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Laparoscopic-assisted percutaneous nephrolithotomy for pelvic kidney stones

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ABSTRACT

Introduction: Ectopic kidneys, including those situated in the pelvic region, are at a higher risk of nephrolithiasis, specially due to impaired drainage of the pyelocaliceal system. Performing percutaneous procedures on pelvic kidneys presents unique challenges as they are encased by pelvic bones in the posterior region and surrounded by intestines anteriorly.
Case Report: Between December 2014 and January 2016, we successfully managed three patients with pelvic kidney stones using laparoscopic-assisted percutaneous nephrolithotomy (PCNL). Among them, two patients had a history of previous open stone surgery (OSS) on the same kidney. The surgical procedure was performed in the supine (Trendelenburg) position under general anesthesia after placing a ureteral catheter. In one patient with no prior surgical history, laparoscopic dissections were unnecessary, since safe access to the pyelocaliceal system was achieved by retracting the bowel with a grasper. Following contrast injection via the ureteral catheter, fluoroscopic control facilitated percutaneous access to the pelvic kidneys. A double-J (DJ) stent was placed at the end of operation.
Conclusion: All patients achieved stone-free status with minimal bleeding (mean hemoglobin drop was 0.5 g/dL) or urine leakage. No major or minor complications occurred, and all patients were discharged on the second-day post-surgery. Laparoscopic-assisted PCNL proves to be a safe and effective surgical option for treating pelvic kidney stones. Its success in managing pelvic kidney stones adds to its value as a available treatment option for patients having this condition.

Case Report

Implication for health policy/practice/research/medical education:
Ectopic kidneys, including pelvic kidneys, carry a heightened risk of nephrolithiasis due to potential impairments in the drainage of the pyelocaliceal system. For the management of pelvic kidney stones, recommended treatment methods involve noninvasive procedures like extracorporeal shock wave lithotripsy (ESWL) and minimally invasive endourological procedures such as retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL). Although PCNL is widely accepted for treating normal-position kidneys, pelvic kidneys require a different and more intricate approach due to their proximity to the pelvic bones and the intestines. Laparoscopic-assisted PCNL is recommended for safely and effectively treating pelvic kidney stones.
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Introduction

The reported incidence of pelvic kidney ranges from 1 in 2200 to 3000 (1). A challenge for urologists is the treatment of nephrolithiasis within a pelvic kidney (2, 3). Percutaneous nephrolithotomy (PCNL) and retrograde intrarenal surgery (RIRS) are favored as the initial treatment options for stones greater than 20 mm in size (recommended by the American Urological Association and European Association of Urology) (4, 5). Although PCNL is the gold standard treatment method in anatomically normal position kidneys, ectopic pelvic kidneys need another and additional methods for PCNL due to a high risk of injury to abdominal vessels and viscera (1,2).

Cases Report

From December 2014 to January 2016, we managed three patients with pelvic kidney stones by laparoscopic-assisted PCNL, two of them had a history of previous open stone surgery (OSS) on the same kidney.

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Ultrasonography, kidneys, ureters, and bladder (KUB) radiography, computerized tomography (CT) scan and routine laboratory and coagulation tests were conducted in all patients. The mean age of the patients was 44.3 years (range: 34 to 54 years). The patients' mean weight and body mass index were 76.3 kg (71 to 90 kg) and 25.3 kg/m^2 (23 to 27 kg/m^2), respectively. The mean stone size was 24 mm (15to 32 mm). One patient had a single stone and two of them had multiple stones that were located in the pelvis and lower calyx (Figure 1). Mean surgery time was 130 minutes(range: 90 to 150 minutes) after general anesthesia.

All patients admitted and underwent surgery at the same day. After placing of the ureteral catheter in lithotomy position, the surgery was conducted in supine (Trendelenburg) position under general anesthesia. The 10 mm optical trocar was inserted above the umbilicus and two 5mm working *ports*, was placed in right and left *pararectal space* at the level of the umbilicus.

In one of the patients without a previous history of surgery, we did not need any laparoscopic dissections, and retraction of the bowel with a grasper was enough for the safe entrance to the pyelocaliceal system, however in two of them with history of previous OSS, we needed dissection and mobilization of colon. Percutaneous access to the pelvic kidney was done under fluoroscopic control after contrast injection via the ureteral catheter. Observation of the course and pulsations of the mesenteric vessels with laparoscope allowed us to reach the anterior surface of the pelvic kidney by blunt and sharp dissection (Figure 2). Then, with the guide of both laparoscope and fluoroscope the desired calyx punctured percutaneously by an 18-gauge Shiba needle and a 0.038 guidewire was inserted into the pyelocaliceal system (Figure 2). After successful access and dilation by fascial dilator and insertion of Amplatz sheath, intra-abdominal pressure was decreased from 15 mm Hg to 8-10 mm Hg and the percutaneous procedure was performed. A 26-F Wolf rigid nephroscope was used to perform nephroscopy. Fragmentation of stones were performed by pneumatic lithotripter (EMS Swiss LithoClast). The stone fragments were extracted by grasper, and at the end of operation, double-J (DJ) stent was placed.

Irrigation fluid that leaks into the abdomen was aspirated by a suction device. A 16-F Foley catheter was placed into kidney in two cases (as nephrostomy tube) and the Amplatz sheath was removed. In one case we sutured and closed the nephrostomy site, thus the nephrostomy catheter was not inserted. Finally, a Penrose drain was placed into the abdominal cavity and the trocars were removed under laparoscopic visualization.

Discussion

Ectopic (including pelvic) kidneys may be at a higher risk of nephrolithiasis due to impairment in drainage of pyelocaliceal system (6).

Most common treatments that were recommended in the literature, include noninvasive procedure (ESWL) and minimally invasive endourological procedures such as RIRS and PCNL (7,8).

A tortuous ureter with a high insertion may cause poor drainage and decrease the spontaneous passage of fragmented kidney stone after ESWL or RIRS. Moreover, due to adjacent intestinal loops and pelvic bones, the efficacy of ESWL in the pelvic kidney stone is poor (9). While RIRS is a good option for these patients, it requires a lot of experience and is technically challenging due to the tortuous path of the ureter of a pelvic kidney (6,10,11). While PCNL is a widely accepted treatment option for normal position kidneys, ectopic pelvic kidneys necessitate a different and more complex method (1,3). PCNL in pelvic kidneys increase risk of bleeding, colon injury and urine leak owing to the abnormal orientation, unpredictable blood supply and the surrounding bowel loops and mesenteric blood vessels (12). Therefore, for decreasing complications, it is necessary to puncture and dilate the tract under direct vision by the use of laparoscopy. Hence, laparoscopic-assisted PCNL is a good alternative option.

In 1985, Eshghi et al described the laparoscopic-assisted

Figure 1. Intravenous pyelography (IVP) image of one of the patients shows multiple renal stones in left kidney (a). KUB and IVP show single stone in second patient (b, c) and KUB and coronal section of CT scan in last patient show three stones in left kidney(d, e).

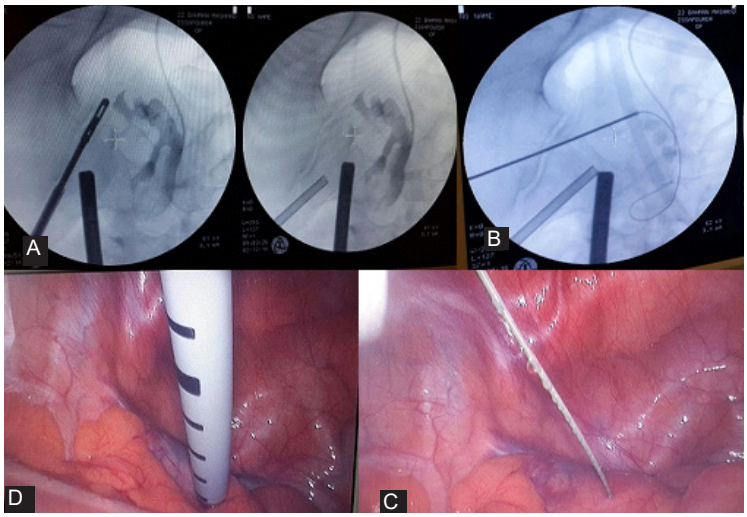

Figure 2. Laparoscopic assisted PCNL. Renal access was made by fluoroscopic (A, B) and laparoscopic (C, D) guidance.

PCNL technique for pelvic kidneys for the first time (13). Following that, a number of authors presented their own methods and demonstrated a variety of approaches for getting access to the pelvic kidney. Holman and Toth described 15 patients that successfully managed with transperitoneal laparoscopic-assisted PCNL by mobilizing adjacent intestinal loops (14). In 2002, Troxel et al reported that the extraperitoneal approach for pelvic kidneys had major benefits over the transperitoneal approach (8). Monga et al used the prone supra-iliac technique to remove a crusted stent in a pelvic kidney (15). For PCNL in a pelvic kidney, Watterson et al indicated an approach via posterior view through the greater sciatic foramen. They used a CT guided method for drainage of pelvic abscess via trans-sciatic approach. The method for trans-sciatic PCNL is similar to this technique but should be performed under fluoroscopic guide and careful review of CT-scan images to optimize tract placement and avoid injury to bowel or aberrant vasculature (16). Zafar and Lingeman modified laparoscopic-assisted PCNL with closing the nephrostomy site by intracorporeal suturing at the end of PCNL to make it tubeless (17).

Additionally, Bhadranavar et al indicated that some methods presented for the treatment of urinary tract especially kidney stones, depends on the size, location, and the prior attempts, however, laparoscopic-assisted PCNL is an option for patients with ectopic kidneys (18).

Soylemez et al, were employed two different laparoscopic methods such as mesocolon dissection and transmesocolic, and four different percutaneous procedures such as standard-PCNL, mini-PCNL, micro-PCNL, and a PCNL through the renal pelvis were utilized for stone removal in pelvic kidneys. Transmesocolic puncture was utilized only in the micro-PCNL group with the guide of laparoscopy and fluoroscopy, In the other method, mesocolon dissection was performed between large vessels of the mesocolon under the control of laparoscopic vision (9).

The stone-free rate in all above studies was 80% to 100% and there were no complications during or after the operation. The current combined method allows for laparoscopic monitoring of the percutaneous procedure and prevents bowel damage by medial mobilization of colon. Direct puncture and dilation under laparoscopic vision lowers the risk of bleeding.

This combined technique necessitates a high level of skill and abilities in laparoscopy and endourology, but it also carries the risks of both methods. Intraperitoneal urinary leakage after surgery is a potential risk that causing ileus and morbidity in transperitoneal approach (19).

We performed laparoscopic-assisted PCNL with transperitoneal approach. The clinical and radiological outcomes were both successful, and our patients had no pain, residual stones and extravasation.

We believe this minimally invasive method using laparoscopy and PCNL at the same time, is a safe and efficient procedure for treatment of pelvic kidney stones.

Conclusion

Ectopic kidneys is accompanied by a higher risk of nephrolithiasis and recommended therapy methods are including noninvasive procedure (ESWL) and minimally invasive endourological procedures such as RIRS and PCNL. PCNL is a widely accepted treatment option for normal position kidneys, but ectopic pelvic kidneys necessitate a different and more complex method. PCNL in pelvic kidneys increase risk of bleeding, colon injury and urine leak owing to the abnormal orientation, unpredictable blood supply and the surrounding bowel loops and mesenteric blood vessels. Laparoscopic-assisted PCNL is a good alternative option. We performed laparoscopic-assisted PCNL with transperitoneal approach. The clinical and radiological outcomes were both successful, while our patients had no pain, residual

stones and extravasation. This minimally invasive method using laparoscopy and PCNL at the same time, is a safe and efficient procedure for treatment of pelvic kidney stones.

Complete blood count, blood urea nitrogen, creatinine, serum electrolytes, and KUB were repeated the day after surgery. Bladder catheter and nephrostomy tube were removed 24 hours postoperatively and the drain was removed on the second day after surgery. All patients discharged on the second postoperative day. DJ stent was removed after 4 weeks. KUB and renal ultrasonography were also done at 3 months postoperatively. All patients became stone free with minimal bleeding (mean hemoglobin drop was 0.5 g/dL) or urine leakage. No major or even minor complications had occurred.

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Authors' contribution

Conceptualization: Davood Arab.
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Investigation: Davood Arab and Arash Ardestani Zadeh.
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Supervision: Davood Arab.
Validation: Ali Ahanian.
Visualization: Ali Ahanian.
Writing-original draft: Davood Arab and Arash Ardestani Zadeh.
Writing-review and editing: Ali Ahanian.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

This case report was conducted in accord with the World Medical Association Declaration of Helsinki. Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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