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Intraperitoneal laparoscopic technique in trendelenburg position: an effective surgical method for pyelolithotomy, pyeloplasty, and heminephrectomy in patients with horseshoe kidneys

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Abstract

Purpose To evaluate the safety and feasibility of intraperitoneal laparoscopic surgery in Trendelenburg position (ILSTP) for pyelolithotomy, pyeloplasty, and heminephrectomy in patients with horseshoe kidneys (HSKs).

Methods Between March 2021 and March 2024, three patients with HSKs underwent ILSSP. Of these three patients, two with pelvi-ureteric junction obstruction with recurrent kidney stones underwent pyelolithotomy and pyeloplasty, one with symptomatic nonfunctioning left moiety of a HSK was managed with heminephrectomy.

Results Mean operating time was 114 ± 64.8 (44–172) min, and estimated blood loss was 63.3 ± 51.3 (20–120) ml. The mean hospital stay was 3.3 ± 1.5 (2–5) days. There were no major intra- or post-operative complications.

Conclusions ILSTP is a feasible and effective technique for performing pyelolithotomy, pyeloplasty, and heminephrectomy in patients with HSKs.

Introduction

Horseshoe kidney (HSK) is the most common renal fusion defect that typically involves the lower poles of the kidney [1]. It may predispose patients to various symptoms that are typically related to hydronephrosis, infection or calculus formation [2]. Surgeries are generally performed in patients with recurrent flank pain, non-functioning kidney, HSK cancer, and symptomatic hydronephrosis [3]. However, laparoscopic surgery in the lateral decubitus position is very challenging and time consuming in HSK, due to compromised exposure related to the kidney's ectopic low-lying position [4]. Here we report our technique of intraperitoneal laparoscopic surgery in Trendelenburg position (ILSTP) in managing three HSK patients with benign diseases.

Patients and methods

All three HSK patients were included in this retrospective study. Investigations performed included urinary radiogram (KUB), enhanced computed tomography (CT) combined with CT ureterography (CTU), and 3D reconstruction examination. Patient #1, 64 years old,

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male. Patient #2, 42 years old, male. Patient #3, 30 years old, female. The specific diagnosis results of patients included patient #1 and 2 diagnosed with right hydronephrosis with recurrent kidney stones, patient #3 with nonfunctioning left kidney. All patients underwent isthmus division surgery using an endoscopic linear stapler. Additional procedures were performed simultaneously, including pyelolithotomy, pyeloplasty, and heminephrectomy. CT and CTU were conducted to assess the postoperative outcomes. The study was approved by the Ethics Committee of South China Hospital of Shenzhen University, and written informed consent was obtained from all patients.

Surgical technique

The patient is positioned in a supine with a 30° Trendelenburg. Four trocars were positioned in all the procedures: the first 10-mm camera port was placed 5 cm below the umbilicus using open Hasson technique (infra-umbilical port); after induction of pneumoperitoneum, two trocars (working ports) were placed at the iliac crest level and 6 cm right (12-mm) and left (5-mm) to the camera port; one 12-mm trocar (assistant port) was placed adjacent to the umbilicus (Fig. 1).

Partial ascending colon and duodenum was mobilized cephalically. The ureter was dissected free of the surrounding tissues and then traced to locate the isthmus. Next, the isthmus was isolated and rigorously divided from the infrarenal supplying arteries, and a tunnel was created between the isthmus and the blood vessels. Then the isthmus was transected with 60 mm Endostapler, and the edges of the isthmus were stitched using 3–0 barbed sutures.

Pyelolithotomy and pyeloplasty were initiated in case #1 and 2. The right renal pelvis was carefully mobilized and opened extending to pelvi-ureteric junction (PUJ), and the stone was removed. Large pieces of the stone were placed in a bag and retrieved, and small fragments were suctioned out. Then the narrowed PUJ was mobilized and a dismembered Anderson–Hynes pyeloplasty

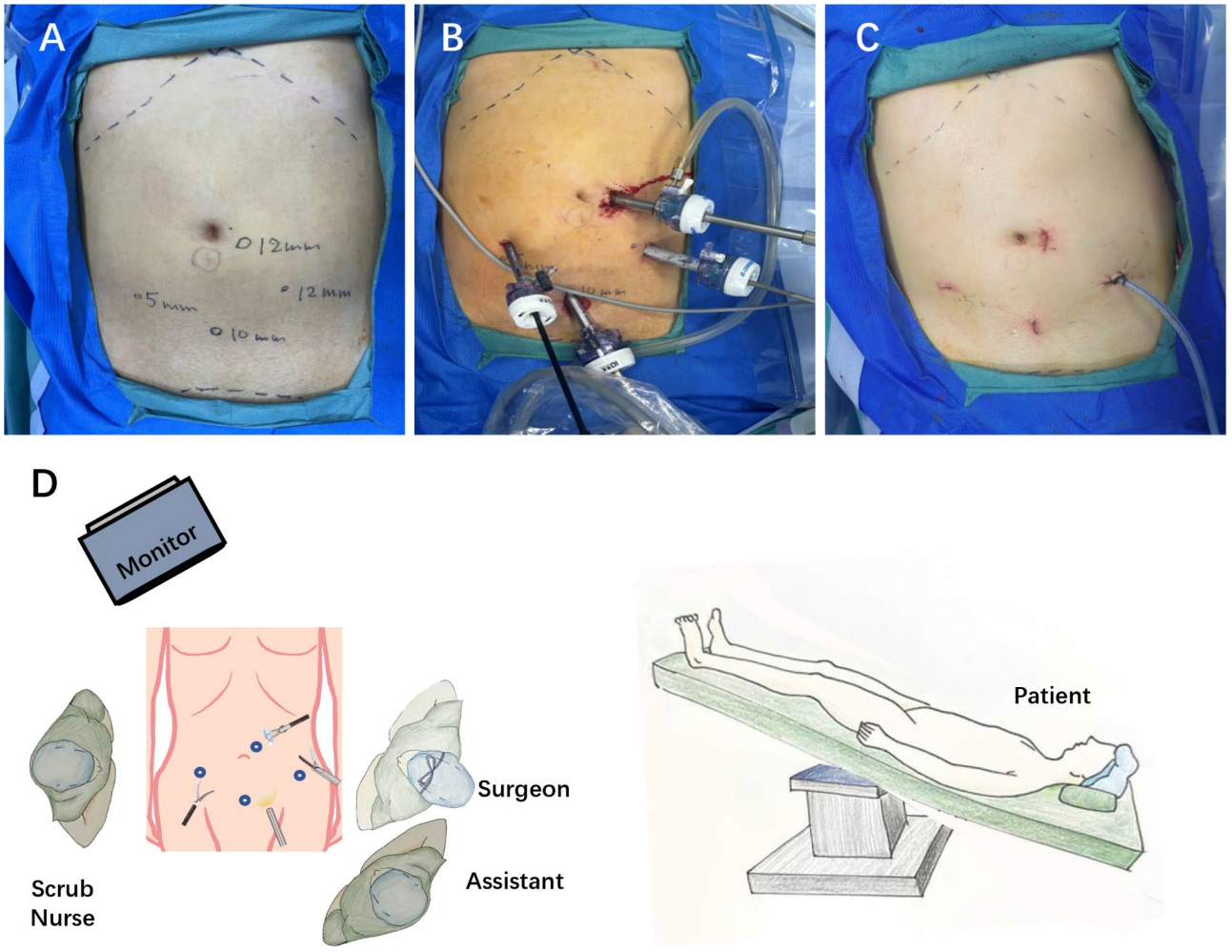

Fig. 1 (**A**-**B**) The patient is in a Trendelenburg position and four ports positions are illustrated. (**C**) Postoperative wound. (**D**) Monitors and positions of surgeon, assistant, scrub nurse, and patient (right side)

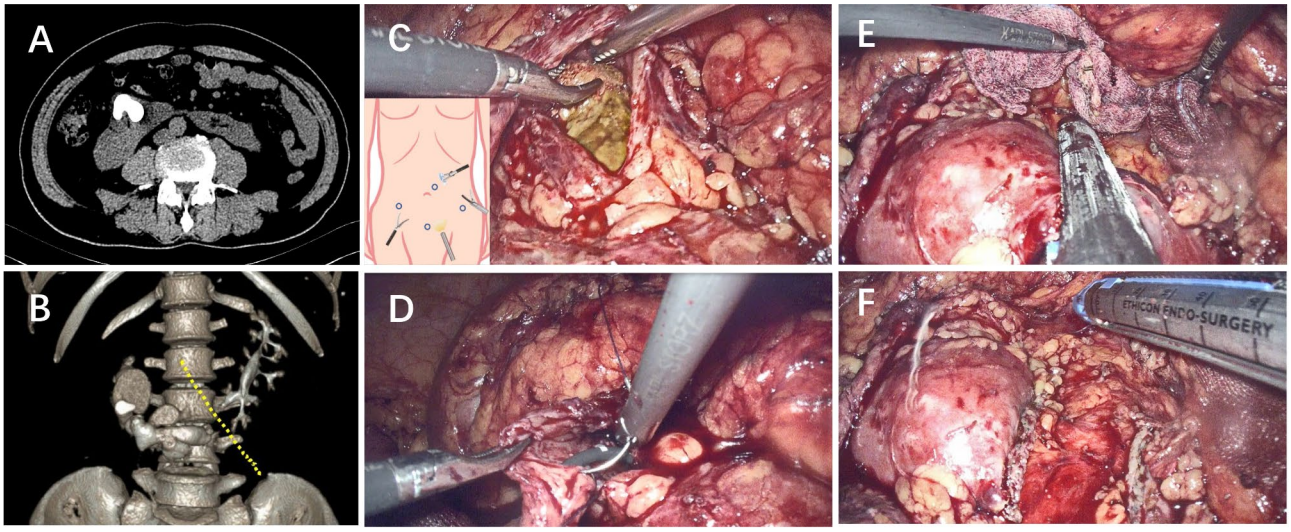

Fig. 2 (**A**-**B**) Case 1 (**A**) and 2 (**B**): CT scan and three-dimensional image show HSK with right renal calculi of the patients. Yellow dashed line indicates the isthmus dividing line in (**B**). (**C**) calculus being removed from the right kidney. (**D**) pyeloplasty being performed. (**E**) The endoscopic linear stapler is fired. (**F**) The isthmus is divided

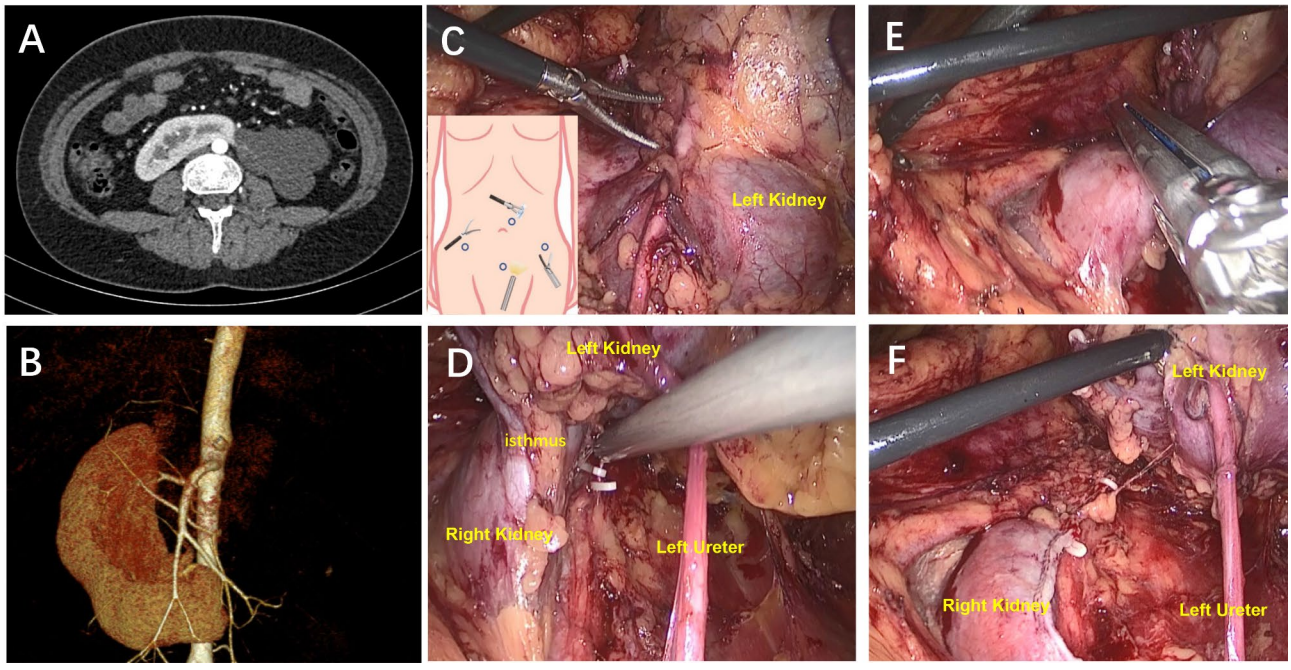

Fig. 3 (**A**) Preoperative CT scan revealed horseshoe kidney with a co-existent nonfunctioning left kidney in case 3. (**B**) Three-dimensional image of the kidney and vessels. (**C**-**D**) Isolation of left kidney and ligation of renal vessels. (**E**) The endoscopic linear stapler is fired. (**F**) The isthmus is divided

was performed. Pelvis was anastomosed with the ureter with Vicryl 4−0 suture followed by double J stent placement and continuous closure of pyelotomy incision (Fig. 2). Heminephrectomy was performed in case 3. The sigmoid colon and descending colon were mobilized first, and the ureter was dissected and traced to locate the isthmus. After splitting the isthmus, renal artery and vein were dissected and clipped. Then, the upper pole was dissected (Fig. 3). The kidney was freed, bagged, and removed through the extended lower port site.

All procedures were successful. There were no intraoperative or postoperative complications. The operative time was 126 min, 190 min, and 44 min in 3 cases, respectively. The intraoperative blood loss was 20 ml, 30 ml, and 5 ml in 3 cases, respectively. The postoperative hospital stay was 3 days, 5 days, and 2 days in 3 cases, respectively. In case 1 and 2, double-J stents were

removed 4 weeks postoperatively, and the patients had symptomatic improvement. In case 1 and 2, follow-up at 6 months shows no evidence of recurrent hydronephrosis or renal calculi.

Discussion

HSK is the most common renal fusion anomaly occurring in 0.15–0.25% [5]. Approximately 50% of HSKs are asymptomatic. The most common causes for symptomatic identification of horseshoe anomalies include ureteropelvic junction obstruction (UPJO), which develops in up to 35% of cases, and renal stone, which occurs in 20–60% of patients and may be associated with UPJO and recurrent infections [6].

Recently, laparoscopic techniques have been proposed as a minimally invasive alternative in the treatment of HSK. However, the long learning curve has prevented its widespread application [7]. In particular, the division of isthmus and dissection of variable arteries can be very challenging and time consuming [8]. Proper choice of surgical approach and preoperative planning can ease the procedure. Depending on the surgeon's expertise, transperitoneal, retroperitoneal, and transmesenteric approaches have been used [9]. However, all patients were placed in a flank position, in which dissecting the isthmus is difficult, as the contralateral side of the isthmus is rarely visible. Our study has shown that ILSTP can provide an appropriate and safe surgical view, allowing dorsal vessels and the isthmus to be safely dissected and transected. Besides, pyelolithotomy, pyeloplasty and heminephrectomy could be feasibly performed without patient repositioning. We believe this approach will reduce the difficulty and ensure the success of HSK surgeries.

Currently, division of the isthmus is not routinely done during HSK pyeloplasty. Certain studies proposed that the isthmus does not contribute to obstruction, and that pyeloplasty without isthmectomy was a highly effective and safe procedure for treating pelvi–ureteric junction obstruction in HSK patients [7, 10]. However, isthmusectomy may allow the kidneys to lie in a more dependent position and maintain an unobstructed upper urinary tract [11]. In HSK patients with recurrent symptomatic hydronephrosis, pyeloplasty and isthmusectomy has shown promising results [12]. In pediatric HSK patients with unilateral PUJO, laparoscopic Anderson-Hynes pyeloplasty with isthmotomy and lateropexy is a highly effective and safe procedure [10]. In the present report, we present two HSK patients with recurrent hydronephrosis and kidney stones. We performed pyeloplasty and isthmusectomy simultaneously to guarantee the free outflow of urine. Long-term follow-up after surgery showed good results. A similar decision was made by Piotr et al., who proposed that if we have doubts about the success of the operation, the decision to perform isthmusectomy may be necessary [3].

On the basis of our experience, the use of the ILSTP may offer several technical advantages. First, in compare to traditional laparoscopy, ILSTP provides intuitive insight into the operative field, increases feasibility for the dissection and suturing. Besides, Trendelenburg position can assist with keeping the intestines out of the way in compare to simple supine position. Second, the isthmus is often in the midline. Therefore, it is dangerous to dissect the dorsal side of the isthmus in traditional laparoscopy with flank position, especially when severe vascular malformations are present. With ILSTP, isthmusectomy would be much easier and less risky to the patient. Third, in HSK patient underwent heminephrectomy, ILSTP may facilitated the stage of division of the isthmus as well. Fourth, ILSTP may also be used in robotic surgery, which we are planning to explore in the near future.

Limitations of this study include its retrospective design and the small number of patients. Additionally, in patients with short pubis to umbilicus distance, the infraumbilical port has the potential to transgress the dome of the bladder. We suggest to insert a camera into the umbilicus port first, and place the infraumbilical port under direct vision to minimal risk of bladder injury.

Conclusion

Our study has demonstrated that ILSTP is safe and feasible with the advantages of a minimally invasive surgery option for the performance of pyelolithotomy, pyeloplasty, and heminephrectomy in patients with HSK.

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Author contributions

Ming Xiong, Zhaohui Chen and Teng Hou contributed to the conception and design of the study. Xiaoming Wang, Huiling Jiang collected and analyzed the data. Zhicheng Luo, and Guancan Liang interpreted the results. Teng Hou drafted the manuscript. All authors critically revised the manuscript for important intellectual content. Teng Hou supervised the study. All authors read and approved the final manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of South China Hospital of Shenzhen University, and written informed consent was obtained from all patients.

Consent for publication
The authors affirm that they take full responsibility for the content and conclusions of the paper and agree to submit it to the journal for publication.

Competing interests
The authors declare no competing interests.

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