



Laparoscopic Assisted Percutaneous Nephrolithotomy: A Promising Surgical Technique for Complex Stone Cases

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Abstract

The surgical management of urinary stone disease varies from open surgery to various minimal invasive treatment options. Although PCNL is an accepted treatment modality in anatomically normal kidneys, ectopic pelvic kidneys require a different and more complicated approach for PNL. The pelvic kidney is in the retroperitoneum and anterior to the sacrum interposing bowel loops between anterior abdominal wall and pelvic kidney. Thus, a blind percutaneous transperitoneal approach to a pelvic kidney should be avoided, because the high risk of injuring the bowel. Laparoscopic assisted PCNL is being widely used especially for pelvic kidneys. As a result, laparoscopic assisted PCNL is an effective and feasible minimal invasive treatment modality for pelvic kidney stone removal. It has no significant intraoperative and postoperative complications that have been published.

Keywords: Laparoscopy assisted; Ectopic kidney; Stone disease; Percutaneous nephrolithotomy; Horseshoe kidney

Abbreviations

SWL: Shock Wave Lithotripsy; PCNL: Percutaneous Nephrolithotomy; CFRE: Crossed Fused Renal Ectopia

Introduction

The surgical treatment of urinary stone formers varies from open surgery to several non-invasive treatment modalities. Nowadays most of the urinary stone diseases are successfully treated with several minimally invasive treatment modalities like Shock Wave Lithotripsy (SWL) and ureterorenoscopy. On the other hand, patients with staghorn or partial staghorn calculi and large stone burden are successfully treated with Percutaneous Nephrolithotomy (PCNL). Despite all these minimally invasive treatment modalities, few patients especially SWL, ureteroscopy or PCNL failed ones and patients with several renal malformations may still require open surgery. In these patients laparoscopic techniques are the major alternative and it can be replaced with open surgery in many conditions [1]. Technologic developments combined with minimal invasive properties of laparoscopy lead the extended indications of this technique. This is especially true with renal malformations such pelvic kidneys, where an anterior percutaneous approach can potentially injure abdominal viscera; and in horseshoe kidneys, where direct percutaneous approach can potentially injure anomalous vessels. Under direct endoscopic vision, anomalous vasculature and iatrogenic injuries can be avoided [2]. Because of the increasing use of laparoscopic techniques in renal stone disease in patients with renal malformations, we will discuss the effectiveness, safety and surgical technique of these procedures. The section will be structured basically around the subheadings of "basics of surgical technique, renal position anomalies such as pelvic ectopic kidneys, horseshoe kidneys and crossed fused renal ectopia and other surgical areas of laparoscopy assisted PCNL".

Basics of Surgical Technique

Several access points such as, retroperitoneal, transperitoneal, suprailiac etc. are been described by several authors according to the position and anomaly of the kidney and patient deformities. But the main goal is to avoid from the vessels and adjacent organ injuries. The first step of the procedure is creating pneumoperitoneum and visualizing the kidney laparoscopically. The number and place of inserted trocars depends on the surgeon and surgical experience. Either *vs.* needle or open technique also can be used for pneumoperitoneum. Second step is exposing the surface of the kidney for appropriate punctuation. For this purpose, all adhesions between the ectopic kidney and bowel parts must be evaluated. With blunt and sharp dissections, the bowel structures must be

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dissected and full exposure of the anterior aspect of the kidney must be gained. Care must be taken to avoid vessel injuries. Punctuation can be done with the guidance of contrast media under fluoroscopic imaging and laparoscopic control. Following steps are similar with a standard PNL and stone removal techniques. Finally, the procedure can be lasted with the placement of a drainage catheter such as a nephrostomy tube or a D-J stent. Some authors also reported intracorporeal suturing by re-establish pneumoperitoneum to avoid catheter usage. Postoperative analgesia and antibiotic prophylaxis must be provided.

Pelvic kidney

The pelvic kidney develops as a result of renal ascension failure and is associated with an incidence of approximately 1 in 2,000 to 3,000 in autopsy series [3]. Gleason et al. [4] noted an increased incidence of hydronephrosis and calculi formation in patients with pelvic kidneys, whereas Dretler et al. [5] found no such association. Most patients with pelvic kidneys are asymptomatic. The diagnosis is most commonly made incidentally when a patient presents with abdominal complaints, which prompts imaging studies that show the ectopic kidney [6]. Despite PCNL is the standard approach for anatomically normal kidneys, PCNL for pelvic ectopic kidneys requires different, complicated and combined approaches. The low position, malrotation, and close proximity of the pelvic kidney to surrounding bony structures make treatment of calculi challenging [7]. Direct transperitoneal puncture must be avoided to prevent possible bowel injuries [8].

Laparoscopic assisted PCNL for ectopic kidneys was firstly described by Eshghi et al. [9]. Subsequent several reports have described various modifications of this approach. While Troxel et al. [10] described extraperitoneal technique; first transperitoneal technique was described by Toth and Holman [11]. In their study, authors performed the surgery in the Trendelenburg position. After the adequate dissection between the kidney and the bowel they performed the kidney puncture. Zafar et al. [12] modified the technique to rule out the insertion of a transperitoneal nephrostomy tube. They described the intracorporeal suturing of the renal access site and ureteral stent insertion. In a more recent series with 5 patients, El-Kappany et al. [13] successfully treated patients with laparoscopy assisted PNL. Neither intra-postoperative complications nor conversion to open surgery was reported. More recently, Tahmaz et al. [14], Matlaga et al. [15], Mousavi-Bahar et al. [16] and Gupta et al. [17] reported their patients successfully treated with laparoscopy assisted percutaneous nephrolithotomy with no intraoperative and postoperative complications. When we generally look at the English literature we can easily conclude that laparoscopy assisted techniques can be considered as effective and safe procedures for ectopic kidneys.

Horseshoe kidney and cross ectopic kidney

The most common congenital renal fusion anomaly is horseshoe kidney and the risk for stone formation is greater than 20% [18]. In the majority of cases the lower poles are fused. This malformation increases the risk of stone formation, which occurs up to 21% of cases [19]. Surgeries performed in horseshoe kidneys are more challenging due to connatural location and rotation anomalies of the kidneys. Nevertheless, all surgical options for stone removal like retrograde ureteroscopy, PCNL, SWL, and laparoscopy can be performed with specific indications and surgical meticulousness. One of these valid treatment options is SWL, but the poor stone clearance rates after this procedure make PCNL a more viable and effective treatment (may

be the most definitive) alternative. Although PCNL is an effective treatment modality in horseshoe kidneys, the percutaneous access must be modified and individualized according to the abnormal anatomy of the kidney. Also it is difficult to reach the isthmic calix even with flexible nephroscope. With limited indications, the laparoscopic approach to horseshoe kidneys is feasible because of the anteriorly rotated renal pelvis. Care must be taken to avoid anomalous vessels. In two reports, pyelolithotomy was used to extract calculi [20,21]. When we look at the English literature laparoscopic assisted PCNL for horseshoe kidneys are not widely accepted and used. To our knowledge, there is only one case report combined laparoscopy with PCNL for the treatment of an isthmic horseshoe kidney stone [22]. In their study the authors conclude that laparoscopy assisted PCNL seems to be a safe, effective and a novel treatment alternative in the patients with calculi in a horseshoe kidney. Despite not being used widely, this technique may also become an alternative for horseshoe kidney stone disease to avoid bowel and vessel injuries especially for isthmic stone diseases.

Another congenital rare renal malformation is Crossed Fused Renal Ectopia (CFRE). The exact incidence is uncertain but estimated as 1:2000 in autopsy series [23]. While it is reported to be usually asymptomatic, it can also be presented with the symptoms of various conditions such as infection, obstruction and nephrolithiasis. As mentioned above in pelvic ectopic and horseshoe kidneys urolithiasis in a CFRE is also a challenging problem for endourologists due to unusual location and rotation of the kidney. In the English literature there is only one case reported by Srivastava et al. [24] in 2009. They reported that, complete clearance of stones was done in a single setting and the patient did not require any ancillary procedure.

Other surgical areas of laparoscopy assisted PCNL

Except above mentioned renal position anomalies some authors reported their experience in regarding to the patients with anterior calyceal diverticula and patients with musculoskeletal deformities.

In their case series of three patients, Brunet et al. [25] used this combined technique in the treatment of anteriorly located middle and lower pole calyceal diverticula. They reported that using laparoscopy to guide the percutaneous access and medialization of the colon (for transperitoneal approach) minimize the risk of intestinal injury. They reported radiological and clinical outcomes as satisfactory. Finally they concluded that laparoscopically assisted procedures are effective for anterior calyceal diverticula. Procedure related low morbidity rates make this combined procedure an interesting alternative to other minimally invasive techniques.

Another challenging topic may be the patients who have several musculoskeletal deformities. In this topic again there is a scarce of data to be interpreted. PCNL under fluoroscopic guidance may carry an increased risk of adjacent organ damage in patients with musculoskeletal abnormalities such as kyphoscoliosis, achondroplasia, thoracic kidney and the like. In these situations laparoscopic assisted PCNL procedures may be the treatment of choice and can lead safe percutaneous access. Despite being a promising technique, in the literature there is only one case study reported by Basal et al. [26] in 2011. The patient had osteogenesis imperfecta and due to difficulties regarding patient positioning, the authors performed laparoscopy assisted PCNL. They concluded that extraperitoneal laparoscopy-assisted PCNL approach might be an alternative treatment approach by decreasing the surgical risks in patients with OI. The combined procedure carries the potential complication risks of both procedures

and should be performed at centers with significant experience in the field of endourology.

Conclusion

After its first description by Eshghi et al. [9] in 1985, laparoscopy assisted PCNL procedures are being increasingly used and accepted worldwide for the treatment of complex stone patients and especially for pelvic ectopic kidneys. The limited literature data shows good stone free rates with insignificant intraoperative and postoperative complications. When we review the English literature it can be easily seen that there is no large and prospective studies regarding its effectiveness but it deserves more clinical studies and usage with its promising results. It must be kept in mind that this combined technique requires good laparoscopic and endourologic expertise because it incorporates the potential complication risks of both techniques. In our opinion with the increasing trend toward minimally invasive techniques, it can be a viable, interesting and promising treatment alternative for complex stone patients.

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