LAPAROSCOPIC ADRENALECTOMY – ASSESSING THE LEARNING CURVE

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Laparoscopic adrenalectomy (LA) has become the “gold standard” for treatment of most of adrenal tumors in last few years. It has many benefits comparing to open surgery, but still is considered as complicated procedure requiring experienced surgical team.

The aim of the study was to assess the learning curve of laparoscopic adrenalectomy and the outcome of the first consecutive 154 LA.

Material and methods. 154 consecutive patients undergoing LA between 2007 and 2010 were reviewed. Collected data included: patients demographics, clinical and histological diagnosis, side and length of operation, conversions to open surgery, complications and hospitalization time. Learning curve was evaluated by dividing all patients into three groups (group I – first 50 patients, group II – second 50 patients and group III last 54 patients). Differences between the groups were analyzed.

Results. There were 154 LAs performed. Indications for LA were hormonally inactive adrenal adenoma (n=57), Conn’s syndrome (n=30), Cushing’s syndrome (n=28), pheochromocytoma (n=27), adrenal cyst (n=8), and others (n=4). Mean tumor size was 45.28 mm. There were 79 left-sided and 75 right-sided procedures and the average time of hospitalization was 4.64 days. Mean operative time was statistically different between the groups (216.2 min. – 164.6 min. – 131.9 min.; p<0.01) as well as the number of conversions to open surgery (18% – 4% – 3.7%; p=0.013). There was not any significant difference in the number of complications between analyzed groups (2% – 2% -3.7%).

Conclusion. To improve the outcome of LA it is necessary to perform approximately 40 to 50 procedures.

Key words: laparoscopic adrenalectomy, learning curve, adrenal tumor

In the last years a number of diagnosed and treated adrenal tumors have increased significantly. This is the result of improved diagnostic techniques and their better access in outpatients clinics (1). The most frequent indications for adrenalectomy are hormonally active tumors, hormonally inactive tumors (>4 cm), adrenal carcinomas and metastatic tumors. Laparoscopic adrenalectomy as the “gold standard” of treatment of these pathologies still remains a technically complex operation, with the possibility of severe complications.

The aim of our study was to assess the learning curve of laparoscopic adrenalectomy and the outcome of the first consecutive 154 such surgeries.

MATERIAL AND METHODS

All the patients treated with laparoscopic adrenalectomy between 2007 and 2010 were enrolled into the study. Prospectively collected database of these patients included following data: age, gender, preoperative diagnosis, surgery time, procedure description and complications, hospitalization time, size of a tumor and histopathological diagnosis. All the patients had MRI or CT examination performed.
and endocrinological diagnosis was made preoperatively.

All surgeries were performed by a single team of surgeons (one operator and two assistants) previously experienced in minor laparoscopic surgeries, such as cholecystectomy or appendectomy. Surgeries were performed via peritoneal approach with four trocars placed in a right or left subcostal area. Next, patients were divided into three groups in which were enrolled chronologically.

Group I consisted of patients from 1st –50th, group II patients from 51st – 100th, and group III patients from 101st – 154th. Number of patients in each group was as follows: group I: 50 patients, group II: 50 patients, group III: 54 patients. Furthermore operation time in ten-person groups was compared.

The data were presented as median, percentage values and in numeric range. Pearson’s correlation and Spearman’s correlation were used for statistical analysis. Firstly distribution of ”surgery time” was evaluated using Kolomogorov-Smirnov test (K-S test) and as variables had no normal distribution logarithmic transformation was made (common logarithm). Such transformed variables had normal distribution, and were further used for statistical analysis. In variation analysis real values of ”operation time” were also used as values of reference for logarithmic values. Statistical analysis was performed (SPSS 19.0, GLM procedure). Probability (p) was assessed as follows, for p≤0.05 correlation was significant, for p≤0.01 correlation was highly significant.

RESULTS

For 4 years number of 154 laparoscopic adrenalectomies were performed. Studied group consisted of 52 (33.8%) male and 102 (66.2%) female patients, aged 18-81 years (mean age 54.5). There were 79 (51.3%) left-sided and 75 (48.7%) right-sided surgeries. Indications for surgery were as follows: hormonally inactive adrenal adenoma (n=57), Conn’s syndrome (n=30), Cushing’s syndrome (n=28), pheochromocytoma (n=27), adrenal cyst (n=8), tuberculosis (n=3), lymphoma (n=1) (tab. 1).

Mean diameter of tumors was 45.28 mm, and there were no significant differences between the groups (p=0.269) as far as this value is concerned. Average hospitalization time was 4.64 days (range 2-22), and was similar for all the studied groups. Mean BMI (27.4) was also comparable in all groups.

The surgery time was shortening along with the number of operations performed, and the difference was statistically significant (p<0.01). Meantime of surgery in group I was 216.2 minutes (range 90-405 min), in group II – 164.6 min (range 80-280 min), in group III – 131.9 min (range 50-240 min) (fig. 1A). The mean operation time compared in ten-person was decreasing in the following groups as well.

The surgery time in male patients was significantly longer when compared to female patients (186 min vs. 155.8 min respectively; p<0.01) (fig. 2A). Similarly left-sided procedures lasted significantly longer than right-sided (183.6 min vs. 158.2 min respectively; p<0.01) (fig. 2B).

Table 1. Demographics

<table>
<thead>
<tr>
<th>Group</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>50</td>
<td>50</td>
<td>54</td>
<td>154</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>52.3</td>
<td>56</td>
<td>55.2</td>
<td>54.5</td>
</tr>
<tr>
<td>Male/female ratio</td>
<td>0.51</td>
<td>0.47</td>
<td>0.54</td>
<td>0.51</td>
</tr>
<tr>
<td>Left-sided/right-sided ratio</td>
<td>0.92</td>
<td>1.27</td>
<td>1.0</td>
<td>1.05</td>
</tr>
<tr>
<td>Mean length of stay (days)</td>
<td>4.94</td>
<td>3.98</td>
<td>5.01</td>
<td>4.64</td>
</tr>
<tr>
<td>Mean tumor diameter (mm)</td>
<td>41.72</td>
<td>47.18</td>
<td>46.3</td>
<td>45.28</td>
</tr>
<tr>
<td>Diagnosis:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hormonally inactive adrenal adenoma</td>
<td>23</td>
<td>16</td>
<td>18</td>
<td>57</td>
</tr>
<tr>
<td>Conn’s syndrome</td>
<td>12</td>
<td>8</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Cushing’s syndrome</td>
<td>3</td>
<td>16</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>Pheochromocytoma</td>
<td>9</td>
<td>10</td>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>Adrenal cyst</td>
<td>3</td>
<td>0</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
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In 13 patients (8.4%) conversion from laparoscopic to open surgery was performed. In 10 patients the reason for this were mostly technical problems during the laparoscopic procedure associated with difficulties with a location of a tumor. In 2 patients conversion was performed due to the fact that either the tumor was communicating with inferior vena cava (infiltrative lymphoma) or right renal vein (ectopic tumor located directly under renal vein). In last patient colon perforation occurred during trocar placement. Summing up, there were nine conversions (18%) in group I, two conversions (4%) in group II and two conversions (3.7%) in group III. The number of conversions was decreasing, when comparing group I with group II and III (p=0.013) (fig. 1B).

Total number of peri- and postoperative complications was 4 (2.5%). In group I there was one complication (2%) (postoperative pleural effusion), which was treated conservatively with a good result. In group II there was one complication as well (2%) (bleeding from a kidney capsule), and this patient was reoperated on a first day after laparoscopic surgery. Finally, in the last group we observed two complications (3.7%) (fig. 1C). First was colon injury and perforation, that occurred during trocar placement; conversion from laparoscopic to open surgery was necessary and colon was sutured successfully. This patient had postoperative infection, prolonged wound healing and required antibiotic therapy. The second complication in group III was gastric injury with high fistula in gastrointestinal tract. This patient was treated conservatively with total parenteral nutrition and antibiotics. The fistula closed spontaneously after 3 weeks. Complications in separate groups were not statistically significant.

During 30-day follow up no deaths were observed.

**DISCUSSION**

Since 1992, when first laparoscopic adrenalectomy (LA) was performed, it gradually displaced open surgery obtaining trust among doctors and patients. On the basis of the results of previous studies, one may judge that laparoscopic adrenalectomy (LA) is a safe and effective method (1) of treatment with many benefits comparing to open surgery. There are for example: decreased postoperative pain,
earlier mobilization of the patient, shorter hospitalization time, smaller blood loss or better cosmetic effect (2, 3). The number of contraindications for this procedure is decreasing. Age above 70 years, obesity (BMI>35), ASA≥ grade III, previously undergone abdominal or retroperitoneal operations (4) or tumor size above 8 cm should not be significant contraindication for LA (5). Lately published studies also imply similar oncologic results of adrenocortical carcinoma (I and II grade WHO) treatment with LA when compared with open adrenalectomy (OA) (6). However, one cannot forget about serious and potentially fatal complications of LA. Tessier et al. recently reported about serious and irreversible abdominal organs injuries (7). In their opinion, the main risk factors for such complications are pheochromocytoma and inexperienced surgeon.

To achieve satisfactory results in LA that are acceptable and comparable to results from centers of excellence, surgeon should have not only good theoretical knowledge but also practical background, which is associated with learning curves.

Learning curves course depends on the level of difficulty of a procedure. For laparoscopic appendectomy it is approximately 20 (8), for laparoscopic resection of rectum it is 50 procedures (9). Some authors claim that in order to achieve better results in LA it is necessary to perform about 30-40 procedures (10).

We assessed our learning curve using four factors: surgery time, number of conversions to OA, number of complications and hospitalization time.

With each next group surgery time was significantly shorter (fig. 3). Time of surgery is the basic indicator of surgeon’s skills level in any kind of operations and is associated with theoretical knowledge about the procedure, following steps, anatomy of operating area and spatial imagination, which is very important in laparoscopic surgeries.

Similarly, number of conversions to OL was decreasing when comparing group I with group II and III. Apart from skills mentioned above, surgeon learns how to react in difficult situations and this undoubtedly decrease the risk for conversion. Our main problem at the beginning were difficulties with allocation of a tumor, especially when operating the left side. Different anatomy of left adrenal gland significantly prolonged the time of surgery on this site – it is also independent risk factor for complications (4).
What may be interesting, surgeries in male patients were significantly longer. The most probable explanation of this is that men’s sagittal diameter is larger, thus preparation of a tumor in male patients may take longer.

A number of complications were relatively small, and for all studied groups was 2.5%. Moreover, a number of complications were similar for each group of patients (1-1-2). In a large series of patients a number of complications reached 6.8% (1) or 4.5% (11).

Mean hospitalization time was 4.64 days (2 – 22 days). Most of the patients were mobilized and fed orally from the first day after the procedure and discharged on day 3, regardless of the group. When conversion form LA do OA was performed, the time was extended to 7-8 days.

CONCLUSIONS

After the thorough analysis of the data from our studies we concluded that performing 40 to 50 procedures significantly improved the results of laparoscopic adrenalectomy, decreased the surgery time and number of conversions to open surgery.

REFERENCES


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