EFFECTIVENESS OF TRANSPERITONEAL AND TRANS-RETROPERITONEAL LAPAROSCOPIC ADRENALECTOMY VERSUS OPEN ADRENALECTOMY

Chun-Hou Liao, Jun Chen, Shih-Chieh Chueh, Yuan-Po Tu, Shyh-Chyan Chen, Ray-Hwang Yuan

Purpose: This study compared the effectiveness of laparoscopic adrenalectomy, using either a transperitoneal or trans-retroperitoneal approach, with that of open adrenalectomy in patients with benign adrenal tumors.

Methods: From February 1995 to April 2000, laparoscopic adrenalectomy was performed on 31 patients with adrenal tumors, including 16 aldosteronomas, 10 Cushing's adenomas, three nonfunctioning tumors, and two pheochromocytomas. A lateral trans-retroperitoneal approach was used for the first 16 patients and a lateral transperitoneal approach was used for the last 15 patients. Twenty-one patients who received open adrenalectomy during the same period served as a control group. Comparisons were made between laparoscopy and open groups, and between transperitoneal and trans-retroperitoneal groups.

Results: Conversion to open adrenalectomy was necessary in two cases — both in the trans-retroperitoneal group during the first 2 years of the study period. No other intraoperative complications occurred and blood transfusion was not used. Compared with the open group, the laparoscopic group had less blood loss (71 vs 124 mL), resumed oral feeding earlier (28 vs 60 hr), required less postoperative narcotics (45 vs 120 mg meperidine), and had shorter postoperative hospital stays (4.9 vs 7.6 days) (all \( p < 0.05 \)). The mean operative time was longer in the laparoscopic group (203 vs 125 min, \( p < 0.001 \)). There were no significant differences between the transperitoneal and trans-retroperitoneal laparoscopy groups in any of the studied parameters, except that the operative time was longer in the trans-retroperitoneal laparoscopy group (244 vs 166 minutes, \( p < 0.01 \)).

Conclusions: Decreased blood loss, less postoperative pain, earlier resumption of oral feeding, and shorter hospital stays were achieved in patients undergoing laparoscopic adrenalectomy. These findings indicate that laparoscopic adrenalectomy is the treatment of choice for benign adrenal tumors. The transperitoneal approach yielded shorter operative time than the trans-retroperitoneal approach, because it offered a clearer view and familiar landmarks.

Since it was first reported in 1992 [1], laparoscopic adrenalectomy has gained widespread acceptance. Although there has been no prospective, randomized trial of open versus laparoscopic adrenalectomy, several retrospective studies showed advantages of laparoscopic adrenalectomy over open surgery, including less blood loss, more rapid recovery, shorter hospital stay, and fewer complications [2–7]. This study compared the effectiveness of laparoscopic adrenalectomy and open adrenalectomy.

Various laparoscopic approaches to the adrenal gland have been described, including anterior
transperitoneal [8], lateral transperitoneal [1–5, 9, 10, 18], lateral trans-retroperitoneal [11–14], and posterior trans-retroperitoneal [15–17] approaches. Most operators performed only one approach at one specific period; there have been no prospective, randomized comparisons of these approaches, and which approach should be the standard procedure remains controversial. This study compared the effectiveness of the lateral trans-retroperitoneal approach and the lateral transperitoneal approach.

Patients and Methods

Patients
From February 1995 to April 2000, 31 patients underwent laparoscopic adrenalectomies in our department. A lateral trans-retroperitoneal approach was used in the first 16 patients and a lateral transperitoneal approach for the last 15 patients. Twenty-one patients who received open adrenalectomy with aldosteronoma (11 patients) and Cushing’s adenoma (10 patients) served as controls during the same time period. An anterior approach was used in 17 of these patients, a flank approach in three, and a posterior approach in one.

Operative procedure
The procedure of lateral transperitoneal laparoscopic adrenalectomy was similar to that originally described by Gagner et al [18], with some modifications as detailed below. All patients underwent general anesthesia and were placed in the lateral decubitus position with the lesion side up after a Foley catheter and a nasogastric tube were inserted. The table was flexed to maximize the distance between the iliac crest and the costal margin on the side of the lesion.

For a left lateral transperitoneal laparoscopic adrenalectomy, a 5- to 11-mm Versa-port (USSC, Norwalk, CT, USA) was created at the periumbilical area using the open technique. The peritoneal cavity was inflated with carbon dioxide up to 15 mm Hg. A 30° telescope was inserted into the peritoneal cavity and another two or three working ports, which included one or two 2-mm Mini-ports (USSC) and one 5- to 11-mm Versa-port, were created at the left subcostal region. The descending colon and spleen were taken down away from their attachments to the parietal peritoneum to expose Gerota’s fascia and the left adrenal gland and tumor inside it. Careful dissection was made beginning from the medial or inferior side of the adrenal gland. Multiple branches from the aorta or renal vessels supplying the adrenal gland were meticulously controlled. After the main adrenal vein was isolated and controlled, the dissection continued superiorly and laterally. The adrenal gland with the tumor was then freed from its surrounding tissues. Finally, the operative field was inspected for hemostasis and the specimen was removed with a retrieval bag.

For the right lateral transperitoneal approach, the ports were created along the right subcostal margin with the 5- to 11-mm working port usually placed in the most lateral position. With the liver retractor positioned to lift the liver, the adrenal gland and tumor were easily identified. An incision in the posterior peritoneum allowed direct access to the retroperitoneal space at the junction of the right adrenal gland and the inferior vena cava. Usually, no mobilization of the hepatic flexure of the colon was required. The adrenal gland was then dissected, mobilized, and removed as described above.

For a lateral trans-retroperitoneal laparoscopic adrenalectomy, the patient was placed as in the lateral transperitoneal approach, and a 5- to 11-mm Visiport (USSC) was used to enter the retroperitoneal space. The working space was developed as previously described [19]. Two working ports (5- and 5- to 11-mm) were made along the posterior and anterior axillary lines, forming a triangle with the camera port. After entering the retroperitoneal space, dissection was performed upward along the superolateral aspect of the kidney to identify the adrenal gland and tumor. The adrenal gland was then dissected, mobilized, and removed as with the transperitoneal approach.

The nasogastric tube and Foley catheter were usually removed within 24 hours after surgery. Clear liquids were given on the day after surgery and oral intake was resumed if no discomfort occurred after taking clear liquid. Pain was controlled with intermittent parenteral narcotics.

Statistical analysis
Data in this study are expressed as the mean ± standard error of mean (SEM). Comparisons between groups were made using the t-test for independent samples. A p value of less than 0.05 was considered statistically significant. All analyses were done using personal computer statistical software (SPSS for MS Windows, Release 6.0; SPSS Inc., Chicago, IL, USA).

Results
The indications for adrenalectomy and type of surgical approach used are listed in Table 1. Comparison of the laparoscopic and open surgery groups revealed no
significant differences in age, sex, tumor size, or medical history (Table 2).

Two (6%) of the 31 laparoscopic procedures were converted to open adrenalectomy; one because of failure to create a pneumoretroperitoneum, and the other because of uncontrolled bleeding. Both of these patients were treated via the trans-retroperitoneal approach in the first 2 years of the study period. In the next 3 years, no other laparoscopic procedures were converted to open adrenalectomy. No major intraoperative or postoperative complications occurred in the remaining 29 patients. Four (14%) patients had minor postoperative complications: one with paralytic ileus, and three with wound infections. These complications were mild and the patients recovered quickly. There was no mortality in the series.

The laparoscopic group had a significantly longer mean operative time but significantly less blood loss than the open group (Table 3). No patients received blood transfusions. Postoperative status was evaluated based on three parameters: narcotic dose (meperidine), time of resumption of oral feeding, and duration of hospital stay; patients in the laparoscopic group had significantly better recovery based on these variables (Table 3).

There were no significant differences in age, sex, tumor size, or medical history between the transperitoneal and trans-retroperitoneal groups (Table 2). There were no differences between these groups in blood loss, narcotic use, resumption of oral feeding, length of hospital stay, or complication rate, although two trans-retroperitoneal laparoscopy procedures had to be converted. However, the operative time was longer in the trans-retroperitoneal group (Table 4).

**Discussion**

Although there has been no prospective randomized trial of open versus laparoscopic adrenalectomy, several retrospective studies showed advantages of
Laparoscopic versus Open Adrenalectomy

Laparoscopic versus Open Adrenalectomy

Laparoscopic adrenalectomy (both transperitoneally [2–6] and trans-retroperitoneally [7]) over open surgery. Less blood loss, more rapid recovery, shorter hospital stay, and fewer complications were achieved in patients undergoing laparoscopic adrenalectomy. Longer operative time was the only disadvantage.

In the present study, despite the longer operative time in the laparoscopic group, there were significant decreases in blood loss, narcotic dose, duration of hospital stay, and time to resumption of oral feeding. These findings are consistent with previous reports [2–7]. The operative time for laparoscopic adrenalectomy has been reported to decrease after familiarity with the procedure is gained [4].

The anterior transperitoneal route was the least frequently employed, mainly because of difficulty in obtaining adequate exposure of the adrenal gland and the need for anti-gravity retraction of surrounding organs [10]. The posterior trans-retroperitoneal approach places the patient in the prone position and creates a working space using a balloon dilator similar to the lateral trans-retroperitoneal approach. This approach was also infrequently used in previous studies, although Baba et al [16] showed less operative time and blood loss with this approach, and Duh et al [17] showed similar clinical results to those obtained with the lateral transperitoneal and posterior trans-retroperitoneal groups. Smaller working space, which limits the volume of gland that can be safely removed, is the main disadvantage of the posterior trans-retroperitoneal approach [10].

In the present study, we compared the lateral transperitoneal and lateral trans-retroperitoneal laparoscopic adrenalectomy. No significant difference was found in blood loss, narcotic dose, time to resumption of oral feeding, duration of hospital stay, or complication rate, although two of the trans-retroperitoneal procedures were converted to open adrenalectomy. However, operative time was significantly shorter in the transperitoneal group (Table 4). This shorter operative time may have been due to three factors. First, we found it easier to identify landmarks, maintain orientation, and locate the adrenal tumor with the

Table 3. Perioperative results in patients receiving laparoscopic or open adrenalectomy

<table>
<thead>
<tr>
<th></th>
<th>Laparoscopic group (n = 29*)</th>
<th>Open group (n = 21)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operative time, min</td>
<td>203 ± 65</td>
<td>123 ± 28</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Blood loss, mL</td>
<td>71 ± 55</td>
<td>124 ± 60</td>
<td>0.002</td>
</tr>
<tr>
<td>Blood transfusion, mL</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narcotics used, mg</td>
<td>45 ± 55</td>
<td>120 ± 120</td>
<td>0.014</td>
</tr>
<tr>
<td>Resumption of oral feeding, hr</td>
<td>28 ± 20</td>
<td>60 ± 15</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Hospital stay, d</td>
<td>4.9 ± 2.0</td>
<td>7.6 ± 2.1</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Data are mean ± standard error of the mean. *Two trans-retroperitoneal patients were converted to open adrenalectomy; these cases were not included in the analysis.

Table 4. Perioperative results in patients receiving transperitoneal and trans-retroperitoneal laparoscopic adrenalectomy

<table>
<thead>
<tr>
<th></th>
<th>Transperitoneal (n = 16)</th>
<th>Trans-retroperitoneal (n = 15)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversion rate, %</td>
<td>0</td>
<td>12.5</td>
<td>0.164</td>
</tr>
<tr>
<td>Operative time, min*</td>
<td>166 ± 48</td>
<td>244 ± 57</td>
<td>0.003</td>
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<tr>
<td>Blood loss, mL*</td>
<td>57 ± 16</td>
<td>86 ± 72</td>
<td>0.152</td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narcotics used, mg*</td>
<td>50 ± 55</td>
<td>40 ± 60</td>
<td>0.944</td>
</tr>
<tr>
<td>Resumption of oral feeding, hr*</td>
<td>26 ± 10</td>
<td>31 ± 27</td>
<td>0.766</td>
</tr>
<tr>
<td>Hospital stay, days*</td>
<td>5.3 ± 2.1</td>
<td>4.4 ± 1.9</td>
<td>0.254</td>
</tr>
<tr>
<td>Major complication, %</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td>Minor complication, %</td>
<td>20</td>
<td>7</td>
<td>0.327</td>
</tr>
</tbody>
</table>

*mean ± standard error of the mean.

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lateral transperitoneal approach. Second, our initial experience with the trans-retroperitoneal approach might have flattened our learning curve when we switched to the transperitoneal approach. Third, recent advances in equipment, including needleless instruments, bipolar electrocoagulation, and the harmonic scalpel, might have also helped to decrease the operative time.

The main advantages of the trans-retroperitoneal approach are that the peritoneal cavity is not transgressed, thus minimizing postoperative ileus and other intestinal complications, and that it provides more-direct access to the adrenal gland [7, 11–13]. However, in this series, there was no postoperative ileus in the transperitoneal group and, paradoxically, there was a case of paralytic ileus in the trans-retroperitoneal group. Although the trans-retroperitoneal approach might theoretically provide more-direct access to the adrenal gland, loss of orientation and a lack of obvious landmarks to guide the dissection increased the operative time in our series. Moreover, we often had to compress the kidney in order to expose the adrenal gland and tumor during the trans-retroperitoneal procedure.

Because more time is needed to take down the colon, spleen, and pancreas in order to reach the left adrenal gland with the lateral transperitoneal approach, Takeda et al [12] and Miyake et al [13] suggested using the trans-retroperitoneal approach for left adrenalectomy. However, our mean operative time with the left lateral transperitoneal approach was 171 minutes, which was not longer than that with right lateral laparoscopic adrenalectomy (161 min, $p > 0.05$) and significantly shorter than that with the left lateral trans-retroperitoneal approach (261 min, $p < 0.001$) in this series. We found that the time required to take down the colon, spleen, and pancreas was usually less than 30 minutes in patients without previous major abdominal surgery (data not shown).

Takeda et al [12] found no significant difference in operative time, blood loss, resumption of oral feeding, or ambulation between the lateral transperitoneal (27 patients) and the lateral trans-retroperitoneal approach (11 patients). Although the trans-retroperitoneal approach was successful in all five of their patients with primary aldosteronoma, the trans-retroperitoneal approach was changed to a transperitoneal approach in three patients with Cushing’s syndrome and open laparotomy was required in one patient because of inadvertent pancreatic injury [12]. In addition, Fernandez-Cruz et al [14] showed the trans-retroperitoneal approach to provide no advantage in avoiding the respiratory and hemodynamic effects of carbon dioxide pneumoperitoneum.

However, a case-control study by Bonjer et al [7] found the transperitoneal approach to be associated with longer operative time, greater blood loss, and longer hospital stay. In contrast to our series, Bonjer et al initially performed consecutive lateral transperitoneal adrenalectomy in nine patients, followed by trans-retroperitoneal adrenalectomy in 12 cases. A prospective, randomized comparison of these two procedures performed by experienced laparoscopic surgeons seems necessary to determine which approach is superior.

Although the choice of lateral transperitoneal or lateral trans-retroperitoneal approach remains controversial and operator-dependent, the transperitoneal approach offers a better and larger operative view, obvious anatomic landmarks, more straightforward dissection, and less kidney compression [9, 10]. The transperitoneal approach is especially safe if a limb of the adrenal gland lies very close to the renal hilum or vessels. During a right transperitoneal adrenalectomy, the tumor is easily approached, and taking down the colon to reach the tumor is often not necessary. Although Bonjer et al [7] claimed that the operation could be continued with retraction of the peritoneum if peritoneal holes are accidentally created while using a trans-retroperitoneal approach, we found the operation may be more difficult because of significant compression of the operative field by the gas leaking into peritoneal cavity.

The trans-retroperitoneal approach is preferable in two special conditions. One is in patients with multiple abdominal operations who may have intraperitoneal adhesions, which might limit exposure and safe dissection of the adrenal gland [10, 17]. The other is in morbidly obese patients, in whom instruments may not be long enough for dissection—the trans-retroperitoneal approach offers a shorter and more direct route to the adrenal gland [10].

Since 1992, more than 600 cases of laparoscopic adrenalectomy have been reported [9]. In our series, aldosteronoma and Cushing’s adenoma were the major indications for adrenalectomy. These tumors are usually small and unilateral and are particularly suitable for laparoscopic adrenalectomy [20]. Although laparoscopic adrenalectomy for pheochromocytoma has been associated with catecholamine release during the creation of the pneumoperitoneum and tumor manipulation [21], the finding that intraoperative catecholamine surges were less than with open surgery indicates that laparoscopy does not increase the surgical risk [22]. Two pheochromocytomas were resected laparoscopically in our series. There was no severe intraoperative hypertensive crisis and no postoperative morbidity in these two patients.

Incidental adrenal tumors can also be removed effectively with laparoscopic adrenalectomy [2–6]. However, open surgery should be considered if the tumor is larger than 5 cm or heterogenous in nature, because of the possibility of malignancy [23]. A 12-cm incidental, well-encapsulated, adrenal tumor suggests...
tive of a benign tumor was removed laparoscopically in our series. The operation time was 243 minutes and blood loss was only 100 mL. The patient tolerated the operation well and no postoperative complication occurred. Tumor size thus seems not to be an absolute restriction, and all benign adrenal tumors could be removed by laparoscopic adrenalectomy.

Recently, we substituted two subcostal working ports with mini-ports while using the transperitoneal approach. The use of 2-mm working ports and needlescopic instruments results in less wound pain and better cosmesis [24]. Although endoclips used to be applied to vessels for hemostasis in laparoscopic adrenalectomy, the use of clips increases the cost and time of this surgery. In our last 15 cases, the adrenal vessels were controlled well with the use of bipolar electrocoagulation or a harmonic scalpel. Clips were used only in one patient, who had a large adrenal vein (diameter > 0.7 cm). "Clipless" adrenalectomy was performed in most (93%) of our last 15 cases.

In conclusion, the results of this study suggest that laparoscopic adrenalectomy has the advantages of decreased blood loss, less postoperative narcotics, earlier resumption of oral feeding, and a shorter postoperative hospital stay, and therefore should be the treatment of choice for benign adrenal tumors. The lateral transperitoneal approach decreased the operative time by offering a clearer view, familiar landmarks, easier dissection, and less compression to the kidney during surgery than did the lateral trans-retroperitoneal approach.

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References