient's specific condition. For benign thyroid diseases, if a small amount of normal dorsal thyroid tissue could be preserved, the recurrent laryngeal nerve was not exposed. For patients requiring

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exposure of the recurrent laryngeal nerve, it was identified below the neck and carefully traced to avoid injury.

2.2.2 Open Group

General anesthesia with tracheal intubation was administered. The patient was placed in a supine position with the shoulders elevated. For patients who had undergone open surgery initially, the original surgical incision was used. For patients who had undergone endoscopic surgery initially, a small incision was made 2 cm above the sternal notch, extending laterally as needed during the procedure. The surgical principles and precautions were the same as in the endoscopic group.

2.3 Observation Indicators

① Perioperative indicators: operative time, intraoperative blood loss, drainage volume, drainage time, and hospital stay. ② Postoperative pain: assessed on the first postoperative day using the Numerical Rating Scale (NRS), where 0 indicates no pain and 10 indicates unbearable severe pain. ③ Postoperative complications: including temporary or permanent recurrent laryngeal nerve injury, temporary or permanent superior laryngeal nerve injury, temporary or permanent hypocalcemia, neck discomfort, and wound effusion. ④ Postoperative cosmetic satisfaction: 1 = dissatisfied, 2 = satisfied, 3 = very satisfied. ⑤ Follow-up: outpatient follow-up for 2 years, with thyroid function and thyroid ultrasound reviewed every 3 months.

2.4 Statistical Methods

SPSS 13.0 statistical software was used for data analysis. Normally distributed measurement data were expressed as mean ± standard deviation, and comparisons between the two groups were performed using independent samples t-tests. Count data were compared using chi-square tests. $P < 0.05$ was considered statistically significant.

3. Results

Both groups successfully completed the surgery. The endoscopic group had significantly less intraoperative blood loss and higher postoperative cosmetic satisfaction compared to the open group ($P < 0.05$). There were no significant differences in operative time, drainage volume, drainage time, hospital stay, postoperative pain, or postoperative complications between the two groups ($P < 0.05$), as shown in Table 3. There were no significant differences in postoperative pathological results or complication rates between the two groups (19.5% vs. 28.3%, $\chi ^2 = 0.966$, $P = 0.326$), as shown in Table 4. The most common complication in the endoscopic group was neck discomfort, with an incidence of 7.3% (3/41), while the most common complications in the open group were temporary hypocalcemia and temporary recurrent laryngeal nerve injury, with incidences of 9.4% (5/53) and 9.4% (5/53), respectively, as shown in Table 5. Temporary hypocalcemia occurred in 2 cases in the endoscopic group (resolved within 1 month) and 5 cases in the open group (resolved within 1-3 months). Temporary recurrent laryngeal nerve injury occurred in 1 case in the endoscopic group (resolved within 1-2 months) and 5 cases in the open group (2 cases improved after 2 months, all resolved within 3-6 months). Permanent recurrent laryngeal nerve injury occurred in 1 case in the open group. Neck discomfort occurred in 3 cases in the endoscopic group (all improved within 3-6 months, with 2 cases resolved and 1 case alleviated) and 2 cases in the open group (resolved within 3-6 months). Wound effusion occurred in 2 cases in each group (both treated with puncture and drainage).

The endoscopic group was followed up for (41.4 ± 8.5) months, and the open group was followed up for (42.5 ± 10.9) months, with no significant difference in follow-up time between the two groups ($t = -0.526$, $P = 0.60$). Postoperative thyroid ultrasound showed no recurrence, and thyroid function was maintained within normal limits using levothyroxine.

Table 3 Comparison of Observed Indicators Between the Two Groups

Group	Operation Time (min)	Blood Loss (ml)	Drainage Volume (ml)	Drainage Time (h)	Hospital Stay (d)	Pain Score (points)	Cosmetic Satisfaction (points)	Follow-up (months)
Endoscopic Group (n = 41)	112.1 ± 24.3	5.9 ±2.3	91.8 ±16.6	69.2 ±19.0	5.7 ±1.8	3.8 ±2.2	2.9 ±0.4	41.4 ±8.5
Open Surgery Group (n = 53)	120.9 ± 26.0	16.5 ±9.4	97.4 ±17.0	75.8 ±20.4	6.0 ±1.7	4.4 ±2.0	1.8 ±0.8	42.5 ±10.9
t-value	t = -1.680	t = -7.90	t = -1.61	t = -1.604	t = -0.869	t = -1.352	t = -7.802	t = -0.526
P-value	0.096	0.000	0.111	0.112	0.387	0.180	0.000	0.600

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Table 4 Comparison of Postoperative Pathology Between the Two Groups

Group	Nodular Goiter	Thyroid Adenoma	Hyperthyroidism	Papillary Thyroid Carcinoma
Endoscopic Group (n = 41)	28	5	5	3
Open Surgery Group (n = 53)	39	4	6	4
χ^2-value		$\chi^2 = 0.63$		
P-value		0.890		

Table 5 Comparison of Postoperative Complication Between the Two Groups

Group	Total (%)	Transient Hypocalcemia (%)	Permanent Hypocalcemia (%)	Transient Recurrent Laryngeal Nerve Injury (%)	Permanent Recurrent Laryngeal Nerve Injury (%)	Neck Discomfort (%)	Seroma (%)
Endoscopic Group (n = 41)	8 (19.5)	2 (4.9)	0 (0)	1 (2.4)	0 (0)	3 (7.3)	2 (4.9)
Open Surgery Group (n = 53)	15 (28.3)	5 (9.4)	0 (0)	5 (9.4)	1 (1.9)	2 (3.8)	2 (3.8)
χ^2-value	$\chi^2 = 0.966$	$\chi^2 = 0.192$	-	$\chi^2 = 0.903$	$\chi^2 = 0.000$	$\chi^2 = 0.087$	$\chi^2 = 0.000$
P-value	0.326	0.661	-	0.342	1.000	0.767	1.000

4. Discussion

With the increasing awareness of health and the popularity of health check-ups, more and more people are being diagnosed with thyroid lesions. Approximately 50% of people are found to have various nodular lesions in the thyroid [6], and a significant portion of them require surgical treatment. Currently, the main surgical approaches for thyroidectomy are traditional open surgery and endoscopic surgery. Endoscopic surgery has been widely adopted in many centers in China and is more popular among younger patients compared to open surgery. Reoperative thyroid surgery is an unavoidable topic for surgeons, often due to irregularities in the initial surgery. Inadequate understanding of the disease and lack of surgical expertise during the initial surgery can lead to incomplete resection of diseased tissue, missed lesions, and residual metastatic lymph nodes, resulting in disease recurrence and the need for reoperation. Reoperative thyroid surgery is more challenging and carries higher risks, with increased complications such as postoperative bleeding, recurrent laryngeal nerve injury, superior laryngeal nerve injury, and hypoparathyroidism compared to initial surgery [3, 4, 7]. The British Association of Endocrine and Thyroid Surgeons reported that the incidence of permanent hypoparathyroidism and permanent recurrent laryngeal nerve palsy in reoperative thyroid surgery is three times and two times higher, respectively, compared to initial surgery [8]. Müller PE et al. [9] reported that the incidence of recurrent laryngeal nerve palsy in reoperative surgery can increase up to five times. Additionally, the complication rate in reoperative thyroid surgery is related to the extent of thyroid tissue removal and the number of reoperations. Patients undergoing bilateral thyroidectomy have a higher complication rate than those undergoing unilateral thyroidectomy, and the complication rate increases with the number of reoperations [10, 11]. Therefore, reoperative thyroid surgery is different from initial surgery and requires more caution and meticulousness from the surgeon to reduce complications.

Currently, open surgery is the primary approach for reoperative thyroid surgery. Whether endoscopic surgery can achieve the same efficacy as open surgery is worth exploring. The results of this study show that there are no significant differences in operative time, drainage volume, drainage time, postoperative pain, or postoperative complications between the endoscopic and open surgery groups. Moreover, the overall complication rate is lower in the endoscopic group. We found that the endoscopic group had less intraoperative blood loss and better postoperative cosmetic outcomes compared to the open group. Therefore, with strict case selection, endoscopic surgery is a safe and feasible approach for reoperative thyroid surgery. However, the following points should be noted during the procedure: ① The surgeon must have extensive experience in open surgery and proficient endoscopic surgical skills; ② Precise operation is essential, and the ultrasonic scalpel should be used to grasp small amounts of tissue intermittently to avoid accidental injury and thermal damage [12]; ③ Adhesions between the residual gland and the infrahyoid muscles should be separated using a

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combination of blunt and sharp dissection. Once the adhesions are sufficiently separated, sutures can be used to suspend and retract the infrahyoid muscles to provide a clear surgical field and further separate the adhesions; ④ The decision to expose the recurrent laryngeal nerve should be based on the extent of the glandular lesion. For benign diseases, a small amount of normal dorsal thyroid tissue can be preserved, and the recurrent laryngeal nerve does not need to be exposed. When full exposure of the recurrent laryngeal nerve is required, the residual gland should be retracted upward and medially, and the residual gland should be removed close to the glandular capsule to avoid cutting the fibrous bands perpendicular to the trachea, which could damage the recurrent laryngeal nerve; ⑤ The superior parathyroid gland can be separated from the upper pole of the thyroid after dividing the Berry ligament and is easier to identify. The inferior parathyroid gland is more susceptible to damage due to scar adhesion. Therefore, the surgical specimen should be routinely checked, and if the parathyroid gland is accidentally removed, it should be immediately transplanted; ⑥ In some patients, the thyroid tissue may be displaced from its normal anatomical position due to scar tissue traction, and intraoperative ultrasound may be used for localization if necessary.

With strict adherence to surgical indications and thorough patient evaluation, endoscopic surgery is safe and feasible for reoperative thyroid surgery. Compared to open surgery, the magnified view provided by endoscopy allows for clearer identification of tissue structures, enabling more precise operations, resulting in less intraoperative blood loss and higher patient satisfaction with cosmetic outcomes.

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