Minimally invasive, video-assisted thyroidectomy: first experience from the United Kingdom

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ABSTRACT

INTRODUCTION Minimally-invasive, video-assisted thyroidectomy (MIVAT) was developed to reduce scarring/trauma associated with cervical incisions used in open thyroidectomy. Results from various centres have been published internationally but none from the UK. This study reports the first results from the UK and compares them with other centres. We also aim to compare the results of a single-surgeon experience in a small/moderately-sized hospital to those of larger tertiary centres.

PATIENTS AND METHODS Retrospective analysis of a single surgeon experience in a district general hospital

RESULTS The cohort was 55 patients (52 female, 3 male), mean age 48 years (range, 21–77 years) who had 64 MIVAT procedures. There were 49 hemithyroidectomies (HTs), 2 isthmusectomy, 4 total thyroidectomies (TTs) and 9 completion thyroidectomies (CTs) with median operating time of 86 min (IQR 66–110 min). Individual operating times were HT 85 min (IQR 60–110 min); TT 130 min (IQR 100–140 min) and CT 77 min (IQR 70–98 min). Median operating time was shorter in the second half of this series (76 min vs 92 min; $P < 0.001$). Length of stay was < 1 day in 92%. Conversions occurred in 6.3% with no haematoma or re-operation. Transient voice change was present in 7 (11%), permanent unilateral recurrent laryngeal nerve palsy in 2 (3%), and transient hypocalcaemia in 2 (3%).

CONCLUSIONS The first results from the UK are similar to those of other international centres. A single-surgeon practice can obtain results comparable to larger tertiary centres provided there is sufficient case-load. MIVAT is safe and effective, but has a steep learning curve with rapid improvement observed within first 30 cases. Future studies should focus on objective assessment of scar/cosmesis and cost-effectiveness. MIVAT is an acceptable alternative to open surgery in highly selected patients.

KEYWORDS

Minimally invasive – Thyroidectomy – Education

Accepted 26 January 2010; online publication 10 April 2010

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Thyroid surgery is commonly and safely performed using an open surgical approach with minimal complications and mortality.^{1,2} However, cervical incision may lead to cosmetic concerns, especially in young women, pain, paraesthesia, constant discomfort and sensation of a foreign body in relation to long scars and excessive subcutaneous and subplatysmal dissection. Minimally invasive surgery was, therefore, proposed as a less invasive alternative.⁵

Endoscopic thyroidectomy (ET) and minimally invasive thyroidectomy (MIT) have evolved to minimise the trauma of long cervical incisions and have been accurately defined.^{2,4} True ET is performed entirely endoscopically using gas insufflation and instrumentation through distant port sites (chest wall, inframammary, axillary).^{5,6} It requires longer operating times, multiple port incisions and radical subcutaneous dissection and hence may not be labelled minimally invasive.^{2,3} In contrast, MIT uses a mini cervical incision (1–2.5 cm) with direct or endoscopic visualisation,

a technique known as minimally invasive video-assisted thyroidectomy (MIVAT).²

While several MIVAT studies have been published by centres in Europe, the US and Asia,^{7–10} none was available from the UK. We describe the first experience of MIVAT in the UK and compare its results with those of the more established international centres. We also compare results of a single surgeon's practice in a district general hospital to those of large volume tertiary referral centres.

Patients and Methods

Data were prospectively recorded for all MIVAT procedures performed by a single surgeon until January 2008 allowing a minimum of 18 months of follow-up, for adequate evaluation of time-sensitive outcomes, such as recurrent laryngeal nerve (RLN) palsy and tumour clearance rates. Standard indications for thyroidectomy were used and

Figure 1 Theatre set-up for MIVAT: (P) patient, arrow indicates direction of head; (S) surgeon; (1) first assistant holding endoscope; (2) second assistant for external retraction; (N) scrub nurse; (M) endoscope stack and video monitor; (A) anaesthetist/anaesthetic equipment.

patients offered MIVAT had extended criteria of thyroid nodule of ≤ 3 cm in diameter and thyroid lobe volume of < 30 ml on ultrasound imaging. Patients with initial radiological/clinical cancer or lymphadenopathy, biochemical thyroiditis, previous open thyroidectomy or neck irradiation were excluded. Selected patients requiring completion thyroidectomy without node dissection for unpredicted cancer were also offered MIVAT at the surgeon's discretion.

We used the gasless MIVAT procedure described by Miccoli *et al.*⁷ where Ultracision® (Ethicon-Endosurgery Inc., Cincinnati, OH, USA) is used in the dissection. The set-up is demonstrated in Figure 1. We also used intra-operative direct neuromonitoring where the vagus (VN) and RLN are identified

and monitored before and after thyroid resection, with the Medtronic NIM-Response® 2.0 Nerve Integrity Monitor (Medtronic Ltd, Herts, UK), using a short-acting depolarising neuromuscular blocking agent. The wound is closed in layers by absorbable sutures without drains (Fig. 2). Postoperative serum calcium is checked prior to discharge.

Data on all MIVAT procedures up to January 2008 were retrospectively analysed ensuring an 18-month follow-up period. Operating time, pathological diagnosis, length of stay and complications were recorded. Hypocalcaemia was defined as temporary (requiring calcium supplementation for less than 3 months) and permanent (requiring long-term calcium supplementation). As postoperative laryngoscopy is not performed routinely, clinical transient voice change lasting less than 6 months was used as a surrogate marker of transient RLN palsy. Permanent RLN palsy was defined as persistent voice change (> 6 months) with laryngoscopic evidence of vocal fold impaired mobility beyond 1 year postoperatively.

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS®, Chicago, IL, USA). MIVAT cases were divided to two halves to assess the effects of learning-curve on operating time and complications. The first half included the first 32 MIVAT cases (September 1999 to March 2004) and the second half represents the remaining 32 cases (March 2004 to January 2008). Continuous data are presented as median with interquartile ranges (IQR) in parentheses. Mann-Whitney test was used to compare median values.

Results

A total of 64 MIVAT procedures were performed on 55 patients (52 females, 3 males) with mean age of 48 years (range, 21–77 years). Hemithyroidectomy (HT) was per-

Figure 2 Closure of MIVAT scar in layers. Note position and size of incision.

formed in 49 patients. two patients had isthmusectomy and were incorporated into the HT group for purposes of statistical analysis. Four patients had total thyroidectomies (TTs) and nine patients had completion thyroidectomy using MIVAT. The overall median operating time for all MIVAT in this series was 85 min (range, 66–110 min). Median operating time was 85 min (range, 60–100 min) for HT, 130 min (range, 100–140 min) for TT and 77 min (range, 70–98 min) for completion MIVAT. The median operating time was significantly shorter in the second half of the series at 76 min (range, 61–105 min) compared to 92 min (range, 70–113 min; $P < 0.001$) in the first half of this series. Almost all patients (92%; 59/64) were discharged within 24 h and five (7.8%) had a hospital stay of > 1 day (2, 3, 4, 5, and 7 days, respectively). The first three patients had non-symptomatic hypocalcaemia and were observed in-hospital as per local protocol. The remaining two patients had concurrent medical conditions, not related to the MIVAT technique. All incisions were ≤ 2 cm. One patient required extension of the incision to 3 cm to allow the delivery of pre-operatively underestimated large gland. In this series, 65% (36) of patients had benign disease and 35% (19) had malignancy (Table 1). The pathology of the completion MIVAT is demonstrable in Table 2.

Conversion/complications

The conversion rate was 6.3% (4/64). Reasons for conversions were: (i) undiagnosed Hashimoto's thyroiditis with gland adherence; (ii) blocked view due to isthmus colloid

Table 1 Pathological diagnosis in all cases

Pathology	n (%)
*Papillary carcinoma	15 (20)
Follicular carcinoma	5 (9)
Mixed (papillary/follicular)	2 (4)
Hurthle cell	1 (2)
Colloid cyst/nodule	9 (14)
Follicular adenoma	2 (4)
Grave's disease	5 (8)
Hashimoto's thyroiditis (not detected pre-operatively)	4 (6)
Multinodular goitre	6 (9)
Nodular hyperplasia	13 (20)
Normal thyroid (completion MIVAT following initial cancer)	2 (4)
Total	64 (100)

*Occurred in 11 patients and in four patients with further contralateral papillary carcinoma following completion MIVAT after primary MIVAT diagnosed papillary carcinoma.

Table 2 Pathological diagnosis of patients with primary MIVAT followed by completion MIVAT for malignancy

MIVAT	Completion MIVAT
Papillary	Papillary
Papillary	Papillary
Papillary	Papillary
Papillary	Papillary
Follicular	Normal
Follicular	Nodular hyperplasia
Follicular	Nodular hyperplasia
Mixed (papillary/follicular)	Normal
Mixed (papillary/follicular)	Colloid nodule

cyst; (iii) partially cystic MNG which did not collapse on aspiration as wrongly anticipated; and (iv) parathyroid adenoma which required thorough exploration and thyroidectomy. Three of the four conversions (75%) occurred within the first 15 cases in this series.

There was no haematoma/seroma formation and no patient required re-operation. Two patients had transient hypocalcaemia but none had permanent hypocalcaemia. Seven (11%) experienced transient voice change which recovered fully within 6 months. Two (3%) patients had permanent unilateral RLN palsy. One patient had primary total thyroidectomy for benign disease and another had completion MIVAT for papillary/follicular carcinoma. The voice quality of the first patient continues to improve owing to compensation of the contralateral normal vocal fold.

Discussion

The first MIVAT procedure was performed in the 1990s but the procedure has not been widely adopted due to the good results achieved by open surgery. In expert hands, open thyroidectomies can be performed through 4–6-cm incisions and last less than 90 min with excellent cosmetic results.¹ However, several centres have published encouraging results of MIVAT, advocating its use in selected patients.^{7,8} Complication rates in MIVAT case series and comparative studies are similar to those of open thyroidectomy.^{5,7,11,12} This was further confirmed in the largest comparative study and a recent review.^{13,14} Furthermore, significantly better scores were observed with incision length, estimated blood loss, length of hospital stay, postoperative pain and cosmetic results.¹⁵ The results of more recent publications are summarised in Table 3.

Operating time

MIVAT is associated with increased operative time, espe-

Table 3 Summary of larger recent studies

	This study	Gal <i>et al.</i> ¹² (2008)	Terris <i>et al.</i> ⁸ (2008)	Vaysberg & Steward ⁹ (2008)	Miccoli <i>et al.</i> ⁷ (2006)	Terris <i>et al.</i> ¹¹ (2005)
Procedures						
MIVAT	64	15	216	92	833	31
Haematoma	0	–	0	0	–	0
RLN palsy						
Transient	7 ^a (11%)	0	9 (3.2%)	1 (0.7%)	8 (0.9%)	
Permanent	2 (3%)	0	0	0	7 (0.8%)	0
Hypocalcaemia						
Transient	2 (3%)	0	5 (8.1%)	2 (3.6%)	20 (3.9%)	
Permanent	0	0	0	(0)	2 (0.3%)	0
Conversion	4 (6%)	0	12 (5.2%)	6 (7%)	16 (1.9%)	0
Operating time (min)						
	85	69		Hemi 67–42 ^b	Hemi 36.2	116
	92 to 76 ^b			Total 110–72 ^b	Total 46.1	

^aNo vocal cord check confirming palsy (voice change recovered).

^bDenotes reduction in mean operating time during study period.

cially in early experiences. Several studies have demonstrated that the operating time rapidly decreases within the first 20–30 cases to levels comparable to open surgery, and continues to decrease even after 50 cases^{3,9,12,15} due to the steep learning curve. The median operating time for hemithyroidectomies in our series is longer than the open technique but may be an over-estimation as it includes the very first cases in our learning curve. We have demonstrated a significant decrease in median operating time in the second half within this series and expect further decrease with further experience.

British indications for surgical intervention in patients with small and generally symptomless solitary thyroid nodules are very narrow compared with the case in other European countries where studies with bigger cohorts of patients are published. While this explains our relatively small number of cases per year, the experience of the surgeon is adequately maintained by the fact that all procedures were undertaken only by the same surgeon, who also employed the same video-assisted technique for all parathyroidectomies for primary hyperparathyroidism.

The 144 min median operating time for TT (4 cases in early stage) was much longer than that for open surgery. Other initial experiences reported mean operating times of 147–170 min in the initial stages.^{11,16} Del Rio *et al.*¹⁵ reported a decrease from 91 min to 63 min after 50 cases and Vaysberg *et al.*⁹ reported a significant decrease in operative time from 110 min to 77 min. The largest MIVAT series reported operating times of 46 min for total thyroidectomy.

Hence, operating times of 60–70 min, which is comparable to open thyroidectomy, can be obtained within a reasonable case-load.

Complications and conversion to open thyroidectomy

The complication rates are similar to other series of similar size.^{9,11,12} Transient RLN palsy appeared high (11%); however, this is due to including patients with voice changes who had no endoscopic laryngoscopy and who have fully recovered. These changes may be attributable to intubation trauma, cervical surgical manipulation or bruising. The largest MIVAT series demonstrated impressively low RLN palsy rates (< 1%) and hypocalcaemia rates.⁷ This is superior to even that of open surgery which emphasises the level of safety achievable by using this technique.

The conversion rate of 6% was similar to other studies.^{8,9,11} Lower conversion rates of < 2% were reported by Miccoli *et al.*,⁷ again due to their extensive experience. This was supported in our study where three out of the four conversions occurred in the first 15 cases. Only one conversion occurred in the subsequent 49 cases to date giving a conversion rate of 2%.

Cosmesis

MIVAT is intuitively superior to open surgery in terms of cosmetic results. In our study, only one incision was extended beyond 2 cm to remove the gland. Although not objectively measured, this would intuitively lead to better cosmetic results and less pain. Several studies and a recent

Figure 3 MIVAT scar size in relation to neck in patient with history of hypertrophic scar formation following total thyroidectomy.

review of evidence report better scar cosmesis, decreased postoperative pain and increased patient satisfaction compared to open surgery.^{13,14,17} This may be an important consideration especially in patients with history of keloid/hypertrophic scars, such as this patient with a history of hypertrophic scars following TT (Fig. 3). However, cosmesis was not objectively measured in this series and further conclusions cannot be drawn based on our study.

Cost effectiveness and day surgery

No cost analysis was performed in this study but we do regard MIVAT to be a cost-effective technique. Similar costing experiences were reported by two other UK centres.^{18,19} The only essential equipment is the Miccoli suction dissector (US\$200), which is re-usable. In addition, the harmonic scalpel was found to be efficient and time-saving. It is, therefore, routinely used in all open thyroidectomies at this centre. A second assistant, who is usually present for our open thyroidectomies, posed no additional staff cost in our MIVAT cases. In our current experience, MIVAT costs the same as open surgery with an additional minimal cost outlay for the Miccoli dissector. No MIVAT patients had surgical drains and most were discharged within 24 h with no complications. As MIVAT is increasingly performed as day-case surgery, it is possible that MIVAT will become superior to open surgery in terms of cost-effectiveness.

Study limitations

We did not perform routine postoperative laryngoscopy on all patients, or those with transient voice change, and hence

are unable to state the true incidence of transient RLN palsy accurately. No objective measurement tools were used and there was no open thyroidectomy group for comparison while previous studies have used graded questionnaires (1–5) or Visual Analogue Scores (1–10) for scar assessment.^{13,17} Randomised trial, to compare outcome with open thyroidectomy precisely, needs a large number of patients.⁷ Furthermore, it is not our belief that MIVAT should replace open thyroidectomy, but rather be an additional, complementary technique undertaken by trained surgeons on selected patients.

Conclusions

These are the first results in the UK on MIVAT in a non-tertiary centre. Complications rates are similar to those of open thyroidectomy. MIVAT is associated with longer operating time which decreases significantly within the first 32 cases. MIVAT results from a single-surgeon practice in small/moderate centres are comparable to those of larger tertiary referral centres provided sufficient case load is present. Future studies should focus on objective cosmetic assessment and cost-effectiveness of MIVAT.

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