The Modification and Optimization of Retroperitoneal Laparoscopic Radical Nephrectomy for the Treatment of Localized Renal Cell Carcinoma

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Research

Keywords: Retroperitoneal laparoscopy, Radical nephrectomy, Technical modification, Operative time, Renal cell carcinoma

Posted Date: September 14th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-72823/v1

The modification and optimization of retroperitoneal laparoscopic radical nephrectomy for the treatment of localized renal cell carcinoma

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Abstract

Background: We report our modified surgical technique of retroperitoneal laparoscopic radical nephrectomy (RLRN) and assess its perioperative outcomes and postoperative complications, with a focus on operative time (OT).

Methods: We retrospectively analyzed a single-center, single-surgeon cohort of 130 consecutive patients who underwent RLRN between January 2015 and March 2019. A study group of 65 patients who received modified RLRN was compared with a control group of 65 patients who received classical RLRN. OT, estimated blood loss (EBL), perioperative complications, postoperative first exhaust time (PFET), pathological stage, and postoperative hospital stay (PHS) were compared between the two groups.

Results: All demographic, clinical, and pathological variables were comparable between the groups. No differences were observed in perioperative complications (p=0.648), peritoneal injuries (p=0.843), PFET (p=0.448), pathological stage (p=0.767), and PHS (p=0.304). The modified RLRN group resulted in a significantly reduced overall OT (53.8±8.4 min vs. 60.5±10.6 min, p=0.000), peritoneal injury intervention subgroup OT (56.3±9.8 min vs. 75.2±12.4 min, p=0.000), and EBL (55.7±10.1 mL vs. 62.3±11.6 mL, p=0.001) compared with the classical RLRN group. We observed a significant reduction in OT and EBL but no increase in postoperative complications, PFET, or PHS with modified versus traditional RLRN for localized renal carcinoma.

Conclusions: Findings from this study present a modified RLRN surgical technique that is standardized, more precise, and has better practicability.

Keywords: Retroperitoneal laparoscopy, Radical nephrectomy, Technical modification, Operative time, Renal cell carcinoma

1. Background

Laparoscopic radical nephrectomy (LRN) has become the most important surgical method for radical nephrectomy [1, 2]. With the development of laparoscopic techniques and equipment in urology, our understanding of retroperitoneal anatomy has deepened. An increasing number of urologists have adopted the retroperitoneal approach to perform LRN [3-5]. In retroperitoneal LRN (RLRN) for renal cancer, many scholars believe that effective identification, early control, and ligation of renal pedicle vessels are crucial [2, 3, 6-9]. However, few have paid attention to the first step in clarifying the extraperitoneal adipose tissue in retroperitoneal laparoscopy surgery, which could better identify the peritoneal reflection and Gerota' s fascia [1]. Complete removal of the kidney along the layers outside the perirenal fascia is required to achieve the goal of radical excision. The peritoneum might be easily injured in the dissection of the perirenal fascia, especially in the dissection of the peritoneum reflection and the anterior pararenal space, even after the removal of extraperitoneal fat.

Peritoneal injury is a special complication of retroperitoneal laparoscopic surgery with a high incidence [10]. Because the operating space is small and the visual field is limited, once the peritoneum is injured, it will lead to a smaller visual field, which directly affects the surgical operation and causes great difficulties in the successful completion of subsequent operation procedures.

In the daily retroperitoneal laparoscopic surgery, our practice found that peritoneal injury or tear was not uncommon, especially in radical nephrectomy. Due to the extensive separation of the peritoneum, the incidence of peritoneal injury is higher. If the injury is not properly handled, it directly affects the surgery, which might lead to more serious consequences. Gill et al. reported peritoneal injuries in 21 patients (2.1%) of 1,043 retroperitoneoscopic operations, which resulted in the intraoperative transition to the transperitoneal approach [11]. The most common conditions for elective transition to open surgery include significant adhesions, peritoneal tears, or insufficient retroperitoneal work space in the retroperitoneum [12, 13].

To prevent and manage this potential complication and improve surgical procedures, we sought new surgical techniques. Our modified technique gradually revealed the anatomical landmarks that would not be easily visible in the retroperitoneal cavity, which did not necessarily reduce the incidence of peritoneal injury but might have significantly decreased the degree of technical difficulty of the remainder of the retroperitoneal surgery, shortened the operative time (OT), and improved surgical efficiency.

2. Methods

2.1. Patients

A retrospective review of the urinary surgery database of patients who had undergone RLRN at our hospital was conducted. One hundred and thirty patients were consecutively enrolled for RLRN from January 2015 to March 2019. All patients were evaluated with ultrasonography, multiphasic contrast-enhanced computed tomography (CT) or magnetic resonance imaging of the abdomen, plain scanning of chest spiral CT, emission-computed tomography (ECT), and routine laboratory tests before surgery.

Patients with renal cell carcinoma (RCC) were diagnosed based on the combination of the above radiological and routine laboratory examinations [14]. Patients who had one or more of the following conditions were excluded from the study: 1) an unresectable tumor or distant metastasis, 2) medical intolerance for radical nephrectomy, 3) had undergone transabdominal pathway LRN or open radical nephrectomy, and 4) unwilling to participate in the study. From January 1, 2015, we used the classical technique for RLRN. All consecutive patients operated with this classical RLRN technique as of January 31, 2017, were compared with a study group, which consisted of all patients operated with the modified RLRN technique between February 1, 2017, and March 31, 2019.

An independent resident fully informed the patients about the pros and cons of various procedures, including open radical nephrectomy, transperitoneal LRN, and RLRN, and allowed them to choose the surgery method themselves. Informed consent and signature authorization were obtained from all patients before the operation.

2.2 Operation preparation

All the main procedures were performed by one high-volume surgical expert, who had extensive experience in RLRN before the beginning of the current study.

Localized RCC was diagnosed during the preoperative imaging examination. All renal masses were considered resectable. The clinical stage was T1bN0N0-T3N0M0. The R. E. N. A. L scores ranged from 7 to 12 and were all cases in which local tumors could not be removed through partial nephrectomy or were at high risk of partial nephrectomy. All patients showed normal renal function reserve, with a serum creatine level of 43–93 μmol/L. Unilateral renal function was evaluated by ECT and was in the normal range. Bowel preparation was performed the night before surgery and fasting for 8 h and drinking water for 2 h were required before the operation.

2.3 Surgical procedures

The procedure was performed by adopting general anesthesia with endotracheal intubation. The patient was placed in a 90-degree lateral decubitus position with the lumbar bridge raised and tilted down the head side by 15° and the foot side 30°. Special objects were placed on the front and back to prevent the patient from shifting.

After routine disinfection and towel laying, a transverse incision approximately 2.0 cm in length was made 2.0 cm above the anterior superior iliac spine of the midline of the axilla to cut through the skin and subcutaneous tissue. After the muscle and the dorsal fascia were obtusely separated by vascular forceps, the index finger was inserted deep into the muscular layer to push the peritoneum toward the ventral side.

The retroperitoneal cavity was dilated by an expander made of a double-layer sterilized rubber glove that was injected with 500–800 mL of gas and continued to dilate for 1 min before being removed from the body.

A 10-mm trocar was placed at site A (Figure 1). A 1-0 silk thread was placed in the incision to prevent air from entering the retroperitoneal cavity. The prepared CO_2 gas was injected from the trocar and used to inflate to an abdominal pressure of 15.0 mmHg, and then the laparoscope was placed into the retroperitoneal cavity. Under direct endoscopic view, two 12-mm trocars were placed at point B (2.0 cm below the 12 costal margin of the posterior axillary line) and point C (2.0 cm below the costal margin of the anterior axillary line) to ensure no injury to the peritoneum.

2.3.1 Classical surgical technique

The first 65 cases were operated using classical RLRN as described by Gill et al. [6, 15, 16]. Surgical procedures included: fully dissociating the posterior renal space in the dorsal side of the kidney, then the anterior renal space in the ventral side, and ultimately the lower and upper poles. The emphasis was on the anatomy of the renal pedicle, skeletonization of the renal artery and vein, and vascular clipping and cutting. After complete resection of the kidney, the specimen was placed in a homemade specimen bag and removed. A drainage tube remained in the retroperitoneal cavity. If peritoneal injury resulted in pneumoperitoneum and limited retroperitoneal visual field, a hole was added between the A and C incisions, in which the assistant (a urologist or urology resident) could use auxiliary forceps to lift the peritoneum to the ventral side.

2.3.2 Modified surgical technique

The 65 subsequent procedures for modified RLRN consisted of the following steps:

First, the removal of extraperitoneal adipose tissue (Figure 2A). Under laparoscopic direct vision, the extraperitoneal adipose tissue was dissected downward with an ultrasonic scalpel and dissociated from the peritoneum and the lateral conical fascia and then placed into the iliac fossae, so that the peritoneal reflection and peritoneum could be clearly identified, and the retroperitoneal space was further enlarged.

Second, the dissociation of the anterior pararenal space. The lateral conical fascia was incised from the side of the peritoneum reflection, and the peritoneum was separated to the ventral side along the non-vascularized interval of the anterior pararenal space between the perirenal fascia and the peritoneum (Figure 2B). During this process, if gas leaked into the abdominal cavity or injured the peritoneum, resulting in pneumoperitoneum, the rupture was clipped with hem-o-lok clips. A small incision was cut at site D (Figure 1, 2 cm below the costal margin of the midclavicular line), and a 5-mm trocar was placed for continuous exhausting. After exhausting, the peritoneum could be pressed rapidly to the ventral side, and the operating space of the retroperitoneal cavity was expanded again.

Third, the dissociation of the posterior pararenal space (Figure 2C). The renal dorsal side was dissociated along the anterior psoas space or the posterior renal fascia space until it reached below the diaphragm, and then it was dissociated downward to the iliac fossa to fully dissociate the dorsal side of the kidney.

Fourth, anatomy and ligation of renal pedicle vessels. When the posterior renal space was fully dissected, renal artery pulsation was clearly visible behind the central fascia of the kidney. After the renal artery was dissected and adequately skeletonized by ultrasonic bistoury, it was cut and clamped with three clips (Figure 2D). It was easy to handle the lower pole of the kidney outside the perirenal fat sac, during which the ureters and gonadal vessels could be easily found. The ureter was ligated and severed 10 cm below the lower pole of the kidney. When lifting the left kidney, the renal vein, genital vein, lumbar vein, and central adrenal vein may be clearly seen on the ventral and dorsal sides, and the inferior vena cava could also be clearly seen on the right kidney (Figure 2E). After clipping with three large clips, the renal vein was cut off.

Finally, the dissociation of the upper pole of the kidney was completely isolated (Figure

2F). If the tumor did not invade the adrenal gland, it was generally retained. After observing no active bleeding at the operating field, the kidney was placed in the specimen bag and tightened. A drainage tube was placed in incision B and fixed. According to the size of the specimen, incision C was extended to the ventral side, and the specimen was removed completely. Extraperitoneal adipose tissue was cut off and removed from the body, and the muscular layer, myofascial layer, and subcutaneous tissue were sutured with 2-0 absorbable sutures. Finally, the incision was sutured intradermally with 4-0 absorbable sutures.

2.4 Postoperative care and follow-up

Patients were encouraged to begin off-bed activities on the first postoperative day and allowed to start an oral liquid diet on the day of the anal exhaust. The drainage tube was removed when the daily drainage volume was less than 10 mL. The patients were discharged when their conditions remained stable after pathological diagnosis and drainage tube removal.

Patients with a pathological stage of T1-2N0M0 did not receive adjuvant therapy and were followed up every 3–6 months for 3 consecutive years and then annually. Some T3 patients received adjuvant therapy. T3 patients were followed up every 3 months for 2 consecutive years, every 6 months for the third year, and annually thereafter. Follow-up examinations included physical examination, routine blood tests, hepatic and renal function, chest CT, and abdominal color ultrasound or CT scan.

2.5 Data collection

Demographic and clinical variables were recorded as follows: age, sex, body mass index, tumor location and size, R. E. N. A. L scores [17], and preoperative serum creatinine.

Additionally, the following perioperative variables were recorded: OT, estimated blood loss (EBL), perioperative complications, postoperative first exhaust time (PFET), pathological stage, and postoperative hospital stay (PHS). Because the majority of the procedures for specimen extraction and incision closure were operated by two assistants (one urologist and one resident), OT was determined between the insertion of the trocar and the placement of the specimen into a homemade bag, which was performed by the same surgeon. Furthermore, for the OT, further data were collected for the peritoneal injury subgroup, which required an additional auxiliary operation.

Operative specimens were treated in terms of standard pathological procedures and assessed by experienced urological pathologists. The pathological stage of the primary tumor and lymph node invasion were classified according to the 2010 tumor-node-metastasis staging system [18].

2.6 Statistical analyses

All normally distributed continuous variables were expressed as mean ± standard deviation and compared by independent sample T test. The qualitative variables were expressed as n (%) and analyzed by chi-squared or Fisher’ s exact test. A P value $\leqslant 0.05$ was considered statistically significant. Statistical analysis was adopted with the IBM SPSS Statistics 25 (Chicago, IL, USA).

3 Results

Of 234 patients undergoing radical nephrectomy in the study period in our group, 130 (55.6%) received an RLRN, 77 (32.9%) received a transperitoneal LRN, and 27 (11.5%) underwent open surgery.

There were 65 (50%) and 65 (50%) patients in the modified and classical groups, respectively. All demographic, clinical, and pathological variables were comparable between the two groups (Tables 1 and 2). Neither the modified group nor the classical group underwent conversion to open surgery.

The comparison of perioperative results between the modified technique group and the classical technique group is shown in Table 2. A statistically significant difference was observed in OT, OT of the subgroup (peritoneal injury intervention group), and EBL. Mean OT was 53.8±8.4 min in the modified group and 60.5±10.6 min in the classical group (p=0.000). For the subgroup, the mean OT was 56.3±9.8 min in the modified group and 75.2±12.4 min in the classical group (p=0.000). The mean OT and OT of peritoneal injury in the modified group were shorter than those in the classical group. There was less EBL in the modified group, with 62.3±11.6 mL in the classical group versus 55.7±10.1mL in the modified group (p=0.001). No complications of intraoperative major vascular injury were observed in either group.

No differences with regard to PFET (28.7±4.5 h vs. 29.2±2.8 h, p=0.448), perioperative complications (3.1% vs. 4.6%, p=0.648), and PHS (6.4±1.0 d vs. 6.6±1.2 d, p=0.304) were observed in the modified and classical groups, respectively.

Postoperative complications occurred in 2 patients in the modified group, including 1 case of postoperative pulmonary infection and 1 case of delayed incision healing. In the classical group, 3 complications occurred, including postoperative intestinal obstruction, pulmonary infection, and delayed incision healing. All patients were cured after conservative treatment.

Postoperative pathological diagnosis in the observation group included 42 cases of clear cell carcinoma, 19 cases of papillary RCC, 3 cases of chromophobe cell carcinoma, and 1 case of collecting duct carcinoma. The postoperative pathological stages were T1bN0M0 in 37 cases, T2N0M0 in 26 cases, and T3aN0M0 in 2 cases. The control group included 40 cases of clear cell carcinoma, 21 cases of papillary RCC, and 4 cases of chromophobe cell carcinoma. There were 40 cases of T1bN0M0 stage, 24 cases of T2N0M0 stage, and 1 case of T3aN0M0 stage. The surgical margin was negative in both groups.

Patients were followed up for at least 6 months. The patients were followed up for 6–40 months without long-term complications, local recurrence, or distant metastasis. In addition, renal function tests at follow-up were normal in all patients.

4 Discussion

The incidence of RCC has been steadily increasing [19-21], accounting for approximately 3% of adult malignant tumors and 90% of all kidney malignancies [14, 22]. In the past two decades, with the increasing popularity of ultrasound and CT, the proportion of early renal cancer has increased significantly. Currently, surgery is still the preferred treatment for RCC, especially for localized RCC [23-25]. In recent decades, laparoscopic technology has made great progress in urology, and the treatment concept of kidney cancer has undergone great changes worldwide. With the continuous improvement of endoscopic imaging systems and surgical devices, laparoscopic surgery has been widely used and popularized in urology [9], and laparoscopic surgery, including robot-assisted laparoscopic surgery, has gradually replaced the traditional open surgery [26-28]. LRN is comparable to open surgery in terms of tumor outcomes such as overall survival, specific survival, and progression-free survival, while it is significantly superior to open surgery with regard to surgical trauma and postoperative recovery [1, 29, 30]. Some studies have found that laparoscopic and open surgery have similar oncological outcomes even for locally more advanced RCC [1, 31, 32].

The cases in this study were T1BN0M0-T3N0M0, and the R. E. N. A. L scores were distributed between 7 and 12 points, all of which were cases with local tumors that could not be partially resected or were at high risk of partial nephrectomy. In our center, the chief surgeon in this research group was proficient in LRN via retroperitoneal and peritoneal approaches. Based on the surgical techniques of Gill et al. [15, 16], our team made some modifications after surgical practice: 1) after the retroperitoneal cavity was established, the extraperitoneal fat tissue was first completely dissected from the peritoneum and perirenal fascia, so that the perirenal fascia, peritoneum reflection, and peritoneum could be clearly identified. 2) Before dealing with the dorsal side of the kidney, the ventral kidney was dissociated in the anterior pararenal space. If the dorsal was dissociated first, the whole kidney would fall to the ventral side because of gravity, which would make it difficult to dissociate the ventral side next and increase the risk of injury to important abdominal organs such as the duodenum. 3) With regard to the impact of an inadvertent peritoneal injury or tear intraoperatively, which might cause pneumoperitoneum, leading to an inadequate working space, we clipped the breach with a hem-o-lok clip and put a 5-mm trocar to exhaust. This trocar, placed 2 cm below the costal margin of the midclavicular line, was applied to open the side hole for continuous exhausting, After exhausting, it was observed that the CO_2 gas injected into the retroperitoneal cavity rapidly pressed the peritoneum to the ventral side, restoring the surgical space, which was conducive to the subsequent operation of the procedure. 4) The classical RLRN was relatively closed after being connected with CO_2 gas.

However, the side hole of the channel operated by the ultrasonic scalpel was opened in the modified group so that the smoke and exhaust gas generated by the ultrasonic scalpel would be quickly discharged out of the body. The air circulation also reduced the frequency of the lens blur and reduced the lens polishing time. The intake pneumoperitoneum pressure was 15.0 mmHg, and the exhaust was discharged through the side orifice and auxiliary orifice of the abdominal cavity. The exhaust velocity was adjusted according to the pressure, and the actual pressure fluctuated between 10 and 12.0 mmHg without affecting the visual field.

Through the above technical improvements, the modified RLRN procedure performed in our operation group was carried out step by step according to the technical route, without the problem of delaying the OT due to unexpected circumstances. In the modified group, the average OT, especially in the peritoneal injury subgroup, and the intraoperative EBL were significantly shorter than those in the control group. There was no intraoperative blood transfusion and almost no intraoperative bleeding during the operation in some cases in both groups. Furthermore, through the modification of the surgical procedure, the accessory renal vein, gonadal vein, and central adrenal vein were dissected clearly, reducing the risk of vascular injury and thus the time to hemostasis by accident.

We do not deny that the control of the renal pedicle is critical; however, procedural, standardized, and precise surgical procedures can make the operation more repeatable and practical. It may also help beginners to quickly master the technology, shorten the learning curve, and thus be more conducive to the application of the technology. For obesity, perirenal adhesions, hilar masses, vascular variations, and other complex conditions, the modified method can be used.

The reported complications were mostly vascular injury and organ injury, which had more serious and dangerous consequences and often required further surgical intervention or conversion to open surgery [13, 33, 34]. In retroperitoneal laparoscopic surgery, peritoneal injury was not uncommon; however, reported cases were not frequent. It might be that peritoneal injury was often overlooked because serious consequences were not observed. Through practice, our team found that retroperitoneal laparoscopic surgery, especially the extensive resection of RLRN, had a higher incidence of peritoneal injury, with a total of 40 cases of peritoneal injuries occurring in 130 RLRN cases. Among them, 35 needed additional assistance to better complete the consequent procedure. There were 18 cases of peritoneal injury in the modified group and 17 cases in the classical group. Most of the injuries occurred during the surgical procedure of separating peritoneal reflection and the anterior pararenal space. In a survey of 24 medical centers, 63% of urologists admitted that peritoneal injury significantly increased the difficulty of the remaining procedures [11]. This was probably due to the peritoneal injury, which led to gas entering the abdominal cavity and increased intraperitoneal pressure, thus causing greater compromise of the operative field and affecting the consequent surgical procedure [10]. In the control group, after peritoneal injury, auxiliary holes were added to the retroperitoneal cavity (generally located between points A–C or A–B), and then the peritoneum was lifted by the assistant with a separation clamp to ensure the successful completion of subsequent surgery. Because the pneumoperitoneum in the abdominal cavity could not be resolved, the operation scope became smaller, and the auxiliary forceps had adverse effects on the operation of the surgeon in vivo and in vitro. However, the method adopted by the modified technique group was simple, easy to operate, and had little influence on the subsequent operation of the subgroup with peritoneal injury after increasing the abdominal auxiliary control of exhaust.

The study also found that it was necessary to dissociate the non-vascular space between the anterior pararenal space and the peritoneum in RLRN. The peritoneum is a very thin and semi-permeable membrane. Between the anterior prerenal space and the peritoneum, CO_2 gas will gradually enter the abdominal cavity through the peritoneum, progressively increasing abdominal pressure and narrowing the retroperitoneal space, which also increases the difficulty of the operation. In view of this, we can consider using the vent hole of the abdominal cavity to maintain the pressure difference between the retroperitoneal cavity and the abdominal cavity, so that the free peritoneum is pressed ventrally. Thus, a relatively large surgical view in the retroperitoneal cavity is maintained to facilitate laparoscopic operation, which can save OT and reduce the possibility of intraoperative injury. Although some cases of peritoneal injury included an auxiliary trocar, the PFET was not prolonged, indicating that the auxiliary hole had little interference with the abdominal cavity and did not affect the postoperative recovery of gastrointestinal function.

The current study was not without limitations. First, it was a nonrandomized controlled study using a historical cohort of different eras as a control group and involved a relatively limited sample size. Second, patients in the modified technique group were operated after the control group, which might have influenced the outcomes. Doctors' experience might not be optimal when performing surgery in patients in the control group compared with the modified group. However, this surgical team is a high-volume laparoscopic surgery group, which has rich practical experience in both peritoneal and retroperitoneal surgery. As early as

2015, the total number of laparoscopic surgeries per year was over 300, and laparoscopic nephrectomy or partial resection averaged over 200. Therefore, the impact might be limited. Furthermore, due to the difference in mean follow-up time between the two groups, no further comparative analysis of oncologic outcomes was performed. Considering that the scope of surgical resection was the same, although the surgical procedure was modified, the impact on tumor prognosis may also be limited. Randomized prospective studies can be conducted to accumulate more data in order to obtain more reliable outcomes in the future.

5 Conclusions

The operative time and intraoperative blood loss of the modified RLRN were shorter than that of the control group. This may be due to the improvement of the surgical procedure in this study. The auxiliary hole and side hole exhaust， making the surgical field of view expand and clearer， improve the surgical efficiency. Despite some limitations, to our knowledge, this study systematically proposed treatment strategies for peritoneal injury for the first time and compared it with the control group. The modified surgical procedure was more programmed, standardized, and precise, which might help beginners quickly master the surgical technique and thus facilitate the application of the technique.

Abbreviations

CT: computed tomography

EBL: estimated blood loss

ECT: emission-computed tomography

LRN: laparoscopic radical nephrectomy

OT: operative time

PFET: postoperative first exhaust time

PHS: postoperative hospital stay

RCC: renal cell carcinoma

RLRN: retroperitoneal laparoscopic radical nephrectomy

Declarations

Acknowledgements

None.

Sources of Support: None.

Number of Figures:7.

Funding: None.

Conflicts of interest: All authors have completed the ICMJE uniform disclosure form. The authors have no conflicts of interest to declare.

Author Contributions: Yimu Zhang: Data analysis, conceptualization, drafting the article, and critical revision of the article. **Zhengyu Zhou**: Data analysis, conceptualization, drafting the article, and critical revision of the article. **Jiyan Bai**: Data acquisition, data analysis, and critical revision of the article. **Pei Tian**: Conceptualization and critical revision of the article. **Dong Yang**: Data acquisition, data analysis, and critical revision of the article. **Pengcheng Zhao**: Data acquisition, data analysis, and critical revision of the article. **Jing Li**: Data acquisition, conceptualization, methodology, and critical revision of the article. **Chaohong He**: Data acquisition, conceptualization, validation, supervision, and critical revision of the article. All authors have read and approved the final version of the article.

Footnote

Ethical Statement：The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki and was approved by the ethics committee of Affiliated Cancer Hospital of Zhengzhou University (Zhengzhou, China). Written informed consent was given by all patients before receiving surgical therapy, according to the institutional guidelines.

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Figure legends:

Fig 1: Positions of trocar ports

Fig 2A: The removal of extraperitoneal adipose tissue.

Fig 2B: the dissociation of anterior pararenal space. The avascular area of the anterior pararenal space is shown as above.

Fig 2C: the dissociation of posterior pararenal space. The avascular area of the posterior pararenal space is clearly visible, as shown.

Fig 2D: Ligation of renal artery.

Fig 2E: Skeletonization of renal vein.

Fig 2F: handling of the upper pole of the kidney.

Figures

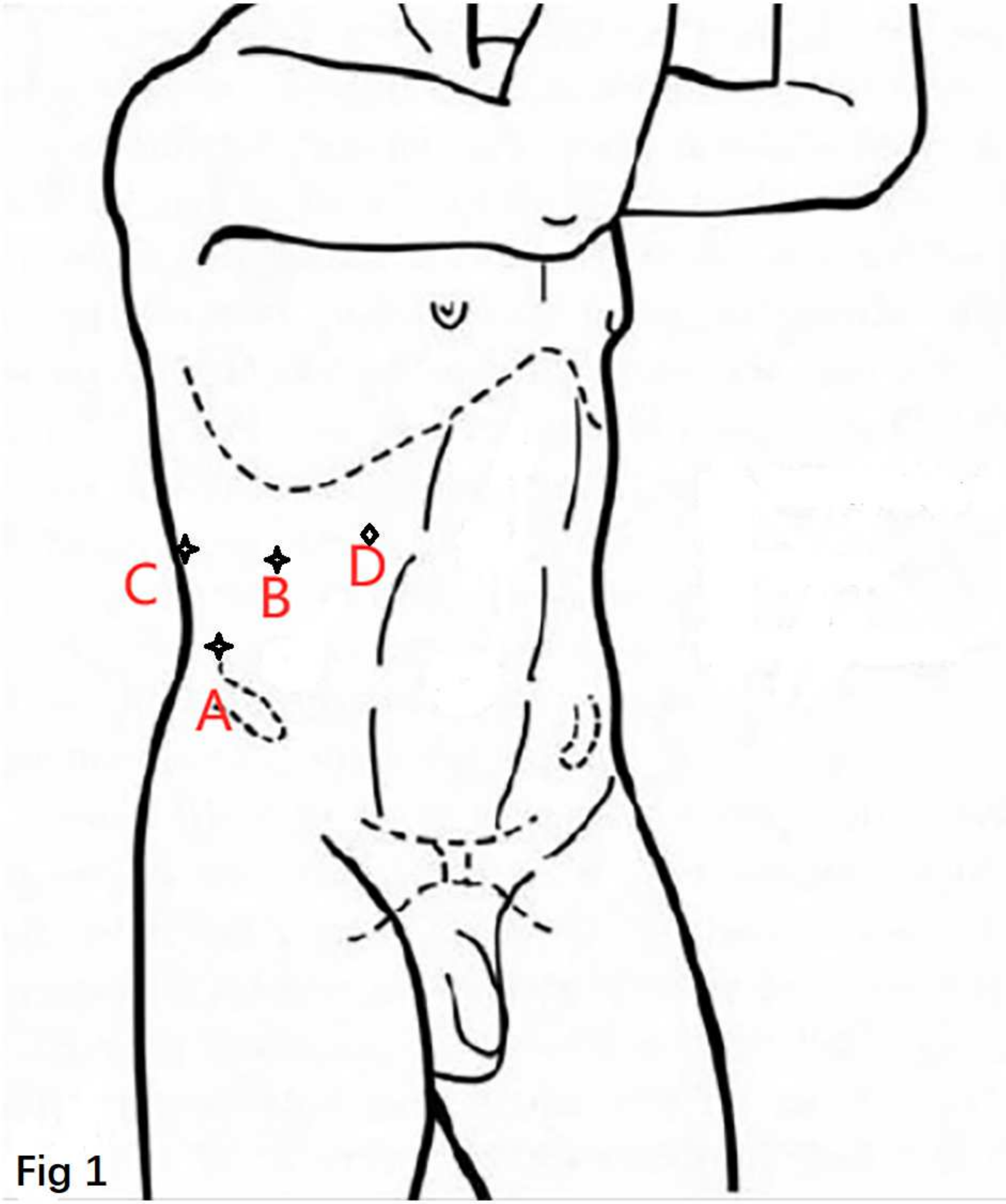

Figure 1

Positions of trocar ports

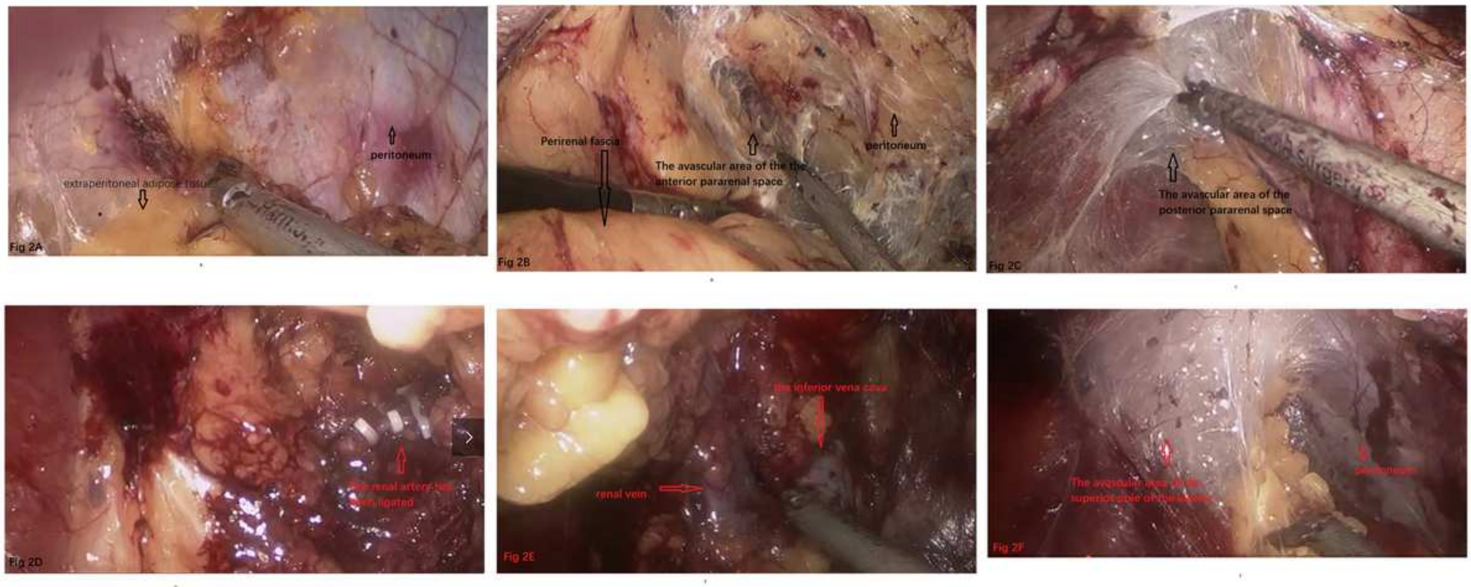

Figure 2

A: The removal of extraperitoneal adipose tissue. B: the dissociation of anterior pararenal space. The avascular area of the anterior pararenal space is shown as above. C: the dissociation of posterior pararenal space. The avascular area of the posterior pararenal space is clearly visible, as shown. D: Ligation of renal artery. E: Skeletonization of renal vein. F: handling of the upper pole of the kidney.

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