

Minimally Invasive Thyroidectomy (MIT)

Indications and results.



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Minimally invasive thyroidectomy (MIT). Indications and results

AIM: *To establish if the indication for different approaches for thyroidectomy and the incision length provided by means of pre-operative assessment of gland volume and size of nodules resulted in safe and effective outcomes and in any notable aesthetic or quality-of-life impact on patients.*

MATERIALS AND METHODS: *Ninehundred eightytwo consecutive patients, undergoing total thyroidectomy, were enrolled. The thyroid volume and maximal nodule diameter were measured by means of ultrasounds. Based on ultrasounds findings, patients were divided into three groups: minimally invasive video assisted thyroidectomy (MIVAT), minimally invasive thyroidectomy (MIT) and conventional thyroidectomy (CT) groups. The data concerning the following parameters were collected: operative time, postoperative complications, postoperative pain and cosmetic results.*

RESULTS: *The MIVAT group included 179 patients, MIT group included 592 patients and CT group included 211 patients. Incidence of complications did not differ significantly in each group. In MIVAT and MIT group, the perception of postoperative pain was less intense than CT group. The patients in the MIVAT (7 ± 1.5) and MIT (8 ± 2) groups were more satisfied with the cosmetic results than those in CT group (5 ± 1.3) ($p < 0.05$).*

CONCLUSIONS: *The MIT is a technique totally reproducible, and easily convertible to perform surgical procedures in respect of the patient, without additional complications, increased costs, and with better aesthetic results.*

KEY WORDS: Minimally Invasive Thyroidectomy (MIT), Minimally invasive video-assisted thyroidectomy (MIVAT), Thyroidectomy

Introduction

Thyroidectomy, one of the most performed surgical intervention, is traditionally completed through an incision as a "collar" at the base of the neck, as described by

Kocher in 1909. However, due to the incision length (usually from 6 to 10 cm), Conventional Thyroidectomy (CT) often results in a little aesthetic scar. Since Gagner¹ reported an endoscopic approach to the parathyroid glands, various techniques have been described and popularised for thyroid surgery as well ²⁻⁴. Using techniques that require smaller incisions is expected to minimize the aesthetic damage of this surgical procedure, highly important principle if one considers that the majority of patients affected by thyroid disease are young women for whom the aesthetic result is important, especially in an area like the neck ⁵. The term Minimally Invasive Thyroidectomy (MIT) refers to a wide range of techniques described in literature; the concept of MIT is attractive because patients are concerned not only about

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Abbreviations

Conventional Thyroidectomy (CT); Minimally Invasive Thyroidectomy (MIT); Minimally invasive video-assisted thyroidectomy: MIVAT

the results of treating their thyroid disease, but also outcomes such as better cosmesis and decreased pain. Many different techniques have been developed for MIT over a short period; these can be broadly classified into pure endoscopic techniques, video-assisted techniques and minimally invasive open surgery. Minimally invasive video-assisted thyroidectomy (MIVAT) is the most widely used MIT technique. MIVAT was first introduced and popularized by Miccoli 6 in Italy in the late 1990s. It has been extensively used in other parts of the world and appears to be an excellent minimally invasive approach to the thyroid. Minimally invasive open surgery techniques are also known as “small incision thyroidectomy” and do not require specialized instruments like endoscopes and video assistance. Broadly speaking these techniques are similar to conventional thyroidectomy but differ only in the length of the incision. Numerous studies demonstrated the efficacy of MIVAT and MIT (performed through a 3 – 5 cm skin incision), regarding both as aesthetic results as procedure security. However, the majority of patients have thyroid volume and nodules size too large to be treated with MIVAT; at the same time, however, in most cases thyroidectomy can be performed avoiding large skin incision as done during CT. Judicious patient selection is the most important cornerstone for the success of any MIT technique for both benign and malignant thyroid swellings. At present, there are no specific criteria laid down for deciding suitability of a particular candidate for MIT; however, there appears to be a consensus on the size of tumor (< 35 mm for benign and < 20 mm for malignant thyroid nodule/gland). Other commonly agreed indications for MIT are that there should be no previous irradiation or surgery. Low-risk papillary carcinoma without any sub-

sternal extension and extra-thyroidal spread is the only malignant thyroid disease suitable at the moment. Aim of this study was to establish if the indication for different approaches for thyroidectomy and the incision length provided by means of preoperative assessment of gland volume and size of nodules resulted in safe and effective outcomes and in any notable aesthetic or quality-of-life impact on patients.

Material and Methods

In the setting of a prospective study, 982 consecutive patients [213 men (21.7%, mean age 45±14.5 years), 769 women (79.3%, mean age 39±16 years)], undergoing total thyroidectomy between January 2007 and December 2011, were enrolled. Indications for surgery are listed in Table I; each subject provided a specific informed consent, including description of the procedure (MIVAT, MIT or CT), before being part of the study. Ethical Committee of Second University of Naples approved study protocol. Preoperative ultrasound evaluations of thyroid gland volumes (ml) are reported as the mean±SD. A mathematical formula (calculated by the ellipsoid volume formula with $\pi/6$ (0.524) as correction factor), able to predict the thyroid volume from the US, provided by US software (Esaote MyLab Desk3), was applied. Also, maximal nodule diameter was measured (mm) by means of US and recorded. Patients underwent MIVAT when the thyroid nodule did not exceed 35 mm and/or the thyroid volume was less than or equal to 30 ml. MIT approach was chosen in presence of a nodule between 35 and 50 mm and/or thyroid total volume was between 30 and 80 ml. In presence of thyroid volumes greater than 80 ml and/or a thyroid nodule larger than 50 mm, recurrences, high-risk carcinomas and suspected positive lymph-nodes, CT performed through incision greater than 5.5 cm was indicated. The MIVAT is characterized by a single access of 2 to 2.5 cm in the middle neck area approximately 2 to 2.5 cm above the sternal notch. The midline is incised, and a blunt dissection is performed to separate the strap muscles from the underlying thyroid isthmus. From this point on, the procedure is performed endoscopically without gas but with

TABLE I - Demographic baseline and preoperative diagnosis

Demographics	Total N= 982	MIVAT N = 179 (18.2%)	MIT N = 592 (60.3%)	CT N = 211 (21.5%)
Sex ratio male/female	213/769	36/143	130/462	47/164
Mean age	45±14.5	43±10.5	44±14	47±15.2
Multinodular goiter	781 (79.6%)	147 (18.8%)	474 (60.7%)	160 (20.5%)
Plummer Adenoma	14 (1.4%)	2 (14.3%)	10 (71.4%)	2 (14.3%)
Basedow	79 (8.1%)	9 (11.4%)	55 (69.6%)	15 (19%)
Carcinoma	108 (11%)	21 (19.4%)	53 (49%)	34 (31.6%)

external retraction. A 5-mm 30° endoscope is used. The optical magnification allows good visualization for the external branch of the superior laryngeal nerve, the recurrent laryngeal nerve, and the parathyroid glands. The vessels are ligated with the Harmonic Ace scalpel (Ethicon Endo-Surgery Inc., Cincinnati, OH, USA) until the lobe is completely free for extraction through the skin incision. The isthmus of the thyroid gland then is dissected from the trachea and divided. Finally, the lobe is removed. After a check for hemostasis and identification of the recurrent laryngeal nerve, a small drain is placed in the thyroid bed. The strap muscles are closed with one or two absorbable stitches and the skin incision by an intracutaneous running suture, without any drainage and glue for the skin sealing. The MIT procedure consists of a 3- to 5-cm skin incision 1 to 1.5 cm above the sternal notch. After division of the platysma, the cervical linea alba is opened without division of the strap muscles. The thyroid lobe is dissected progressively from the strap muscles. After identification of the recurrent laryngeal nerve and parathyroid glands, the vascular pedicles of the thyroid lobe are ligated with the Harmonic Ace/Focus scalpel (Ethicon Endo-Surgery Inc., Cincinnati, OH, USA), and the thyroid lobe is removed 7,8. After a check for hemostasis, a drain is placed in the thyroid bed. The cervical linea alba and platysma are sutured with absorbable sutures, and the skin is closed by an intracutaneous running suture. The CT procedure differs from MIT only because performed through a 6- to 7-cm skin incision. The data concerning the following parameters were collected: operative time, postoperative complications, postoperative pain and cosmetic results. All patients received the same postoperative protocol. All patients in the study were discharged on postoperative day 3 (72 h after surgery) for better evaluation of the postoperative course. The postoperative follow-up care included indirect laryngoscopy to check vocal cord mobility. An indirect laryngoscopy was performed on postoperative day 2 to assess transitional or permanent paralysis of laryngeal nerve; in case of incidence of dysphonic voice, laryngoscopy was also reconsidered after 1 week and 3 months. Blood loss was considered significant when patient needed to return to OR. The serum calcium level also was measured for all patients

at 6, 12, 24, 48 hours. In case of symptomatic hypocalcemia, intravenous calcium was administered; in asymptomatic hypocalcemic patient, oral calcium was given. Postoperative pain was assessed by means of a visual analog scale (VAS) ranging from 0 (no pain) to 10 (maximal pain) at 8, 24, 36, and 48 h after surgery by a physician, fellow or a nurse. With the same method, at 1-6 months after operation, all the patients were asked to evaluate the cosmetic result of the procedure (where 10 in the scale means most excellent cosmetic result). Data are expressed as mean (range) or mean \pm SD as appropriate. Group differences were examined by the Student's t test and Wilcoxon signed rank test; categorical data were analyzed by the Fisher's exact test. Statistical significance was set at $P < 0.05$.

Results

The MIVAT group included 179 patients (18.2%), MIT group included 592 patients (60.3%) and CT group included 211 patients (21.5%). The three groups were well matched for age and gender (Table I). The mean operative time showed a significant difference: 69.4 ± 19 min for MIVAT, 54.1 ± 12 min for MIT and 46.3 ± 14 min for CT. The average length of the skin incision was 1.5 ± 0.5 cm, 3.4 ± 0.2 and 8.2 ± 1 cm respectively in groups of MIVAT, MIT and CT. In particular, in 75% of patients undergone MIT, skin incision length was 4 cm, in 15% of cases of 3 cm and in the remaining 10% of 5 cm. Incidence of complications did not differ significantly in each group. Definitive laryngeal paralysis occurred in 0.56% after MIVAT, 0.17% after MIT and 0.48% since CT (1 case per group). Definitive hypoparathyroidism (6 months $>$) occurred in 1 case (0.56%) after MIVAT, in 4 cases after MIT (0.68%) and in 2 cases after CT (0.95%). One postoperative bleeding requiring intervention was observed in MIT group (0.17%) and one in the CT group (0.48%). Detailed findings about complication are shown in Table II. In MIVAT and MIT group, the perception of postoperative pain was less intense than CT group. The postoperative VAS was 2.6 ± 2.1 (range: 0-8) for MIVAT, 2.6 ± 1.9 (range: 0-7) for MIT and 2.9 ± 2.2 (range 1-8)

TABLE II - Surgical complications in 982 consecutive patients undergoing MIVAT, MIT and CT.

Complications	MIVAT	MIT	CT	P
Total patients	179 (18.2%)	592 (60.3%)	211 (21.5%)	N.S.
Transitory Hypocalcemia	14 (7.83%)	47 (7.94%)	18 (8.54%)	N.S.
Definitive Hypocalcemia	1 (0.56%)	4 (0.68%)	2 (0.95%)	N.S.
Bleeding	0	1 (0.17%)	1 (0.48%)	N.S.
Transitory Laryngeal Paralysis	1 (0.56%)	2 (0.34%)	2 (0.95%)	N.S.
Definitive Laryngeal Paralysis	1 (0.56%)	1 (0.17%)	1 (0.48%)	N.S.
Total Complications	17 (9.49%)	55 (9.26%)	26 (11.4%)	N.S.

TABLE III - Pain VAS score after 8, 24 and 36 h in patients undergoing MIVAT, MIT and CT.

	MIVAT (179)	MIT (592)	CT (211)	P
VAS score 8h	2.6± 2.1 (Range: 0–8)	2.6±1.9 (Range: 0–7)	2.9±2.2 (Range 1-8)	N.S.
VAS score 24H	1.7±1.5 (range: 0–6)	2.1±1.8 (range: 0–7)	2.4±2.1 (range 0-7)	N.S.
VAS score 36H	1.1±1.3 (range: 0–5)	1.0±1.2 (range: 0–6)	1.9±1.9 (range 0-7)	<0.05

TABLE IV - Results summary from different studies comparing MIVAT, MIT and CT

References	N PT	Technique	RESULTS
PERIGLI et al ²³	957	MIVAT vs MIT vs CT	Comparable safety Reduced post-operative pain (MIVAT e MIT) Best aesthetic result (MIVAT e MIT)
DEL RIO et al ²⁴	113	MIVAT vs MIT	Reduced post-operative pain (MIVAT)
TERRIS et al ²⁵	48	MIVAT vs MIT	Comparable safety Smaller skin incision (MIVAT)
HEGAZY et al ²⁶	68	MIVAT vs MIT	Reduced post-operative pain (MIVAT) Appearance similar (MIVAT e MIT) Increased operative time (MIVAT)

TABLE V - Different studies summary for thyroidectomy feasibility through different incision length

References	Skin Incision Length	% Patients
Ferzli et al ³	2,5 - 4 cm	90%
Perigli et al ²³	< 3,5 cm	22,4%
Rafferty Et Al ²⁷	4 cm	75%
Cavicchi et al ²⁸	< 3 cm	15,5%

for CT 8 h after the operation [p=0.8], 1.7±1.5 (range: 0–6) for MIVAT, 2.1±1.8 (range: 0–7) for MIT and 2.4±2.1 (range 0-7) for CT 24 h after the operation [p=0.16], 1.1±1.3 (range: 0–5) for MIVAT, 1.0±1.2 (range: 0–6) for MIT and 1.9±1.9 (range 0-7) for CT 36 h after the operation [p= <0.05]. Also, use of drugs was significantly different in MIVAT (60 mg of ketorolac) and MIT (70 mg of ketorolac) group vs. CT group (90 mg of ketorolac) [p= <0.05]. The patients in the MIVAT (7±1.5) and MIT (8±2) groups were more satisfied with the cosmetic results than those in CT group (5±1.3) [p= <0.05].

Discussion

Several techniques for video-assisted and endoscopic thyroidectomy have been described during the past decade. Thyroidectomy, one of the most common operations worldwide, has low morbidity rate if performed by skilled surgical teams. Conventional thyroidectomy requires a transverse cervical incision that leaves a visible scar on the anterior surface of the neck. The application of minimally invasive techniques for thyroid surgery was motivated primarily by the attempt to improve the cosmetic results of this operation. The aesthetic point of view is particularly important for young women, as they constitute a large part of patients affected by thyroid disease. Findings have shown that minimally invasive procedures for thyroid surgery have some advantages over conventional surgery of cosmetic result and postoperative recovery. However, beyond the description of individual techniques and their possible advantages or disadvantages, it is essential to use a common language that allows a comparison between the various procedures ^{9,10}. In fact, the expression Minimally Invasive Thyroidectomy refers to a wide range of techniques described in the literature. This definition is not limited only to the extent of surgical

TABLE VI - Proposed classification for different thyroidectomy intervention based on thyroid volume and nodule size

	Thyroid Volume	Nodule Size	Intervention	Patients
I GROUP	V< 30 ml	N<3 cm	MIVAT	20%
II GROUP	30<V<80 ml	3<N<5 cm	MIT	70%
III GROUP	V>80 ml	N>5 cm	CT	10%

incision but also considers other issues such as site, extent of surgical dissection, operative time, postoperative pain, rates of complications and aesthetic results¹¹. The traditional cervicotomy is classically defined as a curvilinear skin incision with slight concavity above the base of neck, in front, generally practiced two fingers above the sternal notch, with a length between 6-10 cm, today less than that one proposed by Kocher but still longer than 5 cm. Instead we usually define as minicervicotomy skin incisions between 1.5 and 5 cm. However, a skin incision shorter than 5 cm is not sufficient to consider a procedure as mini-invasive. Certainly the idea of mini-invasive surgery can be less when multiple incisions are made in cervical district¹², or when an extensive dissection for access to the operative field is required, as commonly practiced during robotic surgery with extracervical access, that if on the one hand it eliminates cervical incision, on the other hand, it needs a wider tissues dissection^{13,14}. For this reason, we prefer to consider minimally invasive, along with MIVAT, those surgical procedures performed "via" a cervicotomy shorter than 5 cm, with direct access to the gland and allowing an anatomical dissection and focused to this organ. Moreover, MIT has none of the additional complications that can occur with the endoscopic technique with insufflation of CO₂, such as hypercapnia, emphysema, and pneumomediastinum, and can be converted into conventional thyroidectomy when necessary⁴. The MIVAT technique proposed by Miccoli, a gasless procedure, for its features including a minicervicotomy and a direct access to the gland, where the scope is just a visual aid^{6,15}, return to full membership in the group of minimally invasive procedures enabling surgical treatment of small nodular pathology by means of incisions ranging from 1.5 to 3 cm¹⁶⁻¹⁸. The volume of the gland, pathology and the size of the nodules represent the limit of this method that can be proposed only in some of patients between 10 and 20% of cases. By the way, a significant proportion of patients who cannot enrolled to MIVAT may submit to MIT, which does not differ to CT regarding surgical technique, but it is accomplished through an incision between 3 and 5 cm at a fold of the neck about 2-3 cm above the sternal notch, under direct vision without the need for any endoscopic aid¹⁹. Previous studies verified safety and feasibility of performing thyroidectomy "via" the mini-cervicotomy. Nenkov. reported 145 MIT performed "via" a skin incision between 2.5 and 3.5 cm without complications, concluding that MIT is a simple, secure and feasible procedure in accurate selected patients²⁰. Sturniolo analyzed 125 out of a total of 1356 patients undergone thyroidectomy performed by means of a minicervicotomic access concluding that MIT, in selected cases, involves some benefits including: best cosmetic results, minimal post-operative pain, high patient satisfaction²¹. Other studies evaluated the outcomes of

MIVAT and MIT compared to CT, showing reduction in postoperative pain and a better cosmetic results; Table IV summarizes results from different studies²²⁻²⁵. Feasibility of performing total thyroidectomy through different length of incision are summarized in Table V^{3,22,26-28}. Our findings are consistent to those presented in previous study. In fact, even if operative times were greater for MIVAT group, incidence of postoperative complications, such as transient hypocalcemia, bleeding or reinterventions were similar in the three groups, demonstrating feasibility and safety of minimally invasive approach. Also, in the MIVAT and MIT groups, we observed better cosmetic results and less post-operative pain. From our experience and from the analysis of literature, we believe that patients undergo thyroidectomy can be classified into three useful groups, able to indicate a safe and effective surgical approach:

- I GROUP: patients with up to 3 cm nodules and thyroid volume up to 30 ml (approximately 20%);
- II GROUP: patients with nodules between 3 and 5 cm and thyroid volume between 35 and 80 ml (about 70%);
- III GROUP: patients with nodules and volume over the 5 cm and 85 ml, including those that require lymphectomy (about 10%).

Considering this classification (Table VI), we can suggest that the first group can be safely undergoing to MIVAT, where the third group is candidate to a traditional cervicotomy. However, the second group, which is the largest one, represents the cornerstone; it can be treated with a mini-cervicotomy (meaning an incision between 3 and 5 cm), with a similar incidence of complications for MIVAT and CT, but with less postoperative pain and more satisfactory aesthetic results.

Conclusion

In high-volume centers, thyroid surgery can be safely performed "via" a mini-cervicotomy. Pre-operative ultrasound study to investigate the size and thyroid volume can be very useful, allowing to stratify patients eligible to minicervicotomic access. The MIVAT is certainly the minimally invasive approach allowing the best results with postoperative pain and aesthetical but it can be applied only to a reduced percentage of patients not exceeding 20% of the cases. The MIT, with an incision between 3 and 5 cm, represents a valid alternative when MIVAT cannot be indicated (approximately 70% of patients). CT, instead, can be reserved only to that patients with thyroid diseases particularly voluminous and still with a volume of over 80 ml, reoperations, plunged goiter, advanced tumors. The MIT is a technique totally reproducible, and easily convertible to perform surgical procedures concerning the patient, without additional complications, increased costs, and with better aesthetic results.

Riassunto

OBIETTIVO: Stabilire se la giusta indicazione per i diversi approcci e diverse lunghezze dell'incisione nell'esecuzione di una tiroidectomia, preceduta da una adeguata valutazione pre-operatoria del volume ghiandolare e delle dimensioni dei noduli, determini risultati sicuri ed efficaci, sia dal punto di vista estetico che sulla qualità di vita dei pazienti.

MATERIALI E METODI: Sono stati arruolati 982 pazienti consecutivi, sottoposti a tiroidectomia totale. Il volume della tiroide e diametro massimo nodulo sono stati misurati mediante ecografia ed i pazienti sono stati divisi in tre gruppi: tiroidectomia mini-invasiva video assistita (MIVAT), tiroidectomia mini-invasiva (MIT) e la tiroidectomia convenzionale (CT). Sono stati raccolti I dati riguardanti i seguenti parametri: tempo operatorio, dolore e complicanze post-operatorie, risultati estetici.

RISULTATI: Il gruppo MIVAT ha incluso 179 pazienti, il gruppo MIT 592 e il gruppo CT 211 pazienti. L'incidenza di complicanze non ha mostrato differenze significative in ciascun gruppo. Nei pazienti sottoposti a MIVAT e MIT, la percezione del dolore post-operatorio è stato meno intensa del gruppo sottoposto a CT ed il grado di soddisfazione del gruppo MIVAT ($7 \pm 1,5$) e MIT (8 ± 2) gruppi si dichiaravano erano più soddisfatti con i risultati estetici rispetto a quelli in CT gruppo ($5 \pm 1,3$) [$p = <0,05$].

CONCLUSIONI: La MIT è una tecnica facilmente riproducibile e facilmente convertibili senza aumento del tasso di complicanze, senza aumento dei costi, e con migliori risultati estetici

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