The Assessment of the Influence of the Method for Obtaining Hemostasis on the Occurrence of Postoperative Complications After Thyroid Surgery

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of article; G – other

Abstract

Background. The need to obtain successful surgical hemostasis had a significant impact on the development of electrosurgery. Innovative technical solutions necessitate the continuous training of surgeons in the use of more modern technologies. The diversity of solutions is also associated with the need to adapt the methods for obtaining hemostasis to the type of operation. Each time, the introduction of new technologies requires a critical evaluation of the results of surgical treatment. The most important measure of quality in thyroid surgery is the presence of chronic complications, such as the recurrent laryngeal nerve palsy and parathyroid insufficiency. Transient disorders also have a significant impact on the patient’s comfort and quality of life. The report is preliminary in nature and it requires further investigation.

Objectives. The aim of the study was to evaluate the effect of three methods for obtaining hemostasis on the occurrence of hypoparathyroidism, recurrent laryngeal nerve palsy, bleeding and the surgical site infection after thyroid surgery.

Material and Methods. A retrospective analysis included patients who underwent thyroidectomy (n = 654). Three methods of hemostasis were used. The first group (n = 339) had blood vessels tied off. In the second (n = 192) bipolar electrocoagulation was used and in the third one (n = 123) bipolar electrocoagulation with integrated cutting mechanism.

Results. The transient hypoparathyroidism was found in 1.4% patients in the first group, 8.3% in the second and 27.6% in the third one. Chronic hypoparathyroidism was found in 0.29% in the first group, 0% in the second group and 2.4% in the third group. Significantly statistical differences were found in the incidence of transient hypoparathyroidism.

Conclusions. Significant statistical differences were found in incidences of transient hypoparathyroidism in the group where bipolar electrosurgery was used (Adv Clin Exp Med 2015, 24, 2, 275–278).

Key words: thyroidectomy, hemostasis, complications.

The most important measure of the quality of thyroid surgery is the occurrence of complications, such as the recurrent laryngeal nerve palsy and parathyroid insufficiency, which have a significant impact on the quality of life [1]. The shortening of treatment time, reduction of bleeding during the surgery and the reduction of surgical damage to the tissue as well as the reduction of foreign material in the surgical wound are important issues. The development of surgical techniques involving precise dissection of tissues promotes the reduction of the negative impact of the operation [2]. The surgeon’s actions are supported by the developing electrosurgical systems.

Traditional methods of obtaining hemostasis include tying off and ligation of the cut vessels. The effectiveness of this method depends on the type of suture used and the skill of the surgeon. It is time-consuming and associated with leaving foreign material in the surgical wound. Another method is
the use of ultrasound. Ultrasonic vibrations make
the end effectors of the device operate at a frequency
of 55,500 cycles per second. The result is the induc-
tion of coagulation and cavitation, which allow the
delicate tissue dissection with the simultaneous seal-
ing of the majority of blood vessels [3, 4]. The pro-
cedure is accompanied by the heating of the dissect-
ed tissue. Hemostasis can also be achieved using an
electric current of high frequency generating a ther-
mal effect on the tissues. High temperatures cause
denaturation of intracellular and extracellular pro-
teins [5]. At temperatures of up to 45°C, the ther-
mal effect of operating tissue is reversible. At higher
temperatures, the proteins are denatured and lose
their structural integrity. Above 90°C, the cell liq-
uid evaporates, and at the temperature of 200°C tis-
sue charring is observed. Currently, surgeons have
a large range of equipment available to them for
electrosurgery. For example, monopolar electrodes
can be used. This device involves the flow of cur-
rent between the return electrode applied to distant
parts of the body and the working one in the operat-
field, around which heat is generated. Depend-
ing on the current parameters, the effect of cutting
or sealing the blood vessels is achieved. The second
type is bipolar electrodes. The arms of the surgical
tool constitute electrodes and the current flows be-
tween them, causing the effect of coagulation and
hemostasis. These types of electrodes can be com-
pleted with an individually actuated scalpel moving
along the arms and cutting the tissue located be-
tween them. These methods of hemostasis and tis-
sue cutting can be used in thyroid surgery. [6] The
use of electrosurgery during thyroidectomy requires
special attention because of two aspects. The first is
the heat-affected zone around the electrode and the
second is the surgery topography: the adjacency of
parathyroid glands and their vessels and the recur-
rent laryngeal nerve to the surface of the thyroid
gland. This requires special surgical technique in-
volving the retraction of these anatomical structures
and the thyroid from each other at a distance greater
than the isothermal value of ≥ 45°C.

Innovative technical solutions necessitate the need
for continuous training of surgeons in the use
of new technologies. The diversity is also associat-
ed with the need to adapt the methods for obtaining
hemostasis to the type of operation. Each intro-
duction of new technologies requires a critical
evaluation of the results of surgical treatment.

**Objectives**

The aim of the study was to evaluate the ef-
effect of 3 methods for obtaining hemostasis on
the occurrence of hypoparathyroidism, recurrent
laryngeal nerve palsy, bleeding and the surgical site
infection after thyroid surgery.

**Material and Methods**

The retrospective analysis included patients who underwent thyroid operations in the De-
partment of General Surgery, Provincial Hospi-
The criteria for grouping patients involved the
use of the three methods of hemostasis. The divi-
sion into groups was dictated by the development
of techniques used in the Department of Gener-
al Surgery and the gradual replenishment of sur-
gical equipment by the hospital board. Patients
in the first group (n = 339) had large blood ves-
sels tied off and ligated and the electrocoagulation
of small blood vessels administered. Electrosur-
gery was not used in the dissection of parathyroid
and the recurrent laryngeal nerve. In the second
group (n = 192), bipolar electrocoagulation was
introduced, making it possible to seal blood ves-
sels up to 7 mm. The obtained weld length was
15.5 cm. Activation took place after pressing the
foot switch. In the third group (n = 123), a simi-
lar system of bipolar electrocoagulation was used
by the same manufacturer, with an integrated cut-
ting mechanism in the form of a knife sliding along
the jaws to cut the coagulated vessel. The start took
place after the activation of a switch mounted in
the arms of the tool. The declaration of the tem-
perature reached at the outer surfaces of the jaws
was an important piece of information provided
by the manufacturer. During the operation, no
neuromonitoring was used.

Postoperative hypoparathyroidism or recur-
rent laryngeal nerve palsy lasting 6 months or lon-
ger was described as chronic complication.

The results were statistically analyzed by as-
suming the incidence of postoperative parathy-
roid function disorder, depending on the hemo-
stasis method. All calculations were performed
using STATISTICA 10 (StatSoft, Tulsa OK, Unit-
ed States). The level of statistical significance was
set at p ≤ 0.05. The incidence of various compli-
cations and performing various ranges of thyroid
resection in the analyzed periods were presented
in the form of time, figure and percentage series.
The significance of changes in these parameters
was evaluated in each period based on the Pear-
song’s $\chi^2$ test or Fisher’s exact test. The variables,
whose growth rate was significant in time, were in-
cluded in the multiple regression model evaluating
the effect of the frequency of the selected ranges of
thyroid resection on the risk of a particular type of
complications.
Results

The incidence of transient hypocalcemia increased significantly when time periods were compared (1998–2006 vs 2007–2009: p < 0.001, Pearson’s χ² test, 2007–2009 vs 2010–2012: p < 0.001, Fisher’s exact test; 1998–2006 vs 2010–2012: p < 0.001, Fisher’s exact test). The incidence of chronic hypocalcemia in the period 2010–2012 was higher (on the borderline of statistical significance) as compared to the period from 1998 to 2006 (p = 0.060, Fisher’s exact test) and 2007–2009 (p = 0.059, Fisher’s exact test). For other complications, there was no significant difference in the incidence in the compared periods (Table 1).


In the multiple regression model, it was shown that the growth rate of the total thyroidectomy and reduction in the frequency of subtotal thyroidectomy showed a significant association with the growing incidence of temporary and chronic parathyroid failure in the subsequent years (R² = 0.313, p < 0.001).

A temporary failure of the parathyroid gland was found in 1.4% (n = 5) patients in group I, 8.3% (n = 16) in the second group and 27.6% (n = 34) in the third group of patients. Chronic hypothyroidism was found in 0.29% (n = 1) in the first group, 0% in the second group and 2.4% (n = 3) in the third group of patients.

Significant statistical differences in the incidence of postoperative transient hypoparathyroidism were found in different research groups. The difference in the incidence of chronic hypoparathyroidism was at the borderline of statistical significance. There was no significant difference in the occurrence of other postoperative complications.

Discussion

The temperature of the tissues around the end effectors of the device depends on the method used to obtain the effect of hemostasis and cutting the tissues. The highest temperatures, above 110°C, are caused by the use of ultrasound. Lower

Table 1. The incidence of complications

<table>
<thead>
<tr>
<th>Period</th>
<th>Permanent RLN paresis</th>
<th>Transient RLN paresis</th>
<th>Transient hypoparathyroidism</th>
<th>Permanent hypoparathyroidism</th>
<th>Bleeding</th>
<th>Surgical site infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>1998–2006</td>
<td>2</td>
<td>0.6</td>
<td>5</td>
<td>1.5</td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>2007–2009</td>
<td>0</td>
<td>0.0</td>
<td>2</td>
<td>1.0</td>
<td>16</td>
<td>8.3</td>
</tr>
<tr>
<td>2010–2012</td>
<td>1</td>
<td>0.8</td>
<td>1</td>
<td>0.8</td>
<td>34</td>
<td>27.6</td>
</tr>
<tr>
<td>P-value</td>
<td>0.509</td>
<td>0.818</td>
<td>0.000</td>
<td>0.014</td>
<td>0.140</td>
<td>0.701</td>
</tr>
</tbody>
</table>

Table 2. The frequency of ranges of thyroid resection

<table>
<thead>
<tr>
<th>Period</th>
<th>Total thyroidectomy</th>
<th>Total lobectomy</th>
<th>Subtotal lobectomy</th>
<th>Subtotal thyroidectomy</th>
<th>One side total lobectomy with subtotal second side lobectomy</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>1998–2006</td>
<td>35</td>
<td>10.3</td>
<td>31</td>
<td>9.1</td>
<td>13</td>
<td>3.8</td>
</tr>
<tr>
<td>2007–2009</td>
<td>39</td>
<td>20.3</td>
<td>12</td>
<td>6.3</td>
<td>9</td>
<td>4.7</td>
</tr>
<tr>
<td>2010–2012</td>
<td>82</td>
<td>66.7</td>
<td>5</td>
<td>4.1</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>P-value</td>
<td>0.000</td>
<td>0.142</td>
<td>0.062</td>
<td>0.000</td>
<td>0.784</td>
<td>0.246</td>
</tr>
</tbody>
</table>
temperatures, about 90°C, are achieved when monopolar electrosurgery is used. The lowest temperatures occur during the use of bipolar electrocoagulation [7]. The temperature range involves the extent of permanent damage to the tissues. This has a significant impact on the methodology of the use of electrosurgery in the vicinity of temperature-sensitive tissues. The range of bipolar electrocoagulation safety is > 5 mm [8]. In the case of thyroid surgery, the parathyroid tissue, with its vascularization, and the recurrent laryngeal nerves are the sensitive tissues. Our study did not use ultrasound and the use of monopolar electrocoagulation was limited to coating and sealing small vessels distant from thermally sensitive anatomical structures. Therefore, it can be assumed that the data for the first group focused on classical dissection. Regardless of the impact of heat, the tissue preparation and a very good knowledge of the topography of the operated area are very important. The literature data on complications is not clear. The occurrence of more hypoparathyroidism in the postoperative period while using bipolar coagulation has already been described [9]. There are also papers showing no statistically significant differences in the incidence of complications after thyroidectomy using various systems of obtaining hemostasis and tissue cutting [10, 11]. This can indicate that the surgical technique is important in the occurrence of complications and not in the type of the equipment used.

The authors have concluded that bipolar coagulation method of obtaining hemostasis in the surgery of the thyroid gland has a statistically significant effect on the incidence of postoperative transient hypoparathyroidism.

References


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