Minimally Invasive Video-Assisted Thyroidectomy

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7.1 Introduction

Over the last few decades, different minimally invasive procedures have been proposed for the treatment of thyroid and parathyroid diseases with the primary aim of improving the cosmetic results [1]. Indeed, minimization or elimination of the cervical scar is particularly appealing to patients, particularly women, undergoing thyroid surgery.

In 1996, Gagner described the first endoscopic parathyroidectomy with a cervical access [2], later stating that "As for the other minimally invasive techniques, decreased pain and better cosmetic results may be the greatest expectations from this procedure due to the decreased size of skin incision" [3]. However, the concept of a minimally invasive approach should probably also imply the capability of an innovative technique to minimize the trauma of the surgical exposure, while providing equal operative mortality and morbidity to the traditional counterpart by means of proper application of technological developments and improvements [4]. Other approaches were soon developed, partly to avoid long insufflations in the neck and partly to find effective minimally invasive routes for thyroidectomy.

In 1997, Miccoli et al. described the first video-assisted procedure in the neck for a parathyroidectomy [5]. In 1999, we described the technique for minimally invasive, totally gasless video-assisted thyroid lobectomy [6]. Soon after, Miccoli et al. published their preliminary results with a minimally invasive approach to thyroidectomy [7].

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More than 20 years after its first description, minimally invasive video-assisted thyroidectomy (MIVAT) is one of the most widespread minimally invasive approaches to thyroidectomy [8–10]. Its peculiarity, and the reason for its success, resides in the advantages related to endoscopic magnification that allow the surgeon to perform the same steps as conventional thyroidectomy through a small single neck access [11–14]. Indeed, MIVAT is performed in part under endoscopic view and in part under direct vision. The endoscope magnification allows easier identification of structures located in the narrow space of the neck (inferior laryngeal nerve, external branch of the superior laryngeal nerve, parathyroid glands) that need to be preserved.

It has been demonstrated that MIVAT is a reproducible, safe, and effective technique that can yield the same results as conventional surgery, with advantages in terms of improved cosmetic outcome and reduced postoperative pain [15–19]. Multi-institutional series have further confirmed its efficacy and safety in different clinical settings [8]. MIVAT is comparable to conventional open thyroidectomy in terms of oncologic radicality, time, costs and complication rates [14, 17, 20–22].

In selected cases, MIVAT can be successfully accomplished under local anesthesia, to further minimize its invasiveness [23].

An accurate patient selection plays a key role in ensuring the success of MIVAT [24].

7.2 Surgical Technique

The operative technique has been previously described in detail [25, 26].

- *Patient and surgical team positions*. The patient is supine with the neck in slight extension. The surgical team is composed of the surgeon and two assistants, one of whom handles the endoscope. The absence of any external support allows the endoscope's position to be modulated and changed in relation to the different steps of the dissection.
- *Anesthesia*. MIVAT is usually performed under general anesthesia with endotracheal intubation. With increasing experience, MIVAT can be successfully performed under local anesthesia with superficial modified deep cervical block in selected patients [23].
- *Surgical equipment*. Most of the surgical equipment required for MIVAT is usually available in almost all operating rooms, and it is not a source of additional costs. The only dedicated instruments are small reusable dissection tools: ad hoc designed spatulas and spatula-shaped aspirator. Sealing systems are proven to be useful by allowing a decreased operative time [27].
- *Surgical procedure*. A small (1.5–2 cm) skin incision (Fig. 7.1) is performed between the cricoid cartilage and the sternal notch, in the midline. The cervical *linea alba* is opened as far as possible. The thyroid lobe is then separated from the strap muscles by means of Farabeuf retractors. The thyroid lobe is medially retracted while the strap muscles are laterally retracted. At this point, the

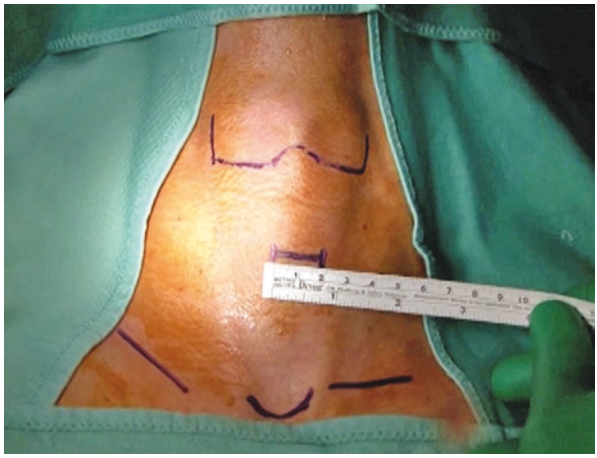

Fig. 7.1 A small skin incision (1.5–2 cm) is performed between the cricoid cartilage and the sternal notch

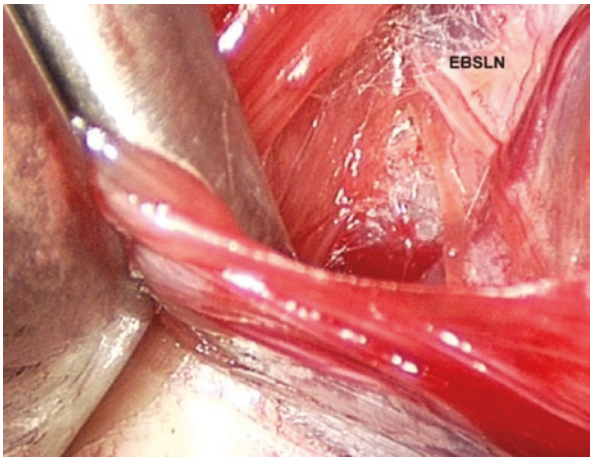

Fig. 7.2 Identification of the external branch of the superior laryngeal nerve (*EBSLN*)

endoscope (5 mm, 30°) and instruments (2 mm in diameter) are introduced through the single skin incision. The first step of the procedure consists of completely freeing the thyroid gland from the strap muscles, down to the prevertebral fascia, which represents the posterior aspect of the dissection. The lateral edge of the dissection is represented by the medial aspect of the common carotid artery, and the medial edge is represented by the tracheoesophageal groove. The dissection is carried out by a blunt technique using two dedicated instruments ("spatulas"); one of the instruments is connected to an aspiration system. After its complete separation from the muscles, the thyroid lobe is retracted downwards, in order to expose the upper pole. During this step, it is usually possible to identify the external branch of the superior laryngeal nerve thanks to the magnification of the endoscope (Fig. 7.2). The thyroid lobe is then retracted medially and slightly upwards to identify the inferior laryngeal nerve (ILN) and the parathyroid glands. The ILN is identified where it crosses the inferior thyroid artery

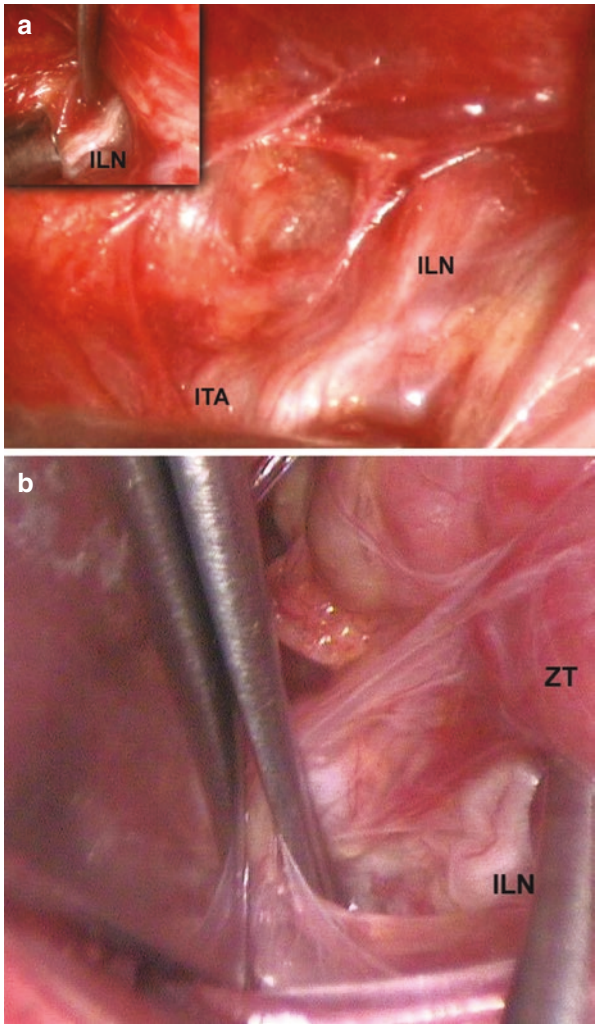

Fig. 7.3 (**a**) The inferior laryngeal nerve (*ILN*) is identified where it crosses the inferior thyroid artery (*ITA*). (**b**) The Zuckerkandl tubercle (*ZT*) can be another useful landmark to identify the ILN

(Fig. 7.3a). The Zuckerkandl tubercle can be another useful landmark to identify the ILN (Fig. 7.3b), as in the conventional procedure. The parathyroid glands are usually easily identified and preserved thanks to the assistance of endoscopic magnification (Fig. 7.4). At this point, the thyroid lobe is extracted and the procedure is completed under direct vision.

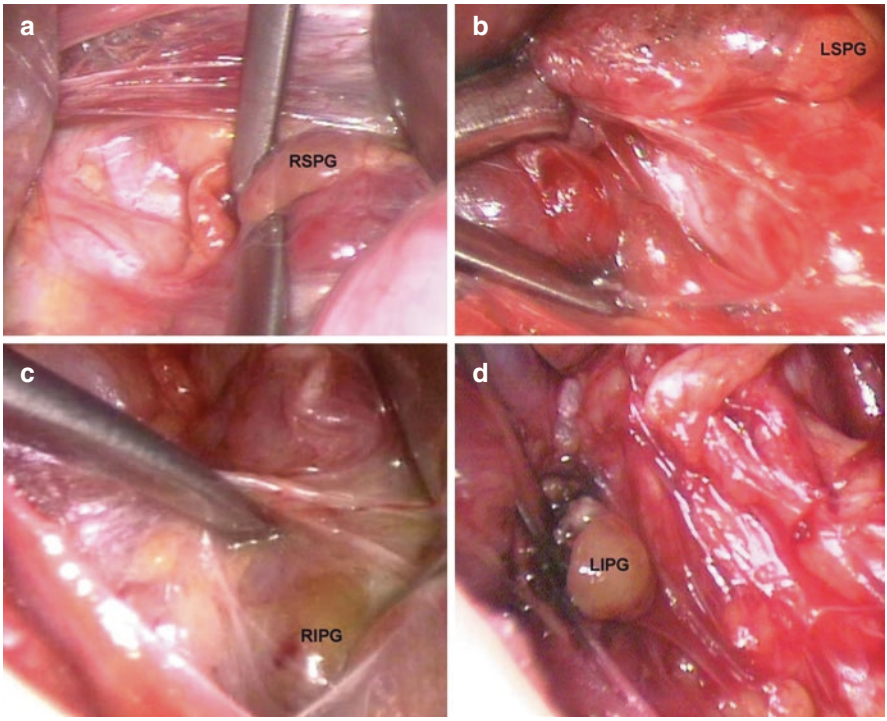

Fig. 7.4 Identification of the parathyroid glands. (**a**) Right superior parathyroid gland (*RSPG*). (**b**) Left superior parathyroid gland (*LSPG*). (**c**) Right inferior parathyroid gland (*RIPG*). (**d**) Left inferior parathyroid gland (*LIPG*)

7.3 Indications

An accurate patient selection plays a key role in ensuring the success of MIVAT. In the early experience with MIVAT the indications were quite limited. Indeed, initial contraindications included thyroiditis and prior neck surgery. With increasing experience, the selection criteria for MIVAT have been widened. Patients with previous contralateral video-assisted neck surgery or thyroiditis can be selected for MIVAT. Similarly, other authors demonstrated that in selected patients with Graves' disease, MIVAT is feasible and safe [12, 28].

In our experience, MIVAT is indicated in the case of nodules ≤35 mm in the largest diameter and in patients with an estimated thyroid volume ≤ 30 mL [24].

Ideal candidates for MIVAT are patients with small nodules with indeterminate or suspicious cytology. In addition, small size hot nodules represent the best indication for this kind of surgery.

Selected patients with papillary thyroid carcinoma (PTC) could be eligible for MIVAT. Indeed, progressive extension of the indications for the video-assisted approach led to the use of MIVAT for the treatment of small PTC [29–32]. Findings

from previous small comparative studies have confirmed the hypothesis that MIVAT produces a complete operative resection comparable with that of conventional surgery [29, 30, 33] with no additional risk of seeding of cancer cells [17].

However, although we have successfully performed a large series of video-assisted lymph node dissections of the central node in PTC with unexpected intraoperative evidence of lymph node enlargement [20], preoperatively diagnosed lymph node involvement represents a contraindication for MIVAT [24].

RET mutation carriers in the absence of detectable nodules and basal/stimulated calcitonin in the normal range are excellent candidates for MIVAT [34].

We believe that an accurate preoperative ultrasound examination, even better if performed by the surgeon, plays a pivotal role in proper patient selection for MIVAT.

In our experience, the rate of patient selection for MIVAT according to the reported indications is about 30% [24]. Similarly, a rate of 30% has been reported in the United States [21, 35], whereas Miccoli et al. recently reported a rate of 20% [36].

7.4 Outcomes

7.4.1 Postoperative Outcome

In a review of our experience in a series of patients who underwent MIVAT over a 10-year period [37], we observed a conversion rate of 0.5% (7/1363), one definitive inferior laryngeal nerve palsy (2507 nerves at risk) and a rate of definitive hypoparathyroidism of 0.8% (10/1175 total thyroidectomies).

Indeed, the postoperative complication rate of MIVAT, similarly to other experiences [14, 36], is comparable to that of the conventional open procedure. In addition, compared with standard thyroidectomy MIVAT has no additional costs [38], and it improves postoperative pain, as demonstrated in a prospective randomized study [39].

The incidence and severity of early voice and swallowing post-thyroidectomy symptoms, in the absence of objective laryngeal nerve injury, are significantly reduced in patients who undergo MIVAT compared with conventional surgery (evidence level II B) [40].

7.4.2 Oncologic Outcome

The results of MIVAT in the case of small “low-risk” PTC are encouraging [31]. In addition, the minimally invasive approach allows adequate clearance of the central neck lymph nodes. Indeed, in a case-control study [41], we compared two groups of patients with PTC who underwent video-assisted or conventional central neck node dissection. The two groups had a similar mean operative time, complication rate, and number of removed and metastatic lymph nodes. Comparative analysis of the follow-up data showed no significant differences between the two groups in terms

of mean serum thyroglobulin levels off levothyroxine suppressive treatment and mean postoperative quantitative ^{131}I neck uptake obtained prior to radioactive iodine therapy.

In order to evaluate the long-term oncologic outcome of PTC patients undergoing MIVAT, we considered all the patients with a minimum of 10 years follow-up [42]. We accurately focused our research on follow-up data including a series of 257 patients with an overall mean follow-up of 144.2 ± 37.3 months (range 120–197). In this relatively long follow-up period, we observed no local recurrences and three lateral neck nodal recurrences 2, 3 and 11 years after the initial surgical treatment. It should be considered that the only recurrences we observed occurred in the lateral neck nodes and not on the thyroid bed. On this particular aspect, it should be stressed once more that the video-assisted approach with central access allows the surgeon to perform a formal central neck compartment dissection when needed, even though overt central neck involvement should be considered a contraindication for the video-assisted procedure.

The results of MIVAT for the treatment of selected PTC patients are encouraging, even in the long term. These results further confirm that MIVAT is a safe and effective option for selected patients with PTC, when strict selection criteria are followed.

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