

## Original Article

# Efficacy investigation of transpostceliac single-port 3-channel laparoscope in the treatment of complex renal cyst

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**Abstract:** This study aims to investigate the surgical method and long-term efficacy of transpostceliac single-port 3-channel laparoscope in the treatment of complex renal cyst. A retrospective analysis was performed towards the 37 patients who underwent renal cyst unroofing decompression with single-port laparoscope from Jun. 2012 to Jul. 2013. The surgery was performed through the postceliac approach, a 2.5 cm incision was made 4-5 cm away from the iliac spine of midaxillary line, the Olympus single-port TriPort was then implanted, with the laparoscopic channel and the other two operation channels all as 5 mm. The operation was completed with the forceps and scissors which had flexible fronts. The cysts of the 37 patients were performed the appropriate surgical treatments according to their subtype grouping, on case was transferred to the open surgery, and there was no blood transfusion case. The operation time was 11-42 min, with the mean time as 23 min; the bleeding volume was 10-50 ml, with the mean volume as 26 ml; the postoperative follow-up was 1-6 months, and the ultrasound review did not find the recurrence of cyst; the postoperative lumbar scar was approximately 2.5 cm, and the patients could leave the bed and perform some acts on the exact day of the surgery; the hospitalization time was 1-2 d, with the average time as 1.2 d. The efficacy of the transpostceliac single-port 3-channel laparoscope in the treatment of complex renal cyst was positive, with low recurrence rate, and worthy of further promotion.

**Keywords:** Renal cyst, postceliac laparoscope, single-port

## Introduction

The laparoscopic technology has brought great changes to the micro-invasive surgical field, because of the slight postoperative pain, better cosmetic result, shorter hospitalization period, and small trauma, this technology has obtained widely used in clinical practice. With the tireless efforts of clinicians, the laparoscopic surgery has developed from classical 4 incisions [1] to 3 incisions [2] and 2 incisions [3], and finally achieved the success of single incision. In 1975, Wheeler [4] firstly reported the transumbilical laparoscopic tubal ligation, which laid the foundation of single-port laparoscopy (SPL). From 1991 to 1992, Pelosi and Pelosi [5] successfully applied the SPL into the hysterectomy, bilateral salpingo-oophorectomy and appendectomy [6], and in 1997, Navarra et al.

[7] performed the transumbilical SPL (TUSPL) cholecystectomy. With time goes on, the SPL has obtained wider range of applications, since 2007, the SPL has been widely used in urology. In 2007, Gettman et al. [8] firstly implemented the transumbilical ureterolithotomy. In the same year, Raman et al. [9] performed 3 cases of TUSPL nephrectomy, including 1 case of suprarenal epithelioma and 2 cases of benign nonfunctioning kidney, and this technology began to be applied into the treatment of malignant tumors. In 2008, Desai et al. [10, 11] firstly reported the TUSPL pyeloplasty and prostatectomy, in the same year, Kaouk et al. [12, 13] reported a series of TUSPL surgeries in urology, including 2 cases of renal cryotherapy, 1 case of wedge biopsy, 1 case of radical nephrectomy, 4 cases of sacral vaginofixation, and 4 cases of varicose vein resection. In 2008, Gill et al. [14]

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also firstly successfully implemented 4 cases of TUSPL nephrectomy from the living kidney donors. In addition, the TUSPL is also applied in the sleeve gastrectomy [15], gastric banding surgery [16] and right hemicolectomy [17], etc.

TUSPL is now widely carried out in China, which inserts a piercing tube with multiple operating channels through the umbilicus, the surgical instruments could then be inserted through the operating channels to complete surgical procedure, and the samples could be removed through the umbilicus. The surgical incision is in the umbilicus, where the umbilical skinfolds could cover the incision, a satisfactory cosmetic result could then be achieved. Although this surgery is still in the exploratory stage, it has already appeared clear advantages: no scar, strengthened cosmetic results, reduced post-operative pain due to the reduced incision, faster recovery, the risks of incision hernia and incision infection decreased.

While TUSPL still has its unnegligible security issues which need to be overcome, such as the SPL is difficult to operate, the abdominal visceral traction would be difficult, the exposed surgical field is limited, how to close the incision safely, and how to prevent the abdominal infection, etc. Moreover, compared with the traditional laparoscopic surgery, the characteristics of inline vision of SPL would result in poor 3D vision, and because the lens would be easily interfered by the surgical instruments inside and outside the abdominal cavity, the screen would be instable. Therefore, in order to avoid the disturbance from the transabdominal surgery towards the abdomen, and play the advantage of SPL, we attempted the transpostceliac SPL (TPCSPL) in the treatment of the renal cyst, providing foundation towards the more complex TPCSPL in the next step.

Whether or not the SPL could be realized via the traditional transpostceliac approach is currently still rarely reported internationally. From Jun. 2012 to Jul. 2013, 37 patients with different types of complex renal cysts (CRC) were performed the TPCSPL renal cyst unroofing decompression with the Olympus single-port TriPort, and the cavity wall and residues were also given different handling. Through these 37 cases of renal cyst unroofing decompression, it was confirmed that the single-port 3-channel approach could be safe and feasible in the

application of TPCSPL towards the renal cyst unroofing decompression.

Our experience showed that the intraoperative combination of two flexible pliers and scissors could achieve the establishment of the posterior abdominal cavity and the complete isolation of the kidneys. We considered that the SPL had two huge advantages: (1) compared with the TUSPL, it would not interfere with the abdominal cavity, retaining the biggest advantage of posterior laparoscopic surgery; (2) compared with the conventional laparoscopic surgery, trauma would be smaller. We named this technology as the transpostceliac single-port 3-channel laparoscope (TPCSP3DL), aiming to differ from SPL.

### Materials and methods

#### *General Information*

The 37 cases in this research included 23 males and 14 females, aged 19-72 years old, with the mean age as 47 years old; the disease duration was 2 months to 6 years; among who 22 cases had the cyst on the right side, 12 cases had it on the left side, and 3 cases had it on the bilateral sides; 22 cases had multilocular cyst, 12 cases had multiple cysts, and 3 cases had pelvic cysts. 12 patients suffered from various degrees of pain and discomfort on the ipsilateral lumbus and abdomen, 8 cases were associated with mild ~ moderate hypertension, 2 patients were accompanied with cyst infection and fever, the cyst fluid appeared cloud-like changes intraoperatively, including 1 case of abscess formation, 8 patients had no obvious symptoms or other diseases accidentally discovered in physical examination, 2 cases appeared the microscopic hematuria, 3 patients had mild~moderate hydronephrosis, with cyst size as 4.2 cm × 5.1 cm ~ 7.6 cm × 12.5 cm. The preoperative imaging studies included the urinary tract ultrasound, renal CT or IVU, etc. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Academy of Military Medical Sciences. Written informed consent was obtained from all participants.

#### *Surgical methods*

The patients were all performed the endotracheal intubation under general anesthesia,

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with lying on the lateral position, and the waist would be padded higher. A 2.5 cm incision was made 4-5 cm away from the iliac spine of the midaxillary line, the subcutaneous and muscular layers were bluntly separated, then isolated the retroperitoneal space with fingers. Olympus single-port TriPort was then implanted, connecting with CO<sub>2</sub> pneumoperitoneum machine, and the pneumoperitoneum pressure was maintained 12-15 mmHg (1 mmHg = 0.133 kPa). The laparoscope was then connected with the operation instrument. The psoas muscle, peritoneum reflection, diaphragm and kidney were set as the anatomical markers, then cut the Gerota fascia, freed the kidney to expose the renal cysts; at the end of surgery, the CO<sub>2</sub> pressure was reduced to 5mmHg. After checking no active bleeding, the drainage tube was placed via the cannula, and withdrew all the instruments.

### *Cyst typing*

Combined with the preoperative imaging data and intraoperative findings, renal cysts were divided into three types according to the portion of the protruding-renal-surface cyst to the total cyst, cyst sizes and locations: type I, the portion of the cyst wall protruding the renal surface was greater than 2/3 of the entire cyst volume, and the cyst located in the lower pole or back side of the kidney, with the average diameter <6 cm (8 cases); type II, the portion of the cyst wall protruding the renal surface was less than 2/3 of the entire cyst volume, and the cyst located in the upper pole or ventral surface of the kidney, with the average diameter > 6 cm (18 cases); type III, including parapelvic cyst, multilocular cyst and multiple cysts (11 cases).

### *Treatment methods*

Type I: fully freed and exposed the cyst, resected the cyst wall 0.5 cm away from the renal parenchyma, then 3% iodine yarn ball was used to rub the residual cyst wall, while the residual cavity was not treated. Type 2: fully freed the cyst wall, then cut a small open with the ultrasonic knife, exhausted the cyst fluid, F7 ureteral catheter was then used to inject the cavity with dehydrated ethanol, retained for 5 min later, then rinsed the cyst cavity with saline, resected the cyst wall 0.5 cm away from the renal parenchyma, then used the gelatin sponge, hemostatic gauze and pedicled perire-

nal fat to fill and eliminate the residual cavity. Type 3: peeled the cyst wall closely and gradually, at the same time, paid attention to protect the renal vessels and not to injury the renal pelvis, the intraoperative usage of gelatin sponge and hemostatic gauze filling the wound surface could eliminate the residual cavity and limit and repair the possible leakage; the treatment method of multilocular cyst could refer to the principle of type 2.

### **Results**

No postoperative complications such as bleeding, subcutaneous emphysema and peritoneal damage occurred. The operation time was 11-42 min, with the mean time as 23 min; the bleeding volume was 10-50 ml, with the mean volume as 26 ml; the postoperative surgical scar was about 2.5 cm, and the patients could get out of bed and did some acts on the exact day of the surgery, the hospitalization time was 1-2 d, with the average time as 1.2 d; the postoperative pathological diagnosis confirmed the renal cyst. The 1 ~ 6-month postoperative follow-up revealed that the ultrasound found no cyst recurrence.

### **Discussion**

The surgery could cure the disease, and is also accompanied with trauma, pain and scarring [11]. In recent years, the rapid development of laparoscopic technique outstandingly exhibits such advantages as small physiological trauma, less bleeding, less pain, quicker recovery, easy acceptance by the patients, small scar, and good cosmetic effects [8]. But, the standard laparoscopic surgery usually requires multiple skin incisions to place the tube (diameter 5, 10 or 12 mm), causing bigger trauma, and the incision would be less beautiful, some patients would have the complications such as vascular injury at the puncturing sites, pain, infection, subcutaneous emphysema and radiological joint pain, etc [9, 12]. Therefore, technologies such as natural orifice transluminal endoscopic surgery (NOTES) [18] and single incision laparoscopic surgery (SILS) [14] emerged since 2007.

SILS uses TriPort, which could be tightly fixed to the abdominal wall, maintaining its tension and the local seal. The whole system has good flexibility, and could be easily fitted into the laparo-

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scopic instruments with a curve or joint, compared with the conventional solid laparoscopic channel, SILS has significant advantages, including that the incision is easy to be hidden, the cosmetic effect is outstanding, so it's a further development and useful supplement towards the traditional endoscopic techniques [19].

Based on basis of mastering the single-port laparoscopic adrenalectomy and single-port laparoscopic partial cystectomy, we conducted a preliminary exploration on the TPCSPL renal cyst surgery [20]. The procedures of TPCSPL renal cyst unroofing decompression surgery included: 1. the preparation of the postceliac space production and the implantation of TriPort; 2. freeing the kidney and exposing the renal cyst; 3. renal cyst unroofing decompression and cyst wall treatment; 4. filling partial cavity. We considered that compared with the conventional TPC laparoscopic surgery, the SPL was suitable for the treatment of renal cysts, with less invasive, and faster patients' recovery. Because the incision was small, the cosmetic effect would be better after healing. Similarly, in order to avoid the damage of the peritoneum, the surgery should open the Gerota fascia along the lateral side of psoas muscle, the perirenal fat should be carefully separated until exposing the renal capsule, which was one of the most important anatomical landmarks in laparoscopic surgery.

Compared with the traditional laparoscopic surgery, SPL also exists some difficulties: 1. The operation is difficult, because the laparoscope was implanted into the body paralleledly with other two operating devices through one port, it would not have sufficient distance that these three device could separate and form a triangular distribution, therefore the laparoscopic lens body and the operating instruments would seriously interfere with each other, creating certain difficulties in operations and exposure to the more complex surgery; 2. the instrument handle would interfere with each other outside the port, the operation handles were close and parallel to each other, so the scope of activities would be small, which might easily produce the illusion under the microscopic and thus affect the operation; 3. the operative area could not be exposed fully. The problem which had always be "criticized" by the European and American

doctors that the "postceliac space was small" would become more prominent. However, these technical difficulties could be solved with time going [21].

To solve the above issues, we used two bendable forceps and scissors during the operation, which partially solved the problem of the parallel and close operation handles, so the scope of activities could be some degree bigger. With the bendable 30. Integrated electronic laparoscopy (Olympus Co., Ltd), the angles of TriPort laparoscope could be changed, and thus minimized mutual interference between devices. As for the organs and tissues which needed the surgical pulling, such as kidney, perirenal fat or Gerota's fascia, etc., the operation might refer to Professor Yang et al. [22], who sutured the organs to the lateral peritoneum or abdominal wall, and they could also be percutaneously sutured, and drawn by the assistant, realizing the establishment of the postceliac cavity and the complete freeing of the kidney, and achieving the complete removal of the renal cysts.

We believed that the SPL had two significant advantages: 1. Compared with the TUSPL, it would not interfere with the abdominal cavity, retaining the biggest advantage of laparoscopic surgery; 2. the operation time was short, SPL had obvious advantages in sleeve implantation, postoperative suture and reducing the intraoperative time than the conventional 3-port method, it could greatly shorten the operation time; 3. compared with conventional laparoscopic surgery, the trauma would be smaller. The transpostceliac approach could better expose the renal cyst and minimize the impact on the gut. Similar to the conventional laparoscopic renal cyst unroofing decompression, being familiar with the TPC laparoscopic surgery, the accurate and delicate operation was the key to shorten the operation time and prevent the complications.

Therefore, the preliminary results of this clinical study showed that TPCSPL had good safety and feasibility in the renal cyst resection, while the clinical effect still needed to be confirmed with long-term follow-up and large-sample controlled studies.

### Disclosure of conflict of interest

None.

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