

An overview on Laparoscopic Pyelolithotomy

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Abstract:

Laparoscopic pyelolithotomy is a minimally invasive surgical procedure used to remove large or complex renal calculi (kidney stones) located within the renal pelvis, particularly when other treatment options such as extracorporeal shock wave lithotripsy (ESWL). The technique involves accessing the kidney through small abdominal incisions using laparoscopic instruments, allowing for direct visualization and precise removal of stones. It is especially beneficial in cases of large staghorn calculi, anatomical abnormalities (e.g., ureteropelvic junction obstruction), or coexisting renal pathologies requiring surgical correction. Compared to open surgery, laparoscopic pyelolithotomy offers several advantages, including reduced postoperative pain, shorter hospital stay, faster recovery, and better cosmetic outcomes. Although it is less commonly performed than PCNL, it remains a valuable option in carefully selected patients. The use of robot-assisted laparoscopic pyelolithotomy is also emerging as an alternative, particularly in centers with advanced surgical expertise, offering enhanced dexterity and precision.

Keywords: Laparoscopic, Pyelolithotomy, xtracorporeal shock wave lithotripsy, percutaneous nephrolithotomy.

Introduction:

Laparoscopic pyelolithotomy (LP) was introduced over 20 years ago and is commonly used to remove stones during laparoscopic pyeloplasty **(1)**. The question is whether this procedure remains necessary for managing renal stones in the current era of advanced endourological treatments.

Laparoscopic pyelolithotomy (LP) offers the advantages of minimally invasive treatment. It is a nephron-sparing procedure,). LP provides a high stone-free rate (85–100%) after a single session for treating large renal pelvis stones.

It can be helpful in patients who require their stones to be removed in a single operative session, patients who have a large single renal stone that cannot be removed with a reasonable number of access and for stones resistant to fragmentation or renal anomalies such as ureteropelvic junction (UPJ) obstruction **(2)** and PNL may not be suitable for the treatment of large stones in the pelvic ectopic kidney, and it may require laparoscopic assistance to avoid visceral organ injury**(3)**

Stein and colleagues shared their experience doing laparoscopic pyelolithotomy (LP) during laparoscopic pyeloplasty in patients with UPJ obstruction **(4)**.

They found that LP is an effective procedure, with high stone-free rates and does not significantly increase operative time or morbidity when using basic laparoscopic tools.

The procedure is easier in patients with an extrarenal pelvis, but more challenging in those with an intrarenal pelvis **(5)**.

Goel and Hemal reviewed their experience with LP and concluded that LP is generally not recommended for patients with orthotopically located kidneys. They observed longer operative times, extended hospital stays, and poorer cosmetic outcomes **(6)**.

Technical Aspects of Laparoscopic Pyelolithotomy

Equipment for Laparoscopic Pyelolithotomy:

- 1- Laparoscopic tower
- 2- Laparoscopic camera
- 3- Laparoscopic trocars
- 4- Laparoscopic Retractor
- 5- Ultrasonic dissector
- 6- Laparoscopic grasping forceps (Maryland clamp, Babcock clamp)
- 7- Laparoscopic irrigation/suction probe
- 8- Laparoscopic needle holder
- 9- Laparoscopic scissors
- 10- Laparoscopic stone extractor forcep
- 11- Laparoscopic endocatch bag(7)

Instrumentation for laparoscopy has significantly evolved over the past several years and continues to improve with advancements in technology. Basic laparoscopic instrumentation includes an insufflator for the establishment of a consistent pneumoperitoneum, an imaging system with camera, and a video monitor (8).

Veress needles and various sized trocars (3, 5, 10, and 12 mm) are now available providing the laparoscopic surgeon with a number of tools with which to approach the laparoscopic procedure (8).

Grasping instruments include traumatic and atraumatic, broad-based and pinpoint graspers, both with and without the ability to lock the handles. A variety of scissors range from minisciissors with sharp tips to larger scissors with a more blunt and rounded tip (7).

A number of different energy-based dissectors allow the surgeon to cauterize or seal vessels before dividing or dissecting the tissue. Both monopolar and bipolar electrocautery instruments are available in a variety of different instrument shapes and applications. Several hemostatic ligating instruments, including metal, polymer, and absorbable ligating clips, can be applied for vessel control. Also, several different stapling devices allow for both vascular and tissue control. These staplers often offer rotation and reticulation to allow for precise placement. Several devices staple and divide the tissue between several rows of staples, while others just lay several rows of staples without dividing the tissue (9).

The choice of method for initial transperitoneal access should be based on patient-specific factors. Open access methods, such as **the Hasson technique**, have the advantage of a more controlled entry into the peritoneum.

This can potentially offer an advantage in settings where extensive adhesions are anticipated. Potential disadvantages to open access techniques include a larger incision, longer dissection time, and the possibility of gas leakage from around the trocar due to the larger size of the fascial defect. An alternative is a closed technique of access using a Veress needle (10).

Veress Needle Technique:

The Veress needle has an internal diameter of 2 mm and an outer diameter of 3.6 mm. It is available in lengths from 70 to 150 mm. The outer sheath has a sharp cutting edge. The inner obturator is blunt and retracts within the sheath during passage through the body wall but extrudes within the abdominal cavity to protect the bowel. The patient and table should be adjusted to allow gravity to help move the bowel content out of the way of the access site. Begin by infiltrating with local anesthetic and then making a very small incision at the site of initial access (11).

Pneumoperitoneum:

filling at an intermediate rate of 2 L/min (the maximum allowed by the caliber of the needle), until the pressure reaches 15 mm Hg in an adult (admitting between 5 and 7 L in about 5 minutes) or 6 mm Hg in a child younger than 6 months of age. A higher pressure may increase the risk for gas absorption and hypercarbia, as well as increasing venous return secondary to compression of the vena cava and reduced renal function. Impaired

ventilation results from excessive pressure on the diaphragm, requiring an increase in ventilatory pressure with risk for pneumothorax (12).

Retractors:

Graspers can often function for retraction. A solid metal bar with a rounded tip is useful for restraining bowel or the edge of the liver. A locking instrument can be used to grasp the abdominal sidewall, retracting the lower edge of the liver superiorly, which is particularly helpful when operating on the right kidney or adrenal gland from a transperitoneal approach. A fan retractor has several flat blunt blades that open into a fan shape for holding back a wider area. Like- wise, the 5- and 10-mm expanding mechanical or balloon retractors are effective, with the latter being atraumatic (8).

Irrigation:

With a combined aspiration/irrigation system, the aspiration channel is connected to the operating room vacuum system and the irrigation channel to a sterile saline or water container(13).

Outcomes and complications:

Several studies have shown the efficacy and safety of laparoscopic pyelolithotomy (LP) for treating large renal stones, with stone-free rates ranging from 88.9% to 100% (7).

Compared to open surgery, most patients benefit from minimally invasive treatment, which causes less discomfort, shorter hospital stays, and quicker recovery (14).

laparoscopic pyelolithotomy does not invade renal parenchymal tissue. As a result, LP is associated with low rates of postoperative hematuria and a minimal decrease in hemoglobin (15).

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