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Minimally Invasive Technique for Thyroidectomy ; A Modification of the Conventional Thyoidectomy Technique

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최소침습 갑상선 수술법 : 전통적 갑상선 수술법의 변형술식

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=국문초록=

배경 및 목적 :

Theodor Kocher에 의해 일반화된 전통적인 갑상선 수술방법은 갑상선 질환의 종류 및 정도, 수술범위와 상관없이 광범위한 수술범위로 인한 조직 손상으로 인해 수술후 환자들의 여러가지 불편감은 물론 경부의 넓은 부위의 통증과 경부 피부부종, 장액종, 혈종 등과 같은 후유증을 동반할 수 있다. 최근 본 저자들은 이같은 전통적 갑상선 수술의 부작용을 최소화하기 위해 작은 피부절개(3~4.5cm) 후 피하 피판(subplatysmal skin flap) 없이 직접 갑상선으로 접근하는 새로운 수술기법으로서 최소침습 갑상선 수술기법을 개발하였기에 그 술식을 소개하고 전통적인 갑상선 절제술에 대한 우월성을 확인하고자 본 연구를 시행하였다.

대상 및 방법 :

1999년 1월 15일 부터 2000년 1월 14일까지 573예의 갑상선 수술 예 중 최소침습 갑상선절제술이 시행되었던 466예와 1998년 1월 15일부터 1999년 1월 14일까지 전통적 갑상선 수술을 시행한 549예 중 거대 종양(양성> 6cm, 악성>5cm), 흉골하 선종, 국소진행암, 재발암, 측경부의 다발성 림프절 전이가 있었던 112예를 제외한 437예의 임상병리적 특성과 피부절개 길이, 수술 시간, 수술중 출혈양, 수술후 진통제 요구빈도 및 재원기간, 수술후 합병증 발생빈도를 비교 분석하였다.

결 과 :

두 군간의 임상병리적 특성상의 유의한 차이는 없었다. 피부절개 길이(3.7±0.7cm, vs 9.6±3.3cm), 수술 시간(57.6±11.7분 vs 85.2±32.3분), 수술 중 출혈양(18.4±15.3ml vs 43.1±21.8ml), 수술후 재원기간(1.6±0.5일 vs 4.3±1.6일), 및 수술후 진통제 요구빈도가 전통적 수술군에 비해 최소침습 수술군에서 통계적으로 유의하게 감소되었으나($p<0.05$), 수술후 장액종 및 혈종 형성, 일시적인 음색변화, 일시적인 저칼슘혈증과 같은 합병증의 발생빈도는 각각 4.3%(n=20)와 4.8%(n=21)로 두 군간에 유의한 차이가 없었다.

결 론 :

최소침습 갑상선 수술법은 새로운 수술기구의 도입 없이도 갑상선 수술의 충분한 시야를 확보할 수 있고 안전하

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고 간단하게 시행할 수 있으며, 기존 수술법으로 인한 부작용을 최소화할 수 있어 전통적인 수술법을 대치할 수 있는 새로운 방법으로 사료된다.

중심 단어 : 갑상선수술 · 최소 침습법 · 전통적 수술법.

Introduction

In recent years, with the widespread use of imaging studies including ultrasonography, computed tomography, or magnetic resonance imaging, as well as the use of fine-needle-aspiration biopsy in the preoperative evaluation of nodular thyroid disorders, the extent of thyroidectomy can be determined preoperatively in most cases[1)2)]. Moreover, the awareness of prognostic-factor analysis in the management of thyroid cancer patients has made it possible to determine whether a patient is in either a low-risk or a high-risk group and to facilitate the selection of the appropriate extent of thyroidectomy[3)4)]. Although there is some debate regarding the extent of surgery, a large number of low-risk patients have been successfully treated with a conservative approach[5)6)].

The conventional technique for thyroidectomy normally requires a long collar incision, wide skin flaps on the anterior neck, and a long midline opening of the strap muscles to provide exposure of the thyroid glands regardless of the extent of thyroidectomy planned. This conventional approach may cause a wide neck scar in addition to a variety of potential complications related to raising the skin flaps and vertically opening the strap muscles.

We have modified the conventional approach to the thyroid gland, designed to minimize the tissue trauma by obviating unnecessary neck exploration, while maintaining adequate exposure ; we termed this process minimally invasive thyroidectomy.

This report describes the technique of the minimally invasive thyroidectomy and compares the results with the conventional thyroidectomy.

Operative Technique

The patient is placed under general anesthesia in a supine position with the neck extended. A 3.0 to 4.5cm unilateral or central skin incision is made along the skin crease in the lower neck. The selection of skin incision depends on what type of thyroidectomy is planned ; a unilateral incision for unilateral thyroidectomy, and a central incision for bilateral thyroidectomy(Fig. 1).

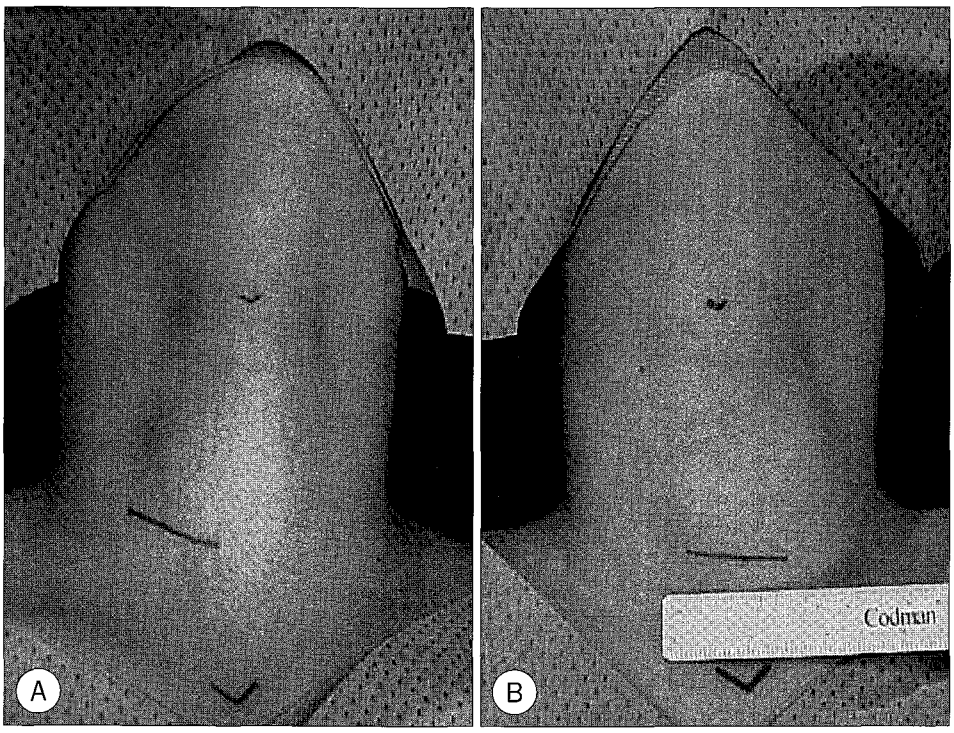

Fig. 1. Unilateral skin incision(a) and central incision(b).

Electrocautery is then used to divide the platysma, the strap muscles and anterior edge of the sternocleidomastoid muscle transversely, exposing the anterior surface of the thyroid. The upper and lower flaps are made beneath the strap muscles to obtain adequate exposure of the diseased thyroid gland(Fig. 2). If the exposure is inadequate, the wound may be extended as necessary. Subsequently, the isthmus is completely freed from the trachea and divided toward the opposite lobe, while the dissection is directed superiorly, exposing the medial margin of the upper pole. By retracting the diseased thyroid inferiorly and medially, the branches of the superior thyroid artery and vein are individually exposed, clamped, divided and ligated as close as possible to the upper pole. With medial rotation of the gland by the first assistant, the middle thyroid vein is divided and ligated. The lymphatic and capsular vessels on the anterior surface of the gland at its lower pole are then dissected, permitting elevation and medial rotation of the lower pole. After full mobilization of the isthmus and the upper and lower pole of the thyroid, the dissected lobe is then delivered out of the wound as a specimen.

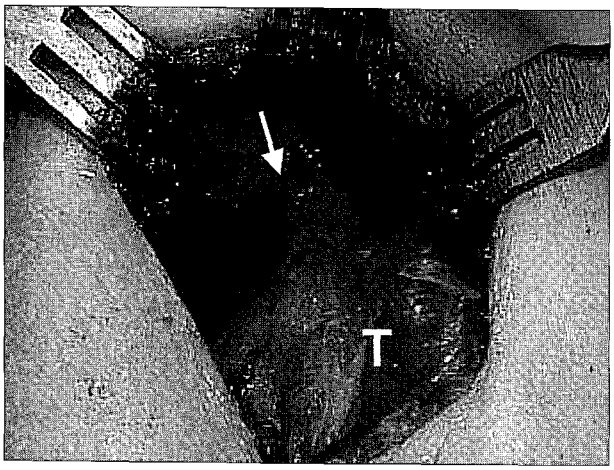

Fig. 2. Exposed upper pole of the ipsilateral thyroid lobe under the flap of strap muscles. Arrow : anterior branch of the superior thyroidal artery ; T : thyroid gland.

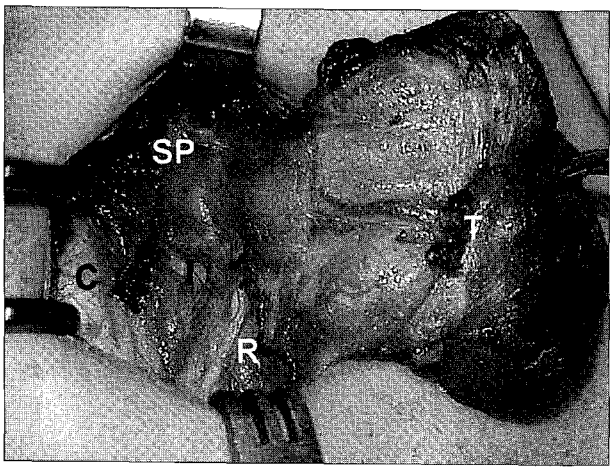

Fig. 3. Wide surgical field of tracheo-esophageal space obtained by anteromedial traction of the ipsilateral lobe outside the wound, and lateral retraction of the lateral wound margin. T : thyroid gland ; SP : superior parathyroid gland ; I : Inferior thyroidal artery ; C : common carotid artery ; R : recurrent laryngeal.

A wide surgical field of tracheo-thyroidal space can be obtained by means of elevation and medial traction of the delivered lobe outside the wound, and by lateral retraction of the wound(Fig. 3). After these steps, the surgical procedures for identifying and preserving the recurrent laryngeal nerve and the parathyroid glands are identical to the conventional surgical technique of thyroidecotomy.

Finally, the dense fascial attachment, the so-called Berry's ligament, is carefully divided under direct vision as the specimen is removed. If the specimen turns out to be malignant on a frozen section, clearance of the central compartment neck nodes may be added at the time of operation. In cases of bilateral disease, a bilateral thyroid resection can be conducted in a similar fashion. However, each lobe should be removed separately through a central skin incision. The strap muscles are reapproximated with interrupted 4-0 vicryl sutures without placing a drain in the wound. The platysma and subcutaneous tissues are reapproximated in a similar fashion and the skin is closed using 5-0 vicryl subcuticular sutures.

Materials and Methods

From January 15, 1999 to January 14, 2000, 573 patients with thyroid nodules were treated surgically at Yonsei University Medical Center. Among these patients, minimally invasive thyroidectomy was employed in 466 patients(81.3%). Conventional thyroidectomy was performed in the remaining 107 patients. This was based on the presence of large(>6cm for benign tumor, >5cm for malignant tumor) or substernal goiter(n=27), Graves' disease(n=25), locally-advanced cancer(n=22), or lateral compartment node involvement that required radical neck dissection(n=33).

To evaluate the merits of the minimally invasive thyroidectomy, the group of 466 patients who underwent minimal-access open thyroidectomy were retrospectively compared to 437 controls selected from the 549 patients who underwent a conventional thyroidectomy between

Table 1. Demographic characteristics : minimally invasive versus conventional thyroidectomy

Variable	Minimally invasive (n=466)	Conventional (n=437)
Age*(years)	43.4±12.7[a]	44.9±16.3
Male to female ratio	54 : 412[b]	56 : 381
Benign to malignant ratio	324 : 142[b]	276 : 161
Tumor size*(cm)		
Benign	4.2±1.5[a]	4.6±1.7
Malignant	2.7±1.4[a]	2.9±1.8
Histology		
Adenomatous goiter	248(53.2%)[b]	196(44.8%)
Follicular adeoma	64(13.7%)[b]	71(16.2%)
Hurthle cell tumor	2(0.4%)[b]	3(0.7%)
Thyroiditis		
Subacute	3(0.6%)[b]	2(0.4%)
Hashimoto's	7(1.5%)[b]	4(0.8%)
Papillary carcinoma	134(28.8%)[b]	150(34.3%)
Follicular carcinoma	5(1.1%)[b]	8(1.8%)
Malignant lymphoma	3(0.6%)[b]	3(0.7%)

* : Mean±SEM
a : $p>0.05$ versus conventional group(t-test)
b : $p>0.05$ versus conventional group(Chi-square test)

January 15, 1998 and January 14, 1999. To avoid possible bias, patients with a large(>6cm for benign tumor, >5cm for malignant tumor) or substernal goiter(n=29), Graves' disease(n=19), locally-advanced cancer(n=35), or lateral compartment node involvement(n=29) were excluded from the study.

All procedures were performed by the same experienced surgeon.

The variables evaluated were the length of skin incision, operating time, amount of blood loss, length of postoperative hospital stay, pain medication requirements, requirements of wound drains and various surgical complications.

Statistical analysis of the data was performed using the standard t-test and Chi-square test. A p- value of less than 0.05 was considered significant.

Results

The demographic characteristics of the minimally invasive thyroidectomy group compared with the conventional thyroidectomy group are presented in Table 1. The two groups were well matched with respect to age, sex, tumor size and histologic findings. There were no conversions to a conventional thyroidectomy in the minimal invasive thyroidectomy group.

Table 2. Extent of thyroid resection

	Minimally invasive (n=466)	Conventional (n=437)
Lobectomy	249(54.5%)*	226(51.5%)
Subtotal thyroidectomy	152(32.6%)*	134(30.7%)
Total thyroidectomy	65(13.9%)*	78(17.8%)

* : $p>0.05$ versus conventional group(Chi-square test)

Table 3. Comparison of minimally invasive and conventional thyroidectomy for perioperative outcome parameters

Variable	Minimal access (n=466)	Conventional (n=437)
Length of incision*(cm)	3.7±0.7[a]	9.6±3.3
Operative time*(min)	57.6±11.7[a]	85.2±32.3
Blood loss*(ml)	18.4±15.3[a]	43.1±21.8
Hospital stay*(days)	1.6±0.5[a]	4.3±1.6
Requirements of drains	4(0.9%)[b]	420(96.1%)
Analgesic requirements	123(26.4%)[b]	389(89.0%)
Postoperative complication	20(4.3%)[c]	21(4.8%)
Seroma	5	5
Hematoma	1	2
Voice change	3	4
Transient hypocalcemia	11	10

* : Mean±SEM
a : $p<0.05$ versus conventional group(t-test)
b : $p<0.05$ versus conventional group(Chi-square test)
c : $p>0.05$ versus conventional group(Chi-square test)

No significant differences in the extent of surgery between the minimal invasive and conventional group were observed(Table 2). A central compartment node dissection was added in cancer patients. However, between the two groups there were no significant differences in the number of positive nodes per patient(3.1±1.0 vs 3.3±1.6) and the number of central compartment neck nodes dissected per patient(9.6±3.2 vs 10.3±4.1)($p>0.05$).

The Results comparing the perioperative outcome parameters for minimal access versus conventional thyroidectomy are shown in Table 3.

Statistically significant reductions for the minimally invasive thyroidectomy were noted with regard to length of the skin incision, operative time, postoperative hospital stay, estimated amount of blood loss, and pain medication requirements($p<0.05$). However, there were no significant differences in the incidence of perioperative complications between the two groups.

Disscussion

The minimally invasive technique thyroidectomy, described here, is very similar to that of the conventional

thyroidectomy. Therefor, each step in the procedure can be performed under the traditional view that most surgeons are familiar with. The procedure differs from the conventional thyroidectomy only by having a smaller skin incision, a transverse division of the strap muscles and no raising of skin flaps. This approach can obviate damage to the subcutaneous tissue and surgical trauma to the midline of the neck, minimizing the potential risk of complications related to raising skin flaps and a longitudinal opening of the strap muscles.

Although the wound opening is small in the minimally invasive technique, sufficient exposure for dissection of the pretracheal and paratracheal space can be obtained by lateral retraction of the wound and anteromedial traction of the specimen outside the open wound. This allows access to the whole length of the recurrent laryngeal nerve, the parathyroid glands, and the lymph nodes along the tracheo-esophageal groove.

At our institution, the minimally invasive technique has proved feasible in 813% of consecutive thyroid surgeries. Since this technique is minimally invasive, no wound drains are required in most cases. This procedure has a shorter operation times, less blood loss, reduced postoperative pain and a shortened hospital stay, without compromising extent of surgery. In addition, the cosmetic results are comparable to the conventional approach.

A pitfall of the minimally invasive technique is the possibility of missing positive nodes in the contralateral tracheo-esophageal groove in some patients due to diminished visibility. However, this limitation can be overcome by extending the wound towards the contralateral side if necessary. In addition, this technique does not always allow for the easy removal of all thyroid nodules. In patients with large or substernal goiters, lateral compartment neck node involvement that requires radical neck dissection, or locally-advanced disease, the conventional approach may be preferable.

In conclusion, the minimally invasive thyroidectomy provides surgeons with adequate workspace and has proved to be a simple, safe, and practicable procedure in selected patients with small to medium sized thyroid nodules.

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