Surg Endosc (2011) 25:3584–3589
DOI 10.1007/s00464-011-1762-6

Impact of posterior retroperitoneoscopic adrenalectomy in a tertiary care center: a paradigm shift

Andreas Kiriakopoulos · Konstantinos P. Economopoulos · Efthimios Poulios · Dimitrios Linos

Received: 11 February 2011 / Accepted: 27 April 2011 / Published online: 3 June 2011

Abstract
Background Posterior retroperitoneoscopic adrenalectomy has substituted its anterior laparoscopic counterpart as the treatment of choice in the management of adrenal tumors at the authors' institution. The authors present their comparative results between these operative techniques, demonstrating the reasons for this change.
Methods From May 2008 to September 2010, 30 patients underwent posterior retroperitoneoscopic adrenalectomy. Operative time, complications, hospital stay, postoperative pain, and cost were compared with those of 30 selected laparoscopic control subjects treated from 2005 to 2010. Statistical analysis was based on Chi-square, the Mann–Whitney *U* test, the independent-samples *t*-test, and the Wilcoxon matched pairs test, as appropriate.
Results The median tumor size was 3.8 cm (range, 1.5–8.0 cm) in the retroperitoneoscopic group and 4.9 cm (range, 2.4–8.0 cm) in the laparoscopic group. The median operative time was similar between the two groups (90.0 min; range, 60–165 min vs. 77.5 min; range, 55–120 min; $P = 0.138$). It was, however, significantly reduced after the 20th case (97.5 min; range, 80–165 min vs. 70 min; range, 60–110 min; $P < 0.001$) in the retroperitoneoscopic group. The median visual analog pain scores were significantly lower in the retroperitoneoscopic group on both the first and the third postoperative days, respectively (1; range, 0–1 vs. 4; range, 3–6; $P < 0.001$ and 0; range, 0–1 vs. 3; range, 2–6; $P < 0.001$). The median postoperative hospital stay also was shorter in the retroperitoneoscopic group (2 days; range, 2–3 days vs. 4 days; range, 3–6 days; $P < 0.001$). The cost of the posterior approach was significantly less than that of the laparoscopic technique ($P < 0.001$).
Conclusions Posterior retroperitoneoscopic adrenalectomy compared with laparoscopic adrenalectomy was safe, fast, and vastly superior in terms of postoperative pain and hospital stay in this series. Because of the ability to reproduce such excellent operative results, the impressive patient recovery, and the significantly reduced operative cost, the authors suggest that the retroperitoneoscopic approach should become the method of choice in minimally invasive adrenal surgery.

Keywords Adrenal tumors · Laparoscopic adrenalectomy · Retroperitoneoscopic adrenalectomy · Retroperitoneum

Among various operative approaches in adrenal gland surgery, posterior retroperitoneoscopic adrenalectomy comprises an alternative option far less popular than the laparoscopic transabdominal method [1, 2]. Direct access, exclusive retroperitoneal dissection, and excellent adrenal gland visualization define some technical advantages of the former approach. In addition, posterior endoscopic adrenalectomy has been met by excellent clinical results in terms of complications, postoperative pain, and patient safety, which are directly comparable with those of the standard laparoscopic technique if not better [3–7].

Presented at the SAGES 2011 Annual Meeting, March 30–April 2, 2011, San Antonio, TX.

A. Kiriakopoulos (✉) · K. P. Economopoulos · E. Poulios · D. Linos
Department of Surgery, "Hygeia"' Hospital, 4 Erythrou Stavrou Street and Kifissias Avenue, Marousi, 15123 Athens, Greece
e-mail: kirian@ontelecoms.gr

K. P. Economopoulos · D. Linos
University of Athens, School of Medicine, Athens, Greece

Because posterior retroperitoneoscopic adrenalectomy replaced its laparoscopic counterpart as the treatment of choice in the management of adrenal tumors at our institution, we present our comparative results between these operative techniques using a case–control setting.

Materials and methods

Participants and study design

From May 2008 to September 2010, we prospectively evaluated 30 patients with various adrenal tumors who underwent posterior retroperitoneoscopic adrenalectomy. The medical records of these patients were reviewed and compared in terms of operative time, complications, hospital stay, postoperative pain, and cost with the records of 30 control patients treated from 2005 to 2010 using the anterior transabdominal laparoscopic approach.

The 30 patients were chosen from our laparoscopic pool and matched in 1:1 ratio to the retroperitoneoscopic cases with respect to gender, patient age, laterality, surgical indication, and histopathologic diagnosis. The control transabdominal adrenal cases were matched initially by case type and then by their demographic characteristics. Our intention was to create a uniform study population for better interpretation of the aforementioned outcome measures.

Nine patients in the retroperitoneoscopic group presented with full-blown Cushing's syndrome, whereas eight patients exhibited a borderline adrenocortical hypersecretion profile compatible with the diagnosis of subclinical Cushing's syndrome. There were six pheochromocytomas (3 sporadic and 3 as a part of multiple endocrine neoplasia, MEN 2A syndrome) as well as four aldosteronomas. One patient exhibited persistent androgen hypersecretion. Two patients showed no evidence of hormonal hyperactivity. The one had a history of lung cancer, and the other had a history of renal cell cancer, and thus a suspicion of metastatic adrenal gland involvement was established in both cases. In terms of location, 20 tumors were on the left side and 10 on the right side.

The nine patients with full-blown Cushing's syndrome and the nine patients with adrenocortical hypersecretion profile compatible with the diagnosis of subclinical Cushing's syndrome were chosen from our laparoscopic pool. Another four patients with aldosteronomas as well as six patients with clinically and histologically proven pheochromocytoma and two patients with histologic confirmation of metastatic adrenal involvement also were included in this series. In terms of location, 14 tumors were on the left side and 16 on the right side.

The data collected from both groups included demographics, details of the surgery, and perioperative complications. The operative time was calculated from the start of the skin incision to skin closure. The visual analog pain scale (VAPS) score was recorded on postoperative days 1 and 3. The pain scale used ranged from 1 (lowest pain) to 10 (worst).

Retroperitoneoscopic adrenalectomy procedure

Retroperitoneoscopic adrenalectomy is performed according to principles described in detail by Walz et al. [2, 8, 9]. The operation is carried out with the patient under general anesthesia and in the prone position supported on mattresses. An arterial catheter, a nasogastric tube, and a urinary catheter are always used.

The operation begins with a 1.5 cm incision placed just below the tip of the 12th rib (Fig. 1). After sharp dissection of the subcutaneous and muscle tissues, the dorsolumbar fascia (Gerota's fascia) is reached and sharply perforated. Special care is needed to ensure that the opening is the right size to accommodate a 10 mm blunt-tip trocar but not large enough to allow the escape of carbon dioxide (CO_2).

Next, 5 and 10 mm reusable trocars are placed under direct finger guidance: the former 4–5 cm laterally toward the midaxillary line and the latter just next to the sacrospinal muscles. Finally, a disposable 10 mm blunt-tip trocar is introduced through the initial incision site. Insufflation of CO_2 starts from this trocar, and a CO_2 pressure within a range of 25–30 mmHg is maintained.

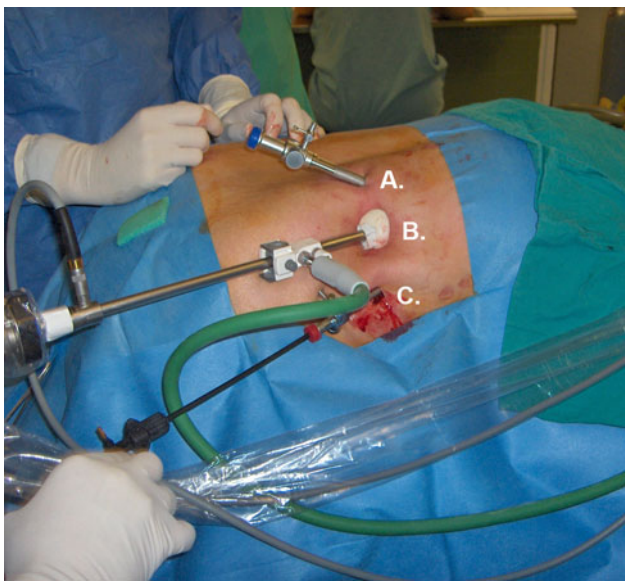

Fig. 1 Patient position in posterior retroperitoneoscopic adrenalectomy. Three trocars (A = 10 mm, B = 10 mm, and C = 5 mm) are inserted below the 12th rib

Retroperitoneoscopy is performed with a 10 mm 30° camera initially introduced through the medial trocar.

The first operative step involves the creation of a cavity by pushing away the retroperitoneal fatty tissue toward Gerota's fascia. This step is accomplished with blunt dissection and is almost bloodless. Subsequently, the camera is placed through the sacrospinal trocar, and the dissection begins using ultrasonic scissors.

At this time, the adrenal gland tumor can be visualized, but the major concern is to find the upper pole of the kidney. After this anatomic landmark is found, the fatty tissue between the kidney and the adrenal gland is sharply separated. From then on, all efforts are focused on finding the adrenal vein. On the right side, the vein is short and found in the posterolateral position on the posterior surface of the vena cava. On the left side, the adrenal vein is long and lies caudal and medial to the upper pole of the kidney.

After adrenal vein ligation, dissection proceeds in a fairly easy manner using ultrasonic scissors. After complete excision of the adrenal gland, extraction is accomplished with a retrieval bag system. No drains are placed. Fascia and skin closure are performed in a usual way with absorbable sutures.

Statistical analysis

Summary statistics are presented as median, range, and 25th (Q1) and 75th (Q3) percentiles. Groups were compared using chi-square analysis, the Mann–Whitney *U* test, the independent-samples *t*-test, and the Wilcoxon matched pairs test, as appropriate. Statistical significance was set at a p value less than 0.05, and all reported P values were two-sided. Data analysis was performed with SPSS 17.0 (SPSS, Chicago, IL, USA).

Results

In this study, 30 patients with retroperitoneoscopic adrenalectomy (21 women and 9 men who had a median age of 53 years; range, 21–69 years) and 30 with the laparoscopic anterior approach (19 women and 11 men who had a median age of 49.5 years; range, 25–64 years) were treated. The baseline demographics were comparable between the two groups in terms of patient age, gender, laterality, surgical indication, and histologic diagnosis (Table 1). However, the laparoscopic patients were treated for significantly larger tumors than the retroperitoneoscopic group ($P = 0.035$).

Table 2 summarizes the intra- and postoperative results. All the retroperitoneoscopic adrenalectomies ended successfully without conversion. In terms of location, 20 tumors were on the left side (median tumor size, 4.5 cm; range, 1.5–8.0 cm), and 10 tumors were on the right side (median tumor size, 3.3 cm; range, 1.5–6.2 cm). The overall median size of the posterior excised tumors was 3.8 cm (range, 1.5–8.0 cm). The final histology of the lesions removed included nine adenomas associated with Cushing's syndrome, eight adenomas associated with subclinical Cushing's syndrome, six pheochromocytomas,

Table 1 Patient demographics

	Posterior retroperitoneoscopic group	Laparoscopic group	*P* Value
No. of patients	30	30	
Median age: years (Q1, Q3)	53.0 (39.5, 62.0)	49.5 (44.5, 55.0)	0.348
Male/female	9/21	11/19	0.584
Laterality (left/right)	20/10	14/16	0.118
Median tumor size: cm (Q1, Q3)	3.8 (2.3, 5.5)	4.9 (3.9, 5.6)	0.035
No. of patients with adrenal disease			
Cushing's syndrome	9	9	
Subclinical Cushing's syndrome	8	9	
Pheochromocytoma	6	6	
Primary aldosteronism	4	4	
Androgen hypersecretion	1	0	
Metastasis	2	2	
Histologic diagnosis			
Cortical adenoma	19	21	
Pheochromocytoma	6	6	
Metastasis	2	2	
Cortical or nodular hyperplasia	3	1	

Q1 25th percentile, *Q3* 75th percentile

Table 2 Intra- and postoperative results

	Posterior retroperitoneoscopic group	Laparoscopic group	*P* Value
No. of patients	30	30	
Median operative time: min (Q1, Q3)	90.0 (73.8, 120.0)	77.5 (67.3, 96.3)	0.138
Median postoperative stay: days (Q1, Q3)	2 (2, 2)	4 (3, 4)	<0.001
Median VAPS on postoperative day 1 (Q1, Q3)	1 (0.8, 1)	4 (3, 4)	<0.001
Median VAPS on postoperative day 3 (Q1, Q3)	0 (0, 0)	3 (3, 4)	<0.001
Cost (€)	1,500	4,500	<0.001

Q1 25th percentile, *Q3* 75th percentile

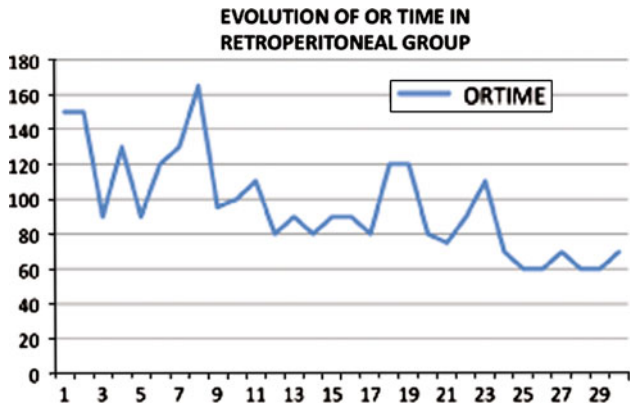

Fig. 2 Evolution of operative time in the retroperitoneal group

four aldosteronomas, two adrenal metastases, and one androgen-producing tumor.

The median operative times were comparable between the two procedures (90 min; range, 60–165 min vs. 77.5 min; range, 55–120 min; $P = 0.138$). The median operative time for retroperitoneoscopic adrenalectomy was the same irrespective of the tumor location (median operative time, 90 min; range, 60–165 min for tumors on the left vs. 90 min; range, 80–130 for tumors on the right). An interesting finding was that the median operative time was significantly reduced after the 20th case (97.5 min; range, 80–165 min vs. 70 min; range, 60–110 min; $P < 0.001$) (Fig. 2).

We had no serious intraoperative hazards, and intraoperative transfusion was never needed. Drainage of the retroperitoneal space was never used. Given the awkward position of the patient, circulation instability never occurred, even in patients with pheochromocytomas who had an uneventful intra- and postoperative course hemodynamically. The upper trunk cutaneous emphysema proved to be the most consistent intraoperative event in these series together with an increase in arterial blood CO_2 pressure and end CO_2 tidal volume. Carbon dioxide retention had no clinical significance and was easily treated with an increase in the respiratory rate. In one patient, the cutaneous emphysema with eyelid edema persisted for 24 h but eventually resolved spontaneously within the next 24 h without any untoward clinical consequence.

The median VAPS scores were significantly lower for the retroperitoneoscopic group on both postoperative days 1 and 3 (respectively, 1; range, 0–1 vs. 4; range, 3–6; $P < 0.001$ and 0; range, 0–1 vs. 3; range, 2–6; $P < 0.001$) (Fig. 3). Postoperative analgesia for the retroperitoneal group actually was required only for the first 24 h by means of paracetamol and one or two doses of a nonsteroidal antiinflammatory drug (NSAID). The patients in the laparoscopic group needed regular doses of the same scheme of drugs for a much longer time (4–5 days) plus some doses of opioids.

The median postoperative hospital stay for the patients in the retroperitoneoscopic group was significantly shorter than for the laparoscopic patients (2 days; range, 2–3 days vs 4 days; range, 3–6 days; $P < 0.001$). No mortality was encountered in either group. A specific complication of the posterior approach was a lateral abdominal swelling that occurred in four patients and persisted for several days postoperatively (in one patient, this swelling resolved in 6 weeks) without any other clinical effect. We had no problems with wound healing, and the cosmetic results were excellent.

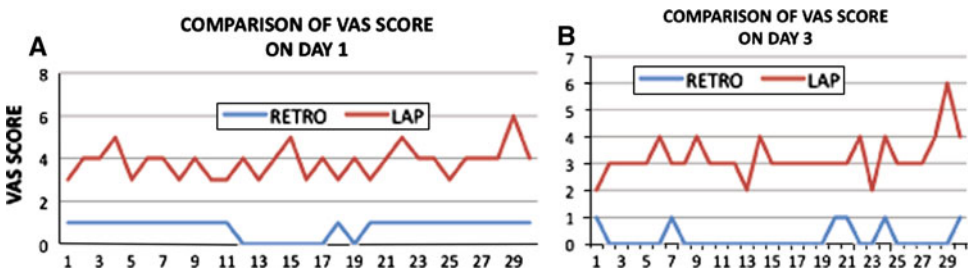

Fig. 3 Comparison of postoperative pain. Visual analog pain scale (VAPS) score on postoperative days 1 (**A**) and 3 (**B**)

The average cost for patient hospitalization was significantly lower for the patients treated by the posterior approach (1500 € vs. 4500 €; $P < 0.001$).

Discussion

During the era of open adrenalectomy, the awkward anatomic position of the adrenal glands in the most cranial part of the retroperitoneal space necessitated large incisions, either anterior or posterior. However, posterior open adrenalectomy had become the standard of care for small adrenal lesions, mainly due to better operating time, less blood loss, and shorter patient recovery compared with its transperitoneal variant [10, 11].

The advent and rapid evolution of minimally invasive surgery brought the laparoscopic approach to the forefront due to multiple reports of minimal postoperative pain, faster convalescence, and shorter postoperative hospital stay [12–14]. A little later, many authors described purely retroperitoneal endoscopic methods using either lateral or dorsal (posterior) approaches [2, 8, 15–17]. Currently, posterior retroperitoneoscopic adrenalectomy comprises an alternative, albeit less popular, option in adrenal gland surgery.

In the current series, posterior retroperitoneoscopic adrenalectomy proved to be equally safe and fast and vastly superior in terms of postoperative pain and overall hospital stay compared with the laparoscopic approach. We started to perform posterior retroperitoneoscopic adrenalectomy after extensive experience with laparoscopic transperitoneal adrenalectomy. Probably, this fact highlights the relatively short learning curve, as reflected by the statistically significant difference in the operative times between our first 20 and final 10 retroperitoneoscopic cases. Moreover, the ability to reproduce comparable operative times between these methods is indeed a compliment for the retroperitoneoscopic method.

The most striking and consistent feature of this series, however, was the negligible postoperative pain and the patient's feeling of well-being. Most patients needed a few doses of paracetamol and one or two doses of an NSAID. All patients felt able to walk around without pain the afternoon on the day of surgery, and all were started on clear liquid diet some hours after the operation. The hospital stay and the overall hospitalization cost also were clearly better for the posterior group.

Few publications have directly compared the transperitoneal laparoscopic and posterior methods. Rubinstein et al. [6] reported a prospective, randomized trial of transperitoneal versus retroperitoneal laparoscopic methods. In their series of 57 consecutive patients with a mean adrenal mass size of 2.7 cm, there were no statistically significant differences, and the authors concluded that for most benign adrenal lesions, laparoscopic adrenalectomy can be performed safely and effectively by both approaches.

Yoneda et al. [18] published a comparison between the laparoscopic and posterior lateral retroperitoneal approaches that favored the former in terms of operative time. It was a small series of eight cases per arm, with a mean adrenal tumor size of 2.4 and 1.75 cm, respectively. Tai et al. [19] in a series of 40 patients showed no statistically significant differences in terms of operative time, rate of conversion, and complications between the lateral transperitoneal and lateral retroperitoneal approaches. All the aforementioned series compared the lateral with the transperitoneal approach in contrast to our series, which analyzed the dorsal retroperitoneoscopic technique.

The financial advantage of the posterior retroperitoneoscopic technique was indeed another consistent feature in our series. This advantage is attributed to the reusable instruments used in the retroperitoneoscopic group, which is in stark contrast to the laparoscopic approach, in which dependence on multiple disposable trocars and instruments appears to be mandatory. In addition, the hospital stay was shorter for the patients treated with retroperitoneoscopic adrenalectomy than for those treated with the laparoscopic anterior approach.

The nonrandomized setting of our study and the fact that the laparoscopic patients were treated for significantly larger tumors than the retroperitoneoscopic group (Table 1) are potential limitations of our study.

Conclusions

In this series, posterior retroperitoneoscopic adrenalectomy compared with laparoscopic adrenalectomy was safe, fast, and vastly superior in terms of postoperative pain and hospital stay. Because of the ability to produce such excellent operative results together with impressive patient recovery and significantly reduced operative cost, the authors suggest that the retroperitoneoscopic approach should become the method of choice in minimally invasive adrenal surgery.

Disclosures Andreas Kiriakopoulos, Konstantinos P. Economopoulos, Efthimios Poulios, and Dimitrios Linos have no conflicts of interest or financial ties to disclose.

References

1. Walz MK, Alesina PF, Wenger FA, Deligiannis A, Szuczik E, Petersenn S, Ommer A, Groeben H, Peitgen K, Janssen OE, Philipp T, Neumann HP, Schmid KW, Mann K (2006) Posterior

retroperitoneoscopic adrenalectomy: results of 560 procedures in 520 patients. Surgery 140:943–948 discussion 8–50
2. Walz MK, Peitgen K, Hoermann R, Giebler RM, Mann K, Eigler FW (1996) Posterior retroperitoneoscopy as a new minimally invasive approach for adrenalectomy: results of 30 adrenalectomies in 27 patients. World J Surg 20:769–774
3. Baba S, Miyajima A, Uchida A, Asanuma H, Miyakawa A, Murai M (1997) A posterior lumbar approach for retroperitoneoscopic adrenalectomy: assessment of surgical efficacy. Urology 50: 19–24
4. Gasman D, Droupy S, Koutani A, Salomon L, Antiphon P, Chassagnon J, Chopin DK, Abbou CC (1998) Laparoscopic adrenalectomy: the retroperitoneal approach. J Urol 159:1816–1820
5. Hanssen WE, Kuhry E, Casseres YA, de Herder WW, Steyerberg EW, Bonjer HJ (2006) Safety and efficacy of endoscopic retroperitoneal adrenalectomy. Br J Surg 93:715–719
6. Rubinstein M, Gill IS, Aron M, Kilciler M, Meraney AM, Finelli A, Moinzadeh A, Ukimura O, Desai MM, Kaouk J, Bravo E (2005) Prospective, randomized comparison of transperitoneal versus retroperitoneal laparoscopic adrenalectomy. J Urol 174: 442–445 discussion 445
7. Terachi T, Yoshida O, Matsuda T, Orikasa S, Chiba Y, Takahashi K, Takeda M, Higashihara E, Murai M, Baba S, Fujita K, Suzuki K, Ohshima S, Ono Y, Kumazawa J, Naito S (2000) Complications of laparoscopic and retroperitoneoscopic adrenalectomies in 370 cases in Japan: a multi-institutional study. Biomed Pharmacother 54(Suppl 1):211s–214s
8. Walz MK, Peitgen K, Krause U, Eigler FW (1995) Dorsal retroperitoneoscopic adrenalectomy: a new surgical technique. Zentralbl Chir 120:53–58
9. Martin K, Walz MK (2005) Posterior retroperitonescopic adrenalectomy. In: Linos DA, van Heerden JA (eds) Adrenal glands: diagnostic aspects and surgical therapy. Springer-Verlag, Heidelberg
10. Proye CA, Huart JY, Cuvillier XD, Assez NM, Gambardella B, Carnaille BM (1993) Safety of the posterior approach in adrenal surgery: experience in 105 cases. Surgery 114:1126–1131
11. Russell CF, Hamberger B, van Heerden JA, Edis AJ, Ilstrup DM (1982) Adrenalectomy: anterior or posterior approach? Am J Surg 144:322–324
12. Fernandez-Cruz L, Benarroch G, Torres E, Astudillo E, Saenz A, Taura P (1993) Laparoscopic approach to the adrenal tumors. J Laparoendosc Surg 3:541–546
13. Gagner M, Lacroix A, Prinz RA, Bolte E, Albala D, Potvin C, Hamet P, Kuchel O, Querin S, Pomp A (1993) Early experience with laparoscopic approach for adrenalectomy. Surgery 114: 1120–1124 discussion 1124–1125
14. Linos DA, Stylopoulos N, Boukis M, Souvatzoglou A, Raptis S, Papadimitriou J (1997) Anterior, posterior, or laparoscopic approach for the management of adrenal diseases? Am J Surg 173:120–125
15. Duh QY, Siperstein AE, Clark OH, Schecter WP, Horn JK, Harrison MR, Hunt TK, Way LW (1996) Laparoscopic adrenalectomy: comparison of the lateral and posterior approaches. Arch Surg 131:870–875 discussion 875—876
16. Gaur DD (1995) Retroperitoneal surgery of the kidney, ureter, and adrenal gland. Endosc Surg Allied Technol 3:3–8
17. Mandressi A, Buizza C, Antonelli D (1993) Retro-extraperitoneal laparoscopic approach to excise retroperitoneal organs, kidney, and adrenal gland. Min Invasive Ther 2:213
18. Yoneda K, Shiba E, Watanabe T, Akazawa K, Shimazu K, Takamura Y, Kim S, Tsukamoto F, Tanji Y, Taguchi T, Noguchi S (2000) Laparoscopic adrenalectomy: lateral transabdominal approach vs posterior retroperitoneal approach. Biomed Pharmacother 54(Suppl 1):215s–219s
19. Tai CK, Li SK, Hou SM, Fan CW, Fung TC, Wah MK (2006) Laparoscopic adrenalectomy: comparison of lateral transperitoneal and lateral retroperitoneal approaches. Surg Laparosc Endosc Percutan Tech 16:141–145