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## CLINICAL STUDY

# Initial experience of percutaneous nephrolithotomy combined with retroperitoneal laparoendoscopic single-site partial nephrectomy in one-stage treatment of homolateral renal diseases

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## Abstract

This study investigated the feasibility of percutaneous nephrolithotomy (PCNL) combined with retroperitoneal laparoendoscopic single-site partial nephrectomy (LESS-PN) in one-stage treatment of homolateral renal calculi and tumors. Between October 2010 and July 2014 one-stage PCNL combined LESS-PN surgery was performed in 23 patients with homolateral renal calculi and tumors. Patients included 17 male and 8 female, ranged from 31 to 66 years old with a median age of 42.7. Operative parameters and occurrence rate of complications were recorded. In all cases renal tumors were successfully removed without converting to open surgery. One-stage clearance rate for renal calculi was 21/23 (91.3%), leaving two cases for second-stage operation of flexible ureteroscopy lithotomy. The operation time was 95–186 min; average 128 min. Intraoperative blood loss was 40–200 mL; average 130 mL. Median warm ischemia time was  $23.8 \pm 9.5$  min. There were no serious post-operative complications such as massive hemorrhage or urine leakage. Length of stay was 5–7 days, average 6 days. There was no recurrence of renal calculus, renal tumors or ureterostenosis and kidney functions were normal. In conclusion, with good practice, one-stage combined operation of PCNL and retroperitoneal LESS-PN in removing homolateral renal tumors and calculi was safe, feasible and would potentially reduce the operative trauma.

## Keywords

Percutaneous nephrolithotomy, renal calculus, renal disease, renal tumors, retroperitoneal laparoendoscopic single-site partial nephrectomy

## History

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## Introduction

Currently, homolateral kidney calculi combined renal tumors are usually treated separately through minimally invasive surgery. Either percutaneous nephrolithotomy (PCNL) or retroperitoneal laparoendoscopic single-site partial nephrectomy (LESS-PN) is performed first and the other one after several days to weeks depending on the physical condition of patients. In order to reduce the trauma of multiple surgeries and the medical cost for patients, we attempted to perform one-stage PCNL combined retroperitoneal LESS-PN on 23 patients with kidney stone and homolateral renal tumors admitted to our hospital between October 2010 and July 2014.

## Materials and methods

### Patients

This study involved 23 patients, including 17 male and 8 female, ranged from 31 to 66 years old with a median age

of 42.7. In 11 cases patient experienced lumbar distending pain and one patient had visible hematuria. Disease courses were 3–43 months with a median of 7 months. Renal tumors combined homolateral renal calculi were confirmed in all patients by both Color Doppler ultrasound and enhanced renal Spiral CT scan with 3D reconstruction (Figure 1). In all cases, only unilateral renal calculi were observed. Renal tumors measured between 0.6 and 3.3 cm (average 1.3 cm). Tumors were located at right kidney in 17 cases and left in 6 cases; at the upper pole of kidney in 8 cases, middle in 9 cases and inferior pole in 6 cases. Five patients had solitary calculus and 18 had multiple calculi. The stones measured longitudinally at 1.8–3.7 cm, average 2.6 cm; transversely at 1.4–2.1 cm, average 1.6 cm. Ten cases were accompanied with hydronephrosis and 13 cases without. Three cases had urinary tract infection. Renal functions were all normal before operation. There was no serious dysfunction in the heart, lung, brain or blood coagulation. Written informed consents were obtained from all patients prior to their inclusion in the study.

## Surgical method

Following anesthesia, patients first took lithotomy position. The F6 ureteral catheter was placed at the affected side under

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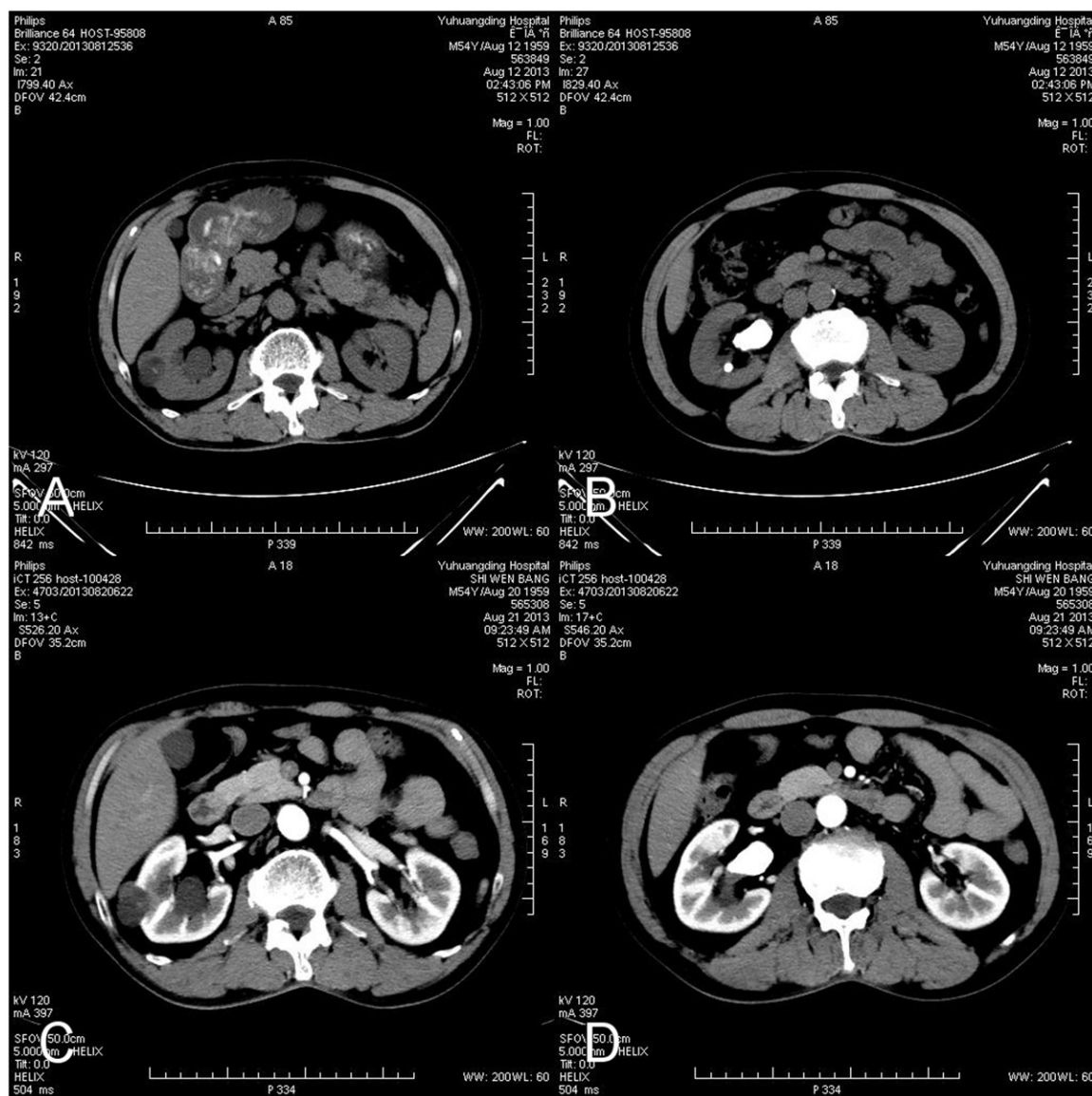


Figure 1. Non-contrast CT scan images of a patient with homolateral renal tumor (A) and renal calculus (B); and enhanced CT scan (C and D) of the same location. Tailed-arrows showed renal tumor and arrowheads indicated renal calculi.

ureteroscope (Olympus). Patients then took contralateral prone position with raised waist bridge. We punctured the kidney calices using 18G renal puncture needle (Cook) under the guidance of B ultrasound. Tumor site should be approached carefully to avoid puncturing through the tumor. Zebra guidewire was placed through the puncture needle and tunnel was expanded to fit the F20–F22 catheter. We placed in the Peel-away introducer as the working tunnel, introduced the nephroscope (Olympus), located and cleared visible stones using EMS third-generation ultrasonic lithotripsy system. D-J tube was introduced *via* zebra guidewire and F20 nephrostomy tube was left (Figure 2).

Nephrostomy tube was removed after compressing hemostasis for 10 min. We extended the nephrostomy tube orifice to about 3 cm and introduced the self-made single-site laparoscopic operation channel (Figure 3). After entering the retroperitoneum, the fatty tissue along peritoneum and Gerota's fascia was cleared from top to bottom and from front to back using ultrasonic knife, so that the peritoneal reflection

and Gerota's fascia can be clearly identified. Then we incised Gerota's fascia near the peritoneal reflection, from over the upper pole of kidney to below 2–3 cm of the lower pole of the kidney, and removed the perirenal fascia and fatty tissue that obstructed the operating field as much as possible. The peritoneal reflection and residual perirenal fascia formed an arc structure under the abdominal pressure, which together with the underneath tissue formed an “arch window” field for the convenience of operation (Figure 4). We dissected along the psoas major fascia, exposing the renal pedicle and then separated the renal artery. Then we incised the perirenal fat layer longitudinally along the outer renal edge, dissected the kidney from in-between the fat layer. The dissection range of the kidney was decided by the size and location of the tumor. After complete exposure of the tumor and dissection of the kidney, bulldog clamp was used and the occlusion time was recorded. Tumor and surrounding tissues were excised 0.5–1.0 cm from the tumor margin. Wounds were then sutured using No.1 14 × 14 cm 1/2 circle bidirectional barbed

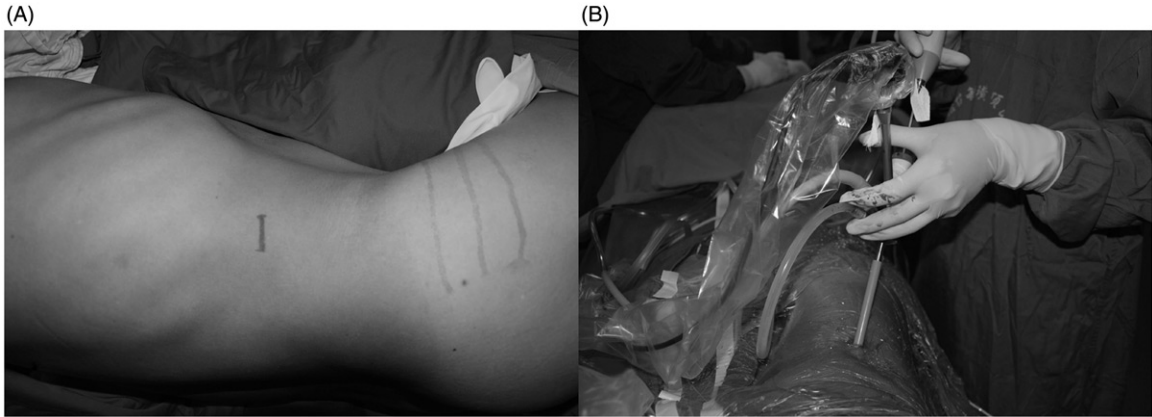


Figure 2. (A) The contralateral prone position and incision site. (B) PCNL surgery.

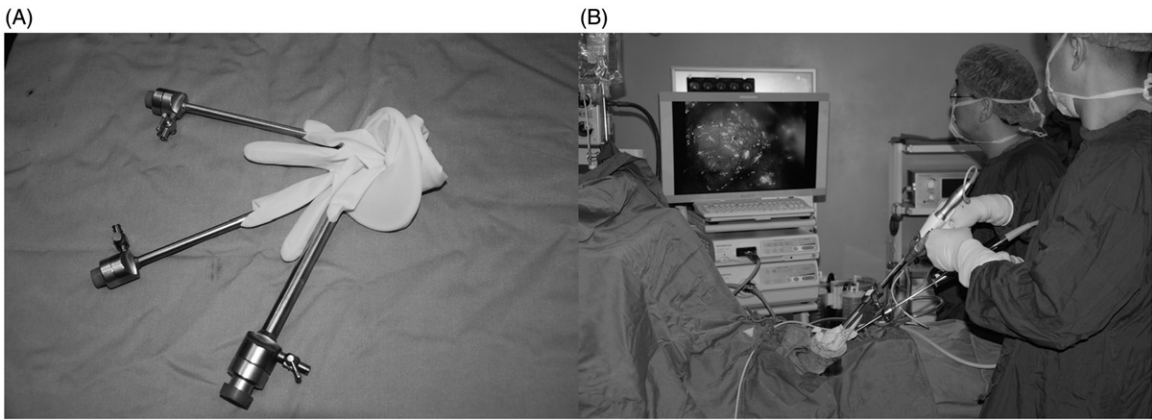


Figure 3. (A) The self-made single-site laparoscopic operation channel. (B) Retroperitoneal LESS-PN surgery.

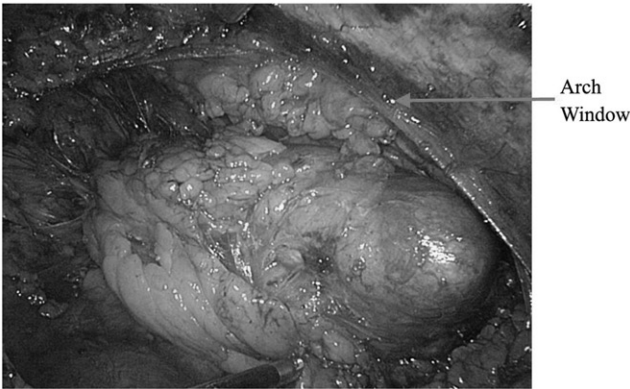


Figure 4. The ‘arch window’ formed during LESS-PN operation.



Figure 5. Appearance of the incision site post operation.

absorption line (Quill line). If renal pelvis and calyx fissure existed, needle went in from the surface of kidney, continuously closing the fissure without tying knot, and then pierced out to the surface, continuously suturing the kidney wound. Each stitch were tightened and tie knots were closed with Hem-o-lok or were cut off the line at both the ends. Remove the blood vessel clamps and check for obvious bleeding. Tumor was taken out from dilated single-site operation channel and sent for pathological examination.

Retroperitoneal drainage tube was left and wounds were closed (Figure 5). Drainage tube was clamped 2–5 days post-operation and removed after a 24 h observation checking for abnormal circumstances. For patients with pre-operation urine tract infections, controlling of infection was the priority. During the follow-ups, Doppler ultrasound, urinary tract X-ray of KUB and excretory urography were performed. Renal function was evaluated by measuring the glomerular filtration rate by renal ECT.



## Ethical statement

This study has been approved by the appropriate ethics committee and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All persons gave their informed consent prior to their inclusion in the study.

## Results

In all 23 patients, partial nephrectomy was successfully performed to remove renal tumor without converting to open surgery. One-stage operation removed renal stones in 21 patients (one-stage clearance rate 91.3%), leaving two cases for a second-stage operation of flexible ureteroscope lithotomy. The operation time was 95–186 min; average 128 min. Intraoperative blood loss was 40–200 mL; average 130 mL. Median warm ischemia time was  $23.8 \pm 9.5$  min. Artificial hydronephrosis was not required for PCNL. Intraoperative frozen tumor sections all showed negative margins. There were no post-operative complications such as massive hemorrhage or urine leakage. Two patients had postoperative hematuria, which was considered to be caused by bleeding from the puncture channel, and both patients recovered following conservative treatment. Pathological examination reported all 23 cases of renal clear cell carcinoma. Length of stay was 5–7 days, average 6 days. Patients were followed 7–49 months, average 26 months. There was no recurrence of renal calculus, renal tumors or ureterostenosis and kidney functions were normal.

## Discussion

The ultimate purpose for kidney stone treatment is relief of obstruction thereby improving renal function, and reduce trauma on the body. Currently the AUA, EUA and CUA guidelines for treating urinary tract stones unanimously recommended PCNL for treating kidney stones larger than 2 cm in diameter.<sup>1</sup> PCNL surgery causes less pain and bleeding, enables faster recovery and shorter hospital stay, and thus has replaced open surgery as the preferred method to treat kidney stones.<sup>2</sup> PCNL is applicable to all renal calculi requiring open surgery, including solitary and multiple calculi, staghorn calculi, open surgery residual or recurrent stones, symptomatic small renal calyx or urethral diverticulum calculi, stones failed to be removed by ESWL or ureteroscopy, combined ureteropelvic junction obstruction renal calculi, and combined calculi obstruction of solitary kidney and horseshoe or transplanted kidney.

Similarly, for treating renal carcinoma, especially T1a stage tumors, laparoscopic partial nephrectomy is eventually replacing open surgery as well, and it has evolved to minimally invasive surgical techniques such as the LESS. LESS surgery is performed through a single 3–4 cm incision, through which laparoscopic instruments are introduced. It maximally reduces the size and number of abdominal scars in order to minimize morbidity, reducing surgical aggression and therefore the need for analgesia during the postoperative period, and offers excellent cosmetic results.<sup>3</sup> Karakan et al. compared 34 LESS and 42 multiport laparoscopic surgeries and found that LESS was superior to multiport laparoscopic

surgery regarding perioperative parameters and may confer benefit with respect to analgesic requirement.<sup>4</sup> Besides, due to limited Trocar number in LESS, the occurrence of Trocar-related risks such as morbidity from bleeding, hernia and/or internal organ damage are therefore reduced to minimum.<sup>5</sup>

In this study, we reported our initial attempt of one-stage removal of homolateral renal calculi and tumors through combined PCNL and retroperitoneal LESS-PN. We achieved complete tumor removal and a promising one-stage calculi clearance rate of 91.3%. Our experiences are summarized as follows:

- (1) The puncture site for PCNL needs to be chosen with extreme care to avoid puncturing of the tumor, which may lead to implantation metastasis, and also prevent damage in surrounding tissues and vessels. If necessary, an “artificial hydronephrosis” could be induced by infusing saline water through ureteral catheter to reduce the operative difficulty,<sup>6</sup> although in this report it was not utilized.
- (2) During retroperitoneal LESS-PN surgery, the “arch window” operative field formed by the peritoneal reflection and residual perirenal fascia under abdominal pressure would significantly reduce the surgical difficulty, thus reducing the suture time and warm ischemia time.
- (3) The dissection range of the kidney was determined by the size and location of the tumor. For small ventral tumors, we could only dissect the ventral tissue, reaching the upper and lower pole of kidney. If the tumor is located at either pole or dorsal side, the dissection range should be larger to allow the movement and overturn of kidney. For tumor larger than 5 cm, complete dissection of the kidney is required.
- (4) A recent study suggested that the warm ischemia time was ideally limited to less than 20 min.<sup>7</sup> In our study, we used the bidirectional barbed absorption Quill line to suture the pelvis and kidney section, which significantly reduced the suture time, thus reducing the warm ischemia time to an average of 23.8 min.
- (5) We made our own single-site laparoendoscopic channel with latex gloves, which are cost effective, and provided a relatively sufficient operative space and largely relieved the limitation for laparoendoscopic instruments.
- (6) One-stage PCNL and LESS-PN combined surgery was likely to lead to prolonged operation, therefore operative tolerance need to be evaluated carefully prior to operation especially for high-risk patients with complications of heart, lung or brain lesions. During the operation vital signs also required close monitoring and operative time should be controlled. Any urinary tract infection should be treated prior to the operation to prevent the likelihood of sepsis, which could be lethal.

Combination of PCNL and LESS-PN would potentially reduce the trauma and mental stresses caused by multiple operations, reduce the chance of disease development during the treatment, better preserve the patients’ renal functions and reduce the medical cost. There were little short-term complications providing relatively good physical conditions of the patients. However, the long-term complications were still unidentified and further follow-up and more case numbers are required. In summary, from our initial practice, we believe

that PCNL combined retroperitoneal LESS-PN is a safe and feasible method for treating homolateral kidney stones and tumors.

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## Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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