NEW TECHNOLOGIES IN SURGERY:  
DIAGNOSIS AND TREATMENT OF COMPLICATIONS OF MIVAT  
(MINIMALLY INVASIVE VIDEO-ASSISTED THYROIDECTOMY)  

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The aim of the study was to present evolution of the technique of minimally invasive video-assisted thyroidectomy, its advantages, limitations and possible complications related to the method.  

Material and methods. Minimally invasive video-assisted thyroidectomy (MIVAT) is characterized by a unique central incision of 1.5 cm, 2 cm above the sternal notch. The operative space is maintained by means of an external retraction: no gas insufflation is utilized. Potential complications of Minimally Invasive Video-assisted Thyroidectomy (MIVAT) are roughly the same as in open surgery.  

Results. Since June 1998 to March 2008 1524 patients underwent a minimally invasive video-assisted thyroidectomy. Complications were represented by transient monolateral recurrent nerve palsy in 38 cases (2.4%), definitive monolateral recurrent nerve palsy in 18 cases (1.1%), bilateral transient recurrent nerve palsy in 2 cases. Fifty five patients exhibited a hypoparathyroidism, which corresponds to 5.1% of the 1059 total thyroidectomies performed, but only 5 complained of a permanent hypocalcemia which necessitated a substitutive therapy, thus reducing the rate of permanent hypoparathyroidism to 0.4%. We registered in two cases of postoperative bleeding requiring re-operation; wound sepsis occurred in three cases.  

Conclusions. MIVAT unlike other minimally invasive endoscopic techniques proposed for thyroidectomy, reproduces the standard operation and does not introduce any modification of the traditional technique and in our series total complication rate resulted similar to that described in literature for standard thyroidectomy in large series. As long as these criteria are carefully respected one need not to be concerned that these techniques might increase the complication rate.  

Key words: minimally invasive videoassisted thyroidectomy, complications  

The Gagner report (1) describing endoscopic subtotal parathyroidectomy for secondary hyperparathyroidism in 1996 represented the first application of a minimally invasive technique to the field of endocrine neck surgery.  

Since then, several minimally invasive approaches to thyroid gland (2-7) have been described, all of them aiming to improve the cosmetic outcome, reduce the postoperative pain and improve the postoperative recovery, either performing the incision in a not visible area such as the axilla or around the nipple, or minimizing the hyperextension of the neck and reducing the length of the scar in the neck.  

The thyroid gland is highly vascularized and surrounded by critical nerves and blood vessels, so a variety of ingenious contrivances have been devised to address the challenges associated with this organ. In tab. 1 the different approaches are summarized.  

The development of these new techniques added also new sort of complications to those already typical of traditional thyroid surgery.
Subcutaneous emphysema was described firstly by Gottlieb et al. (8) after endoscopic parathyroidectomy, but this complication, associated also with hypercarbia and tachycardia, is possible during any endoscopic thyroid procedure in which the operative space is maintained by insufflation. In fact the neck cannot be considered a pre-determined cavity, being not circumscribed by a continuous serosal layer such as the pleura or the peritoneum which actually avoid a massive passage of carbon dioxide from the cavity to the blood stream. The carbon dioxide insufflation method creates operating space by insufflating the neck after incising the skin and the lower layer of platysma. Some authors though, who usually perform this procedure, suggest that just lowering the carbon dioxide pressure even to 4 mm Hg in order to avoid the described complication (9, 10).

The gasless anterior neck skin lifting method described by Shimizu et Tanaka (11) and based of the Nagai method for the abdomen (12), in which the edges of the chest wall wound and the lateral neck wound are pulled by sutured threads to create the working space (fig. 1), potentially could encounter a new complication represented by the rupture of the skin due to excessive traction.

Potential complications of Minimally Invasive Video-assisted Thyroidectomy (MIVAT) are roughly the same as in open surgery. In fact, this minimally invasive technique described by Miccoli in Pisa in 1998, does not present any new additional risk or variant such as gas insufflation of special retraction described in other minimally invasive endoscopic thyroid procedures (4, 5, 6).

At this point is important to recall the common thyroidectomy complications, summarized as follows:
- inferior laryngeal nerve injuries,
- external branch of the superior laryngeal nerve injuries,
- bleeding,
- hypoparathyroidism.

Inferior laryngeal nerve injuries can be temporary (resolution within 6 months-one year) or definitive, monolateral or bilateral and represent with hypoparathyroidism the most frequent complication of thyroidectomy. The causes most frequently responsible for nerve damage are accidental section of the nerve, perineural edema consequent to manipulation, stretching, heating. The incidence of this complication is most variable in literature depending from type of disease, type of operation and surgeon experience. The rate of definitive palsy is around 1% but ranges from 0.5 to 14% in literature (13-18).

The external branch of the superior laryngeal nerve innervates the crico-thyroid muscle which is responsible of vocal fold tension. The nerve is jeopardized during section of the upper pedicle, due to the variability of its course. The incidence of this complication is underestimated because symptoms are minimal and demonstration of damage difficult.

Bleeding is considered the most life-threatening complication. Postoperative bleeding can be defined as early (within 10 hours) or delay-
ed (after 10 hours). The former are often massive and require immediate reintervention for compressive haematoma, while the delayed bleeding usually do not cause airway obstruction and are treated conservatively.

Hypoparathyroidism can be transitory (resolution within 6 months-one year) or definitive. It is considered the most frequent complication following total thyroidectomy. Transitory hypocalcemia is reported in literature ranging from 0.5 to 16% while definitive ranges from 0.5% to 12% (13-18).

MATERIAL AND METHODS

MIVAT-technique

Briefly, minimally invasive video-assisted thyroidectomy (MIVAT) is characterized by a unique central incision of 1.5 cm, 2 cm above the sternal notch. The operative space is maintained by means of an external retraction: no gas insufflation is utilized. Subcutaneous fat and platysma are carefully dissected so to avoid any minimum bleeding. The cervical linea alba is divided longitudinally as much as possible (3-4 cm). A 30° 5-mm endoscope is inserted through the skin incision. Under endoscopic vision (fig. 2) the dissection of the thyrotracheal groove is completed by using small (2 mm in diameter) instruments: atraumatic spatulas in different shapes, spatula shaped aspirator, ear-nose-throat forceps and scissors (fig. 3). Haemostasis is achieved by means of small (3 mm) vascular clips either conventional or disposable and in particular when operating on thyroid, by ultrasonic shears (Harmonic®).

A careful selection of the patients is the only guarantee of a low incidence of complications and a good outcome. In fact, only a minority of the cases are eligible for a video assisted approach to the thyroid. An important limit is, at present, the volume both of the nodule and of the gland to be operated on. The lobe in fact has to be removed without disrupting its capsule because of the necessity of an accurate histological evaluation being these nodules often suspect for a carcinoma (either follicular or papillary). Other limits of these techniques are represented by the presence of adhesions that can make dissection difficult to carry out: this can happen in presence of a redo surgery and also in presence of a thyroiditis unveiled both by increased thyroid antibodies and ultrasound aspects. General indications might be summarized as follows:
- thyroid nodules less than 30 mm on their largest diameter,
- thyroid gland volume less than 20 ml, as estimated by ultrasound,
- no history of thyroiditis,
- no previous neck surgery or irradiation.

RESULTS

Since June 1998 to March 2008 1524 patients underwent a minimally invasive video-assisted thyroidectomy (MIVAT). There were 1315 females and 209 males. Lobectomy was carried out in 465 patients, total thyroidectomy in 1059 patients. Mean operative time of

![Fig. 2. Endoscopic vision during MIVAT; the inferior laryngeal nerve is easily identified](image1)

![Fig. 3. Instruments for MIVAT](image2)
lobectomy was 32.3 (range 20-120) minutes, for total thyroidectomy was 42.1 (30-130) minutes.

The 3 most frequent preoperative diagnoses were respectively: papillary carcinoma (“low risk”) in 458 patients, follicular tumor in 441 patients, multinodular goiter in 372 patients. The other indications altogether account for not more than 20% of the total (tab. 2).

Conversion to standard cervicotomy was required in 36 cases (2.3%).

Complications were represented by transient monolateral recurrent nerve palsy in 38 cases (2.4%), definitive monolateral recurrent nerve palsy in 18 cases (1.1%), bilateral transient recurrent nerve palsy in 2 cases.

Fifty-five patients exhibited a hypoparathyroidism, which corresponds to 5.1% of the 1059 total thyroidectomies performed, but only 5 complained of a permanent hypocalcemia which necessitated a substitutive therapy, thus reducing the rate of permanent hypoparathyroidism to 0.4%. We registered in two cases (0.1%) of postoperative bleeding requiring reoperation; wound sepsis occurred in 3 cases (0.2%).

**DISCUSSION**

MIVAT unlike other minimally invasive endoscopic techniques proposed for thyroidectomy, reproduces the standard operation and does not introduce any modification of the traditional technique. Operative space is maintained by small retractors put on the strap muscles and neither by new device like skin lifting method nor by gas insufflation; the gland is approached from a central, anterior, cervical wound and neither laterally from the nipple nor from the axilla.

Moreover, during MIVAT, the magnification of the endoscope allows a better visualization of the structures and gentle dissection by means of spatulas and other atraumatic tools guarantees a less traumatic dissection. Some concerns might be expressed about stretching the parenchyma and the inferior laryngeal nerve during the extraction phase. At the beginning of our experience we recorded some transient nerve palsies probably due to that. Since then, complete dissection of the nerve during the endoscopic phase and lower traction on the lobe during the extraction, avoided at all this type of complication.

In our series total complication rate resulted similar to that described in literature for standard thyroidectomy in large series (tab. 3) (13-18).

Nerve injury rate in this series (both temporary and definitive) did not differ from the standard reported in literature (13-18). Is true that we had to cope with small thyroids but surely also the endoscope magnification gave a view of the nerves which, particularly for the superior laryngeal nerve, is far better than in the open operation. The external branch of the superior laryngeal nerve can be easily identified during most of the procedures once the different components of the upper pedicle have been prepared. Performing MIVAT we realized that the external branch of the superior laryngeal nerve is much easier to identify rather than during the standard procedure.

Also the inferior laryngeal nerve can be easily identified during MIVAT thanks to the magnification of the endoscope.

An excellent anatomical landmark for searching the inferior laryngeal nerve is the posterior lobe of the thyroid because it generally lies

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**Table 2. MIVAT: preoperative diagnosis**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number (Percentage)</th>
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<tbody>
<tr>
<td>Follicular adenoma</td>
<td>441 (28.9%)</td>
</tr>
<tr>
<td>Papillary carcinoma</td>
<td>458 (30%)</td>
</tr>
<tr>
<td>Multinodular goiter</td>
<td>372 (24.5%)</td>
</tr>
<tr>
<td>Hurthle cell adenoma</td>
<td>87 (5.8%)</td>
</tr>
<tr>
<td>Toxic goiter</td>
<td>10 (0.6%)</td>
</tr>
<tr>
<td>Toxic adenoma</td>
<td>35 (2.3%)</td>
</tr>
<tr>
<td>Graves' disease</td>
<td>74 (4.9%)</td>
</tr>
<tr>
<td>Genetic RET mutation</td>
<td>27 (1.7%)</td>
</tr>
<tr>
<td>Completion thyroidectomy</td>
<td>19 (1.3%)</td>
</tr>
<tr>
<td>Thyroglossal duct carcinoma</td>
<td>1 (0.1%)</td>
</tr>
</tbody>
</table>

**Table 3. MIVAT: complications**

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number (Percentage)</th>
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<tbody>
<tr>
<td>Transient monolateral recurrent nerve palsy</td>
<td>38 (2.4%)</td>
</tr>
<tr>
<td>Transient bilateral recurrent nerve palsy</td>
<td>2 (0.3%)</td>
</tr>
<tr>
<td>Definitive monolateral recurrent nerve palsy</td>
<td>18 (1.1%)</td>
</tr>
<tr>
<td>Transient hypoparathyroidism*</td>
<td>55 (5.1%)</td>
</tr>
<tr>
<td>Definitive hypoparathyroidism*</td>
<td>5 (0.4%)</td>
</tr>
<tr>
<td>Postoperative bleeding</td>
<td>2 (0.1%)</td>
</tr>
<tr>
<td>Wound sepsis</td>
<td>3 (0.2%)</td>
</tr>
</tbody>
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* Hypoparathyroidism and recurrent nerve bilateral palsy rate is calculated on total thyroidectomies (1059)
over the nerve. In conventional surgery the recurrent nerve is generally prepared at its emergency from the thoracic outlet but this area can be difficult to visualize with the endoscope while the middle part of the thyroid gland is very well visible and nerve dissection can be carried out at its best.

Also the incorrect use of the new device harmonic scalpel can jeopardize the nerve. The surgeon should always remember to keep the inactive blade of the instrument oriented during the artery section so to avoid jeopardizing the nerve which always lies posterior to it and is very sensitive to heat transmission.

Safety of harmonic scalpel, with low thermal injury or energy diffusion, was demonstrated by other authors (19-24) however, we think that a minimal distance from the inactive blade and the nerve must be kept in any case, using small clips when dealing with small vessels crossing the nerve near its entrance into the larynx.

Also parathyroid glands are generally easily visualized thanks to the endoscope magnification and their manipulation by spatulas is smoother than in open surgery. The incidence of transient and permanent hypoparathyroidism in our series is comparable with that described in literature for traditional thyroidectomy. During the minimally invasive approach we observed a lower traumatism on parathyroid glands, confirmed by the good and healthy appearance of most of the glands at the end of the procedures and by the low rate of transient hypoparathyroidism. This can be probably explained both by a technically correct dissection (their vascular supply is preserved by selective ligature of the branches of the inferior thyroid artery), and also by to the low lateral spread of energy produced by harmonic scalpel (25).

Postoperative bleeding occurred only in 2 cases in our series (0.1%). The low incidence of this complication can be probably due to the highly selective section of vessels endoscopically achieved and finally to the fact that thyroid volume is always small if inclusion criteria of MIVAT are respected.

CONCLUSIONS

In conclusion, the limited number of cases of video-assisted thyroidectomy reported in the literature showed the complication rate to be similar to open surgery for hypoparathyroidism and recurrent nerve palsies (25, 26).

A multicentric study with different surgeons operating in different centres also showed similar complication rate among centres (27, 28). It could be argued that these series are biased because of selection. Cases that fit the inclusion criteria tend to be the easiest cases.

As long as these criteria are carefully respected one need not to be concerned that these techniques might increase the complication rate.

REFERENCES


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