ULTRASONIC SCALPEL VERSUS CLASSIC PROCEDURES WITH LIMITED ACCESS IN THYROID GLAND SURGERY

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The aim of the study was to demonstrate the advantages of employing the ultrasonic scalpel in maintaining appropriate intraoperative hemostasis as compared with traditional methods of thyroid vessel ligation and coagulation

Material and methods. Between December 2003 and May 2006, 2410 patients were managed for various thyroid diseases at the Department of Endocrine Surgery. In the presented group, 179 procedures that employed minimally invasive surgical techniques including 101 operations in which US was used to secure the thyroid vessels (group A) and 78 operations in which the superior thyroid vessels were clipped and subjected to bipolar coagulation without US (group B) were performed. Both groups were similar with respect to gender, age, indications for surgery and mean thyroid volume. Statistical analysis included mean operative time, postoperative blood loss, scar length and cosmetic satisfaction assessed on visual-analogue scale (VAS) at 1 month following surgery.

Results. Mean operative time was significantly greater in group B vs A (54.5±14.2 vs 35.4±8.7 min, respectively; t-test; p<0.001). Mean postoperative blood loss was significantly higher in group B vs A (32.8±13.0 vs 12.9±5.7 ml, respectively; t-test; p<0.001). One case of transient paralysis of the recurrent laryngeal nerve and two instances of postoperative drop in calcium concentration values below the normal range was observed. The mean scar length at 1 month following surgery was significantly longer in group B vs A (21.5±1.9 vs 15.6±1.4 mm, respectively; t-test; p<0.001). Cosmetic satisfaction was significantly lower in group B vs. A patients (81.9±5.4 vs 88.9±9.7pts, respectively; t-test; p<0.001).

Conclusion. The use of an ultrasonic scalpel in thyroid surgery reduces the mean operative time, achieves good hemostasis and improves cosmetic results without increasing the risk of morbidity

Key words: ultrasonic scalpel in thyroid surgery, minimal-invasive thyroid surgery, hemostasis of thyroid gland

Over the past several decades, thyroid surgery techniques have changed minimally, nevertheless, the past twenty years have witnessed the dynamic development of new surgical instruments that have exerted a major impact on the improvement of old methods and the introduction of new operative techniques. The development of advanced surgical methods combined with the desire to perform minimally invasive procedures has increased the need for designing surgical instruments, which would limit intraoperative trauma. Appropriate hemostasis and non-traumatic tissue preparation in conjunction with protecting the tissues against excessive thermal injury that results in their structural destruction are the foundation of modern surgical management. A tool that has met the above-mentioned criteria is the ultrasonic scalpel, introduced into surgical practice at the turn of the 21st century. M. Ga-
gner’s used the endoscopic technique in para-thyroid surgery in 1996 and thyroid surgery in 1998. His efforts initiated a new stage in the development of minimally invasive procedures involving the endocrine glands. (1, 2, 3). Limiting the surgical trauma, decreasing pain, shortening the necessary hospitalization, or, finally, better cosmetic effects – these considerations undoubtedly represent the most important advantages of employing these techniques.

Surgical management of thyroid diseases is associated with possible complications, with hemorrhage being the most serious. Nevertheless, appropriate and thorough surgical techniques combined with careful identification of all anatomical structures leads to a considerable reduction in the number of complications.

The objective of the presented investigations was to demonstrate advantages in employing the ultrasonic scalpel to maintain appropriate intraoperative hemostasis, as compared to traditional methods of thyroid vessel ligation and coagulation (4).

MATERIAL AND METHODS

Between December 2003 and May 2006, 2410 patients were managed for various thyroid diseases at our department. In the presented group, 179 procedures employing minimally invasive surgical techniques (7.4% of the 2410 individuals) were performed. The classic principles of the selected surgical method included performing a skin incision not exceeding 20 mm in length in the central part of the neck, 2 cm above the sternal notch, followed by tissue preparation using narrow retractors and special instruments and employing the 2-5 mm videoscopic technique. This type of procedure described by Paolo Miccoli and termed MIVAT (Minimally Invasive Video-Assisted Thyroidectomy) was performed in 59 patients (2.45% of the 2410 individuals). In the remaining 120 patients (5% of the 2410 individuals) – group B, intraoperative hemostasis was achieved by classic ligation and coagulation of the thyroid vessels (VICRYL 3.0 sutures, Johnson & Johnson/Ethicon, and bipolar coagulation with an EMED unit, with power range of 20-60 units).

Both groups were similar with respect to sex (89% of females; 11% of males), age (41.7±7.8 years), indications for surgery (tab. 1) and goiter size. Statistical analysis focused on the mean operative time, postoperative blood loss, complication rate and cosmetic effects (including the quality of postoperative scar). The latter was measured using the Visual Analogue Scale (VAS) with a scoring system that ranged

<table>
<thead>
<tr>
<th>Sex</th>
<th>Ultrasonic scalpel (group A) n = 101</th>
<th>Vascular ligatures + electrocautery (group B) n = 78</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>88 (87%)</td>
<td>71 (91%)</td>
</tr>
<tr>
<td>Males</td>
<td>13 (13%)</td>
<td>7 (9%)</td>
</tr>
<tr>
<td>Age</td>
<td>39 (±12) (17-65)</td>
<td>43 (±7) (18-70)</td>
</tr>
</tbody>
</table>
from 1 to 100, with 1 denoting the poorest and
100 – the most excellent cosmetic effect.

In preparation for surgery, patients were
placed in the supine position, without retrofle-
xion of the head. The skin incision was performed
transversely and the short muscles of the
neck were dissected.

In group A (tab. 2) where the harmonic scal-
pel was employed, consecutive stages of the
procedure included preparation of the working
space through releasing the thyroid gland from
the surrounding tissue, coagulation of the thy-
roid capsule veins followed by identification of
the recurrent laryngeal nerve and parathyro-
ids, coagulation of the superior thyroid veins,
mobilization of the lower thyroid pole, coagu-
lation of the inferior thyroid veins, and finally
releasing the remaining portion of the thyroid
tissue from the trachea, paying particular at-
tention to small vessels that accompany Ber-
ry’s ligament, which extends courses in the vi-
cinity of the recurrent laryngeal nerve.

In group B (tab. 2) where bipolar diather-
my was employed, the small capsular vessels
were coagulated and the remaining large thy-
roid vessels (the superior thyroid artery and
vein, the middle thyroid vein and the branches
of the inferior thyroid artery), as well as the
structures situated in the immediate vicinity
of the recurrent laryngeal nerve were ligated.

Intraoperative blood loss was assessed in all
patients based on measuring the volume of blo-
od suctioned from the surgical field using a
spatula with a suction canal from the original
surgical set designed by Professor Miccoli (5).
The resected fragments of the thyroid tissue
were referred to histopathology. Primary clo-
sed drainage using Redon catheters (12 Fr) was
obligatory in all the patients and maintained
for 18-24 hours, postoperatively. Postoperati-
ve pain was controlled by administration of
divided doses of ketoprofen. Six hours posto-
peratively, the patients were allowed to have
their first meal. All patients were subjected to
laryngological assessment using indirect laryn-
goscopy prior to and after the procedure.

Differences between the investigated groups
were assessed employing the Student t-test and
the $\chi^2$ test.

RESULTS

The recommendations for surgery, its sco-
pe, mean operative time and postoperative blo-
od loss are presented in tab. 1 and 2 and in fig.
1 and 2, respectively. The mean operative time
in patients, in whom the ultrasonic scalpel was
employed (group A) was 35.4±8.7 min with the
duration ranging from 23 min for unilateral
lobectomies to 122 min for total thyroidecto-
mies. In group B, where ligatures and bipolar
coagulation was employed, the mean operati-
ve time was 54.5±14.2 min, oscillating within
the range of 35 min in unilateral lobectomies to
137 min in total thyroidectomies. A compari-
sion of the mean operative times in both groups

![Fig. 1. Mean operative time](image-url)

Table 2. Indications for surgery

<table>
<thead>
<tr>
<th>Minimally invasive procedures</th>
<th>Ultrasonic scalpel</th>
<th>Vascular ligatures + electrocautery</th>
</tr>
</thead>
<tbody>
<tr>
<td>ultrasonic scalpel (group A)</td>
<td>n = 101</td>
<td>n = 78</td>
</tr>
<tr>
<td>Singular follicular nodule of the thyroid gland</td>
<td>54 (30.2%)</td>
<td>41 (23%)</td>
</tr>
<tr>
<td>Singular toxic adenoma of the thyroid gland</td>
<td>34 (19%)</td>
<td>27 (15%)</td>
</tr>
<tr>
<td>Papillary carcinoma of the thyroid gland T1N0M0</td>
<td>3 (1.7%)</td>
<td>3 (1.7%)</td>
</tr>
<tr>
<td>Graves’ disease</td>
<td>5 (2.8%)</td>
<td>4 (2.1%)</td>
</tr>
<tr>
<td>Thyroid adenoma + parathyroid adenoma</td>
<td>5 (2.8%)</td>
<td>3 (1.7%)</td>
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revealed a significant difference (t-Student test; p<0.001). The subsequent evaluation was focused on postoperative blood loss. In group A, its volume was 12.9±5.7 ml, while in group B, the volume was significantly greater at 32.8±13 ml (t-Student test; p<0.001). No cases of early reoperations due to excessive bleeding were noted in either of the groups. No significant difference was observed in the risk of transient paralysis of the recurrent laryngeal nerve or hypoparathyroidism. The authors encountered one case of transient paralysis of the recurrent laryngeal nerve and two instances of postoperative decreases in serum calcium below the normal range. Cosmetic aspects for arbitrary visual-analog scale were assessed one month postoperatively. In group A, the mean score was 88.9±9.7, while in group B, the corresponding value was 81.9±5.4. This difference was statistically significant (t-Student test; p<0.001) (tab. 3 and 4).

**DISCUSSION**

For many years, the development of new operative techniques in endocrine surgery, and especially in surgery of the thyroid gland was limited by factors such as the achievement of appropriate hemostasis, postoperative pain control, purulent wound infection risk, as well as understanding the pathophysiological mechanisms of thyroid hormonal activity. Complications imposed significant limitations on the quality of thyroid surgery. Intraoperative and postoperative bleeding frequently resulted in serious consequences, starting from immediate reoperation and ending with considerable damage to major functional structures, i.e. the laryngeal nerves and parathyroid glands. In the majority of cases, such complications were triggered by improper identification of tissues surrounding the thyroid, as well as the lack of care for non-traumatic preparation of these tissues.

The initial complete reports based on randomized trials and addressing the issue of using the ultrasonic scalpel in thyroid surgery were published in the late 1990s. Voutilainen PE et al. initially conducted their investigations in a small group of surgical patients. Of 36 individuals subjected to surgical procedures due to...
thyroid diseases, the procedure was performed using the ultrasonic scalpel in 19 patients. Even with their fairly long mean duration of surgery (99 min. in procedures conducted with the use of the ultrasonic scalpel vs 135 min. in operations employing conventional techniques of vessel cauterization), the investigators demonstrated the usefulness of the ultrasonic scalpel in thyroid gland surgery. These results were in accordance with the publication of Meurisse M, which was also based on a randomized trial of surgical patients (6, 7, 8). Shortened operative time in the case of both unilateral lobectomies and total thyroidectomies while employing the MIVAT technique was observed in this study by Professor P Miccoli. (9) Because the presented group of patients in whom the ultrasonic scalpel had been employed was fairly small (only 26 individuals of 116 investigated patients), the presentation of all possible complications is unlikely. The limited experience of the surgeons combined with the lack of agreement as to the scope of procedures where the novel device might be employed led to the conclusion that the rate of possible complications was not significantly lower as compared to procedures performed using traditional methods. In their report, Marchesi M et al. demonstrated an increased probability of damaging the recurrent laryngeal nerve with simultaneous shortening of operative time and decreases in intraoperative blood loss (10). Minimally invasive procedures performed using the ultrasonic scalpel and large vessel clamping were conducted by Professor Bellantone. The investigations included 73 patients. The surgeons achieved shortened hospitalization times (mean, 1.5 days) and very good cosmetic results, albeit still with a fairly long operative time (the mean time for lobectomies was 82 min, while the corresponding value for total thyroidectomies equaled 100 min) (3).

In a study by Siperstein AE et al. and Shehmen L, who investigated differentiated groups of patients operated on employing the classic method and using the harmonic scalpel, the authors reported clearly visible shortening of operative time (11, 12). In turn, Cordón et al. reported shorter operative times and decreased intraoperative blood loss in their randomized trial (13).

Increased surgical experience with this novel instrument and a constant desire to limit the scope of surgery while providing complete vascular hemostasis have resulted in the introduction of the ultrasonic scalpel as a permanent fixture in numerous endocrine surgery centers. Numerous authors have demonstrated significantly decreased intraoperative and postoperative blood loss, thus reducing increasing costs associated with prolonged hospitalization, and contributing to decreased operative times and increased patient safety. According to the data published by Professor Miccoli’s team in 2006, 833 patients were subjected to minimally invasive procedures using the ultrasonic scalpel. The authors observed significantly decreased operative times (36 min). for lobectomies and 46 min for thyroidectomies with a low rate of fixed complications, i.e. unilateral paralysis of the recurrent laryngeal nerve noted in seven patients (0.8%) and fixed hypoparathyroidism in two individuals (0.3%) (5). A valuable report was published by Ortega et al. based on a randomized trial involving two groups of 100 patients each, who were surgically treated for thyroid diseases. The authors demonstrated, not only the above-mentioned difference in operative times, but also a true decrease in total hospitalization costs (14).

An improvement was also observed in the histopathological assessment of the surgical margin of the resected tissue due to a lower degree of mechanical and thermal destruction of the cells, leading to their irreversible structural damage, which previously rendered the reliable assessment of surgical preparation impossible (15).

The reports published in the literature on this subject have been confirmed in the present investigation. Both the shortened operative times and decreased postoperative blood loss, combined with the minimally invasive surgical technique, have resulted in improved cosmetic effects and decreased complication rates. The video technique significantly improved intraoperative visibility and allowed for better identification of functionally and anatomically important structures that surround the thyroid gland. It should be emphasized, however, that more than 90% of procedures were unilateral lobectomies and were performed in patients with a single, small nodular lesion or multiple small nodules involving one thyroid lobe only. In addition, despite the statistically significant intergroup difference in blood loss observed by the present authors (the mean blood loss for group A amounted to
12.9±5.7 ml vs 32.8±13.0 ml in group B), the volume of blood loss (50 ml) in both groups is extremely low, especially in an adult patient. No significant differences were noted in the number and quality of postoperative complications.

In summary, it should be stated that the harmonic scalpel has become an instrument that may be employed in all surgical procedures involving soft tissues. It has allowed for the simultaneous achievement of hemostasis and tissue preparation, with low-temperature effects exerted on surrounding structures. More than a 10-year experience in employing the ultrasonic scalpel and the annual number of procedures performed using the device in excess of 3 million cases have undoubtedly provided strong arguments for widespread utilization of the ultrasonic scalpel. Its usefulness has been also proven in thyroid gland surgery. Nevertheless, the above mentioned advantages of the ultrasonic scalpel should never release the surgeon from the obligation of correctly and safely identifying surrounding structures and using the instrument indiscriminately. Thus, the ultrasonic scalpel should be an instrument that assists the surgeon in providing appropriate intraoperative hemostasis, rather than be a tool necessary for safe and bloodless surgery. It should be also stressed that purchasing a new harmonic scalpel with all attachments can be afforded only by selected, highly specialized surgical centers. There is a price to pay for shortened operative time, decreased intraoperative and postoperative blood loss, and thus decreased hospitalization times. However, the limitations are set by high equipment costs and financial resources of the surgical center.

CONCLUSION

The use of an ultrasonic scalpel in thyroid surgery reduces the mean operating time, achieves good hemostasis and improves cosmetic results without an increased risk of morbidity.

REFERENCES

1. Gagner M, Inabnet III WB: Endoscopic thyroidec-
tomy for solitary thyroid nodules. Thyroid 2001; 11(2): 161-63.
5. Miccoli P, Berti P, Frustaci GL et al.: Video-assi-
9. Miccoli P, Berti P, Raffaelli M et al.: Impact of har-
10. Marchesi M, Biffoni M, Cresti R et al.: Ultraso-
ized, prospective, parallel group study comparing the harmonic scalpel to electrocautery in thyroidec-
14. Ortega J, Sala C, Flor B et al.: Efficacy and Cost-
Effectiveness of the UltraCision® Harmonic Scal-
15. Vach B, Fanta J, Velenska Z: The harmonic scal-
The study compares some parameters pertaining to minimal access thyroid surgery performed:

- by means of a new surgical technique – minimally invasive video-assisted thyroidectomy (MIVAT) – with the use of the ultrasonic knife
- by using the classical technique with sutures and ligation of sectioned elements.

It should be noted that small goiters up to 30 ml in volume were selected for the described operations. Upon clinical assessment, they correspond to the first-degree goiter. Such surgeries can be conducted on the patients that reported symptoms early and qualified for surgical treatment. However, there have been some difficulties in selecting the proper patients. In a relatively large study of 2410 patients operated on for goiters in a 2.5 year period, only 179 (7.4%) were qualified for minimally invasive surgeries, despite the fact that the study was conducted in the centre with extensive experience in thyroidectomy, equipped with suitable diagnostic facilities. The Authors have demonstrated usefulness of the ultrasonic knife and its significant advantage over the classical operation in the range of:

- reduction in operative time,
- improvement in cosmetic effects,
- reduction in operative blood loss.

All mentioned parameters, especially the first two, can be directly and indirectly expressed in surgery-related costs. Moreover, a beneficial outcome, not mentioned by the Authors, is the lack of foreign material in the postoperative wound after using the ultrasonic knife. At present, the cost of this equipment purchase and its single use is rather high, which has been emphasized by the Authors. It should be expected that with time, the cost will decrease considerably and become more available for centers with low financial resources. This should account for significant savings resulting from the diminished use of surgical sutures and other equipment, which in the case of 1000 surgeries annually, can provide substantial money. Moreover, a reduction in operative time can be translated into an increase in operating theater efficacy and the possibility of performing multiple operations daily.

The well-designed surgical technique and the Authors’ extensive experience resulted in the shorter operating times, minimal number of complications and despite the statistical difference in the volume of operative blood loss, nearly a bloodless (blood loss of <50 ml) thyroidectomy.

The Authors should be congratulated on the concept of the study, good preliminary results and should be encouraged to continue their work and publish long-term results after several years of experience with this new technique and other comparable surgical methods.

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