Minimally invasive video-assisted thyroidectomy: experience of 200 cases in a single center

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Abstract

Introduction: *Minimally invasive techniques in thyroid surgery including video-assisted technique originally described by Miccoli have been accepted in several continents for more than 10 years.*
Aim: *To analyze our preliminary results from minimally invasive video-assisted thyroidectomy (MIVAT) and to evaluate the feasibility and effects of this method in a general department over a 4-year period.*
Material and methods: *Initial experience was presented based on a series of 200 patients selected for MIVAT at the General Surgery Department of Yantai Yuhuangding Hospital affiliated with Qingdao University during the period from May 2008 to June 2012. The enrolling criteria were rigorously observed. An above sternal incision with average length of 2.5 cm (1.5–3.0 cm) was made. Clinicopathologic characteristics, postoperative pain, length of hospital stay, cosmetic results and complications were retrospectively analyzed.*
Results: *All patients received general anesthesia. Thyroid unilateral lobectomy was successfully accomplished in 108 cases, total thyroidectomy in 84, and partial lobectomy in 8. Conversion to standard conventional thyroidectomy was required in 6 patients (3%) because of thyroiditis and bleeding. The mean lymph node yield of the cancer specimens was 3.6 per patient. Permanent unilateral recurrent laryngeal nerve (RLN) palsy occurred in 1 case (0.5%), transient unilateral RLN palsy in 6 patients (3.0%, complete recovery after 1–6 months), and transient hypocalcemia in 7 patients (3.5%). No definitive hypocalcemia was observed. No postoperative hematomas occurred. Postoperative pain was endurable. The cosmetic result was excellent in most cases.*
Conclusions: *The MIVAT is feasible and safe in selected patients, with better results comparable to conventional thyroidectomy. The MIVAT can also be performed in a general surgery department.*

Key words: *video-assisted thyroidectomy, minimally invasive surgery, thyroidectomy.*

Introduction

Conventional thyroid surgery has stood the test of time for over a century after being described and perfected by Theodore Kocher [1]. With experienced hands, high success rates can be achieved in 6–8 cm neck incision. After the first endoscopic parathyroidectomy performed and described by Gagner in 1996 [2], minimally invasive techniques in thyroid surgery including various endoscopic approaches and the video-assisted technique originally described by Miccoli have been accepted in several continents [3–8]. The incision length is about 2.5 cm or even less. Cosmetic results, traditional procedure and better postoperative outcome are the key points accepted by thyroid surgeons. Minimally invasive video-assisted thyroidectomy (MIVAT) has proved to be one of the most widely used techniques in Europe and Asia. From May 2008 to June 2012, about 216 consecutive MIVAT operations were performed

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in our general surgery department. Sixteen patients without comprehensive records were excluded. Through a small central incision (1.5–3.0 cm) and external retraction without neck insufflation, good postoperative results including cosmetic results, little pain, operative time, and shorter hospitalization were achieved.

Aim

This study tried to summarize the safety and feasibility of MIVAT performed in 200 cases in a general surgery department.

Table I. Clinical characteristics of patients who underwent MIVAT

Gender:	
Male	172 (86%)
Female	28 (14%)
Age [years]:	
Mean	38.6
Range	23–67
Thyroid volume [ml]:	
Mean	16.1
Range	5–35
Operation type:	
Unilateral lobectomy	108 (54%)
Total lobectomy	84 (42%)
Partial lobectomy	8 (4%)
Operation time:	
Unilateral lobectomy	45.8 (20–70)
Total lobectomy	63.3 (45–110)
Final pathology:	
Follicular adenoma	46 (23%)
Papillary cancer	64 (32%)
Nodular goiter	74 (37%)
Hashimoto's thyroiditis	6 (3%)
Subacute thyroiditis	4 (2%)
Others	6 (3%)
Postoperative pain on VAS	1.70
Mean hospital stay [day]	1.89

Material and methods

Between May 2008 and June 2012, 200 patients (28 male, 172 female; with an age range of 23 to 67 years, mean age 38.6 years) were selected for MIVAT.

Eligibility criteria were similar to a previous study [9]: In our hospital, the selection process is based on clinical examination and ultrasonography. Patients with thyroid nodules smaller than 35 mm in the largest diameter in thyroid glands with a volume less than 20 ml, Graves' disease gland smaller than 20 ml in volume, and low risk papillary thyroid carcinoma (PTC) < 2 cm in diameter without proof of enlarged lymph nodes in the lateral neck were all enrolled. Patients with a short neck in obese patients, history of thyroiditis, previous neck surgery or irradiation were excluded. Proper patient selection is critical for a successful outcome (Table I).

Complete preoperative evaluation (biochemical assessment, ultrasonography, etc) was performed in all cases. Fine needle aspiration cytology (FNAC) was performed in 87 selected cases. Cervical enhanced computed tomography (CT) scanning was performed in patients with doubted lymph node metastasis in ultrasound inspection. Pre-operative informed consent was obtained from all patients.

Surgical technique

The patient's neck is slightly hyperextended. The procedure, totally gasless, is carried out through a single mean 2.5 cm skin incision in the central neck, 1.5 cm above the sternal notch. This technique needs one surgeon and two assistants involved, with the first assistant opposite the main surgeon and the second assistant situated at the head of the patient. All procedures were performed by the same surgeon.

The procedure typically was performed under general anesthesia with endotracheal intubation. The skin was protected by means of a sterile film. Dissection is performed as a conventional skill under endoscopic vision. Video assistance was obtained using a 5 mm 30° endoscope inserted. Hemostasis of the main thyroid vessels is mainly achieved by a 14-cm long harmonic ultrasonic scalpel (Ethicon Endo-Surgery Inc. Cincinnati, OH, USA), sometimes by tying knots in dealing with the vessels of the upper thyroid peduncle. In the case of partial lobectomy, the recurrent laryngeal nerve (RLN) need not be

exposed routinely. Intraoperative neuromonitoring (IONM) was performed in 56 selective cases. Identification of both parathyroid glands with preservation of their vascular supply is routine. The RLN and parathyroid gland can be seen clearly compared with conventional open operation because of the endoscope amplification effect. After being dissected completely, the thyroid lobe was extracted through a small skin incision. After one lobe was extracted, the contralateral maneuver was much easier. The skin was closed by subcuticular suturing or a skin sealant such as Dermerband. Drainage was usually used in patients once the blood loss was more than 20 ml in the operation. The drainage tube was removed 24–48 h after surgery, in the morning, before discharge.

Postoperative pain was assessed in all patients by means of a visual analogue scale (VAS) according to the Joint Commission International's Guidelines. This numeric pain intensity scale consisted of a 10-cm line with the words "no pain = 0" on the left side and "worst possible pain = 10" on the right side. The verbal response scale had four options: 1 (poor), 2 (acceptable), 3 (good), and 4 (excellent). All the patients were asked to grade the cosmetic appearance of their wound and complaints about the neck region 1 month after surgery.

A follow-up period ranging from 6 to 48 months was possible in 200 patients, with a mean follow-up period of 27 months. Follow-up evaluation included laryngoscopy to check vocal cord mobility in partial patients within 30 days after the operation because of cost. When clinical evidence of dysphonia existed, laryngoscopy was performed obligatorily every 4 weeks until recovery.

In all patients, serum calcium levels were measured on the first postoperative day. Hypocalcemia was defined as serum calcium < 8.5 mg/dl. In the case of postoperative serum calcium levels as low as 8.0 mg/dl, patients were treated with substitutive therapy with calcium carbonate tablets and with dihydrotachysterol solution per os. The serum calcium level of hypocalcemic patients was rechecked every 3 days.

Cervical ultrasound scanning was used twice a year in the follow-up period. Radioactive ^{131}I treatment was performed in selected cancer patients. ^{131}I whole body scan (WBS) 3 to 6 months after surgery was performed in thyroid differentiated thyroid cancer.

Results

The mean thyroid volume was 16.1 ±7.2 ml (range: 5–35 ml) and the mean nodule size was 2.0 ±0.9 cm (range: 0.7–3.5 cm). Total thyroidectomy was performed in 84 cases and 108 underwent unilateral lobectomy. The blood loss averaged 12 ml per patient.

Mean operative time was 45.8 ±12.2 min (range: 20–70 min) for unilateral lobectomy and 68.3 ±18.6 min (range: 45–110 min) for bilateral thyroidectomy. Mean postoperative hospital stay was 1.89 days (range: 1–3 days).

Only 6 patients (3%) were converted to traditional open surgery, for bleeding in 1 case, for large nodule size in 1 case, and the others because of inflammatory adhesions making video-assisted dissection difficult.

Paraffin section proved pathology results with benign multinodular goiter (37.0%), follicular adenoma (23.0%), low-risk papillary thyroid carcinoma (PTC 32.0%), Hashimoto's thyroiditis (3.0%), subacute thyroiditis (2.0%), diffuse hyperplasia (2.5%) and others (0.5%).

Complications included permanent unilateral RLN palsy in 1 case (0.5%), transient unilateral RLN palsy in 6 (3.0%, complete recovery after 1–6 months), and 7 cases (3.5%) of transient hypocalcemia. No postoperative hematomas occurred. No definitive hypocalcemia was observed. There were 11 patients (5.5%) who suffered from a superficial skin burn and had delayed but complete resolution of incisional erythema with a favorable cosmetic result.

In cancer patients, level six lymph nodes were removed and sent for paraffin section examination. The mean lymph node yield of the cancer specimens was 3.6 per patient. In these patients, no lateral neck metastases were found by CT scanning. No evidence of recurrent or residual disease was found at follow-up. At the most recent check, 90% of patients had low/undetectable (1 ng/ml) thyroglobulin.

In our cohort, the postoperative pain at 24 h after the surgical procedure was 1.70 ±0.75 (range: 0–5), whereas in conventional thyroidectomy, it was 2.80 ±0.93 ($p < 0.05$). It is unnegligible compared with traditional thyroidectomy – the difference is obviously. Traditional thyroidectomy results need not shown.

The median scar size was 1.70 ±0.75 (range: 0–5). Patients who underwent MIVAT were more satisfied

Table II. Operative complications after MIVAT

Complications	No.
Hemorrhage	0
Wound burning	11 (5.5%)
Recurrent nerve palsy:	
Transitory	6 (3%)
Permanent	1 (0.5%)
Transient hypocalcemia	7 (3.5%)
Permanent hypoparathyroidism	0
Reasons for conversion:	6 (3%)
Hemorrhage	1 (0.5%)
Difficult dissection	4 (2%)
Large goiter	1 (0.5%)

with the cosmetic results, except 5 patients because of occasional stabbing pain (Table II).

Discussion

Conventional open thyroidectomy has been a standard operation method for more than 100 years. In the past decades, a minimal scar and better cosmetic results become the goals of the doctor and young women patients. Endoscopic cervical exploration for endocrine diseases was initially developed for excision of the parathyroid glands, first using a totally endoscopic approach [2], then using a video-assisted technique through a single skin incision including by a subclavicular approach [10–12]. The MIVAT clearly demonstrates excellent results regarding patient cure rate and comfort, with lower postoperative pain, shorter hospital stay and more attractive cosmetic results.

Miccoli *et al.* [13] noted that the average surgical time for the procedure fell from 73.6 min for partial thyroidectomy for his first 67 patients to an average of 47 min for this procedure in his more recent paper. In another report in 2008, mean operative time was only 31.1 min for lobectomy and 41.1 min for total thyroidectomy [14]. With regard to the learning curve, 10 patients represented the early stage of the learning curve, and 30 patients represented the number of procedures required to reach the advanced level [15]. It should be noted that the operative time for MIVAT in our previous cases decreased gradually with increased experience. It is well known that different types of operations need to be performed 15 to 100 times before reaching a low plateau of complications [16].

Thyroid surgery is associated with significant complications, particularly recurrent laryngeal nerve damage and hypocalcemia [17]. As lobectomies were finished through a small incision hole, the reported average temporary hypocalcemia rate was from 11% to 25% [18]. Del Rio *et al.* [19] report a 7.58% rate of hypocalcemia cases with clinical symptoms. In fact, serologic hypocalcemia can reach as high as 27.9%, with the mean value of calcium concentration 7.5 ±0.27 mg/ml. Seven (3.5%) cases of transient hypocalcemia were observed. No definitive hypocalcemia occurred. Many studies have demonstrated that this technique is feasible and safe. Miccoli *et al.* [13] reported complication rates similar to the conventional thyroidectomy technique. They successfully carried out the procedure in 572 patients and reported hypoparathyroidism only in 0.2% of these patients.

Neidich *et al.* [20] reported that no permanent hypocalcemia or hypoparathyroidism occurred in elective MIVAT central neck dissection for thyroid cancer, while transient hypocalcemia and hypoparathyroidism were 10.7% and 25% respectively.

According to our results, the rate of hypocalcemia was similar to reports in the literature. In our opinion, avoiding direct thermal damage or clip pinch is important. The head of the harmonic scalpel is rougher than that of the tip of the electronic knife. Keeping the operative field clean is also of great importance to avoid damaging the parathyroid glands. The forceps of the ultrasonic scalpel should not be held with too much tension when dissecting tissues or vessels, otherwise, bleeding can contaminate the operative field.

The RLN generally lies in the thyrotracheal groove, behind the Zuckerkandl tubercle. The relationship with the inferior parathyroid gland is more variable, but the RLN always lies at a level deeper to the plane of the gland [21]. We also got a low rate of RLN palsy in this cohort. Transient unilateral laryngeal recurrent nerve palsy was observed in 6 cases (3%); all recovered in 6 months. One permanent unilateral nerve paralysis occurred (0.5%). Miccoli *et al.* [13] reported definitive recurrent laryngeal nerve palsy in 1.3% of these 572 patients.

We suggest that RLN need not be exposed in partial lobectomy, whereas routine identification of the nerve is necessary in total lobectomy. The low incidence of RLN injury may partly have been the re-

sult of correct use of the ultrasonic scalpel. In the maneuver, avoiding directly dissecting the RLN with the ultrasonic scalpel instead of fiber forceps was prohibited. It is always preferable to keep the active blade of the ultrasonic scalpel facing the RLN. The forceps of the ultrasonic scalpel should deviate from the RLN by at least 3 mm [22, 23]. It is better to wait a moment before next cutting the surrounding RLN. Another way is to use microclips rather than cautery or ultradissection when working close to the recurrent laryngeal nerve [21].

Because of the extensive utilization of neck ultrasonography and ultrasound-guided fine-needle aspiration cytology, PTC patients are discovered more and more frequently in clinical practice. One of the major limitations inhibiting MIVAT use is the lack of evidence that it can produce comparable results to a conventional thyroidectomy in the treatment of malignant thyroid tumors [24, 25].

Neidich *et al.* [20] reported that the mean lymph node yield of the specimens was 5.2 per patient. We observed the mean lymph node yield of 3.6 per patient. Some authors have stated that elective central neck dissection performed with MIVAT in thyroid cancer is a safe and feasible procedure [26, 27].

In recent years, a number of investigators have shown the completeness of MIVAT for low-risk papillary cancer by demonstrating that serum thyroglobulin levels after LT4 suppression therapy were undetectable in most patients. In the case of mean ^{131}I uptake and mean thyroglobulin serum levels in the MIVAT group and in the conventional near-total thyroidectomy group, the differences were not statistically significant concerning low-risk PTC [28].

Miccoli further reported low and intermediate-risk papillary thyroid cancer in 2008. At the time of thyroid remnant ablation, no differences in serum Tg, TSH levels, or ^{131}I neck uptake were observed between the MIVAT group and the conventional group [29].

The value of thyroglobulin after 12 months in the MIVAT group was 0.648 ±0.2 ng/ml whereas the value was 0.705 ±0.2 ng/ml in the conventional thyroidectomy group (p = NS) [30]. These data are comparable with the data from other published studies [31]. All these studies demonstrate that satisfactory radicality can be achieved with this kind of carcinoma.

In our department, we treat PTC by total thyroidectomy alone followed by eventual activated radioactive ^{131}I treatment in selected patients. We attempted a central compartment clearance regularly. Postoperative calcitonin and thyroglobulin measurements were undetectable after surgery in the follow-up period. We did not directly compare the complication rates between MIVAT and conventional thyroidectomy. These data proved again that the operation was successful in terms of radicality.

Most importantly, it is easy to convert to conventional surgery in cases of massive bleeding or other emergency by enlarging the cervical incision. Changeable characteristic is one of important advance in MIVAT technique.

Central or lateral lymphadenectomy is rather difficult to accomplish using thoracic/breast or axillary access. Therefore, a suspected malignant thyroid nodule is one of the major contraindications for total endoscopic thyroidectomy [32].

Twenty consecutive consenting patients were compared by Ikeda *et al.* using endoscopic thyroidectomy and by MIVAT in Japan [33]. All thyroidectomies were completed successfully. No recurrent laryngeal nerve palsies occurred. Operating time for the video-assisted approach was significantly shorter than that for the axillary approach. The amount of pain for the axillary approach was much higher compared to the video-assisted approach. The postoperative course was significantly less painful in patients undergoing the video-assisted approach on postoperative days. The degree of satisfaction for the axillary approach was better than the video-assisted procedure. In a word, the video-assisted approach is less "invasive" than the axillary approach, but the axillary approach may be indicated for patients who are anxious about the visible cosmetic results.

Like conventional thyroidectomy, nevertheless, the MIVAT procedure still produces slight cervical hypoesthesia, paresthesia, and swallowing discomfort, which can be avoided by pure endoscopic thyroidectomy through endoscopic tunnel access.

Cosmetic results were excellent in most patients. One of the disadvantages is mild skin burn. Though the boundary of the incision was coated with films, the heat can cause damage conducted from the ultrasonic scalpel.

There were 11 patients (5.5%) who suffered from a superficial skin burn and had delayed but complete resolution of incisional erythema with a favorable cosmetic result. Vaysberg and Steward [34] report a 6% incidence of skin injury resulting from thermal damage from harmonics. Limitations due to

a narrow working space make the risk greater with MIVAT. Analysis of skin burn incidents demonstrated that the majority of burns happened in the early stages of our experience. Once awareness and vigilance were emphasized, the incidence of the complication fell.

In our cohort, the postoperative pain at 24 h after the surgical procedure in the MIVAT group was 1.70 ±0.75, whereas in the conventional thyroidectomy group, it was 2.80 ±0.93 ($p < 0.05$).

Recently, Miccoli *et al.* reported that VAS scores were significantly higher in the open group, whereas TGF-β and MCP-1 levels were significantly lower in the open than in the MIVAT group [35]. In a prospective outcome study similar results were obtained [36]. Less postoperative pain might be related to the minimal incision and lower neck hyperextension, reducing postoperative bone and muscular pain [37].

Sahm *et al.* [38] presented examination results after long-term follow-up of 22.4 months (1–64 months). The measurable width of the cervical scar was 0.17 cm (range: 0.05–1.5 cm), 10.4% of patients had diverse proliferation, and 96.8% were very satisfied or satisfied with the cosmetic result.

Conclusions

Our initial results of MIVAT confirm that it is both safe and technically feasible. In our experience, mean operative time and the complication rate are slightly higher compared to conventional thyroidectomy, but they declined once passing the learning curve. Our findings are in accordance with those reported by previous studies that compared MIVAT with conventional surgery [34]. There is a trend that MIVAT appears to offer some advantages in terms of postoperative pain, postoperative distress, shorter hospital stay, and better cosmetic results compared with open surgery. We believe that MIVAT surgery is an attractive and promising approach for the surgical treatment of thyroid lesions. Our initial results should encourage other endocrinology surgeons to adopt this procedure in the near future.

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