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CASE REPORT

Bilateral simultaneous robot-assisted pyelolithotomy for large (>6 cm) kidney stones: technique and review of literature

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Abstract With wide availability and demonstrable efficacy of endourological techniques, open surgery for renal stone disease has largely been replaced in contemporary urological practice. However, with increasing experience of laparoscopy and robotic surgery in urology, the principle of open renal surgery is being revisited. In certain situations, laparoscopic or robotic pyelolithomy may be an excellent minimally invasive alternative to percutaneous nephrolithomy with its unique advantages. We present a case of bilateral large kidney stones managed with bilateral simultaneous robot-assisted laparoscopic pyelolithotomy with excellent results.

Keywords Robotic pyelolithotomy · Laparoscopic pyelolithotomy · Kidney stones · Robotic stone surgery

Introduction

Surgical management of kidney stones has evolved from open surgery to minimally invasive endourological procedures. Percutaneous nephrolithotomy (PCNL) is the gold standard treatment for kidney stones of 2.5 cm or larger in diameter [1]. However, the clearance rates achieved with PCNL depends upon many factors such as the stone bulk, location, composition and collecting system anatomy [2, 3]. More than one session of PCNL or even a combination of different methods like lithotripsy (ESWL) and flexible ureter renoscopy (RIRS) are occasionally required in situation of large stone bulk. Any additional procedure not only increases overall morbidity but also has cost implications. In some extraordinary situation where large stone is predominantly occupying extrarenal pelvis with minimal calyceal extension, laparoscopic pyelolithomy may provide a good alternative to PCNL providing complete clearance in single session, with low morbidity [4]. Robotic assistance adds another dimension to laparoscopic approach because of its inherent ergonomics [5]. We present a case of bilateral large (>6 cm) kidney stones, managed successfully with bilateral simultaneous robot-assisted laparoscopic pyelolithotomy. To the best of our knowledge this is first such case reported in the literature.

Case report

A 54-year-old male presented with large bilateral kidney stones with dull aching pain of many-year duration. CT urography (Fig. 1) showed bilateral extra renal pelvis with normal configuration of ureteropelvic junctions and single large partial staghorn stone (7.0 cm × 5.5 cm on left side, 6.0 cm × 4.5 cm on right side). Renal parenchymal thickness and excretory kidney functions were preserved on both sides. Given that the stone was large but confined to renal pelvis without significant branching, we felt that simultaneous bilateral pyelolithotomy (laparoscopic/robotic) approach provided the most efficient and convenient means of removal.

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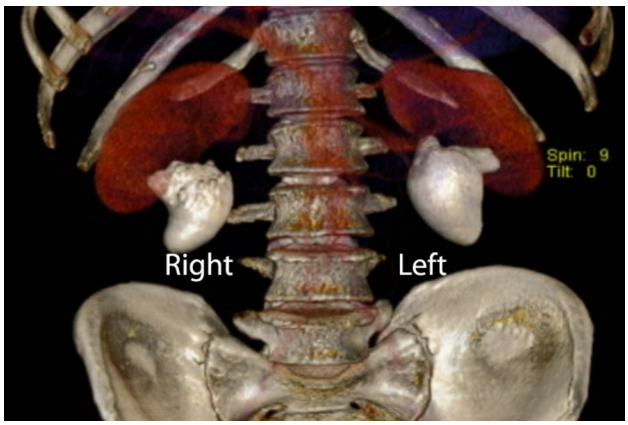

Fig. 1 Reconstructed image of computed tomography showing large kidney stones on both sides, occupying predominantly extrarenal pelvis and preserved kidney parenchyma

Procedure

Patient was first placed in right lateral decubitus position with minimal flexion of the operating table. Decision to operate right side first was based upon more symptomatic status on this side (just in case we perform a staged procedure). Pneumoperitoneum was achieved with the Veress needle placed in right iliac fossa. Final port placement is shown in Fig. 2a.

The procedure was initiated using 30° downward-facing lens by limited mobilization of colon overlying the right kidney and renal pelvis. Dissection was performed using a fenestrated bipolar forceps in left robotic arm and curved scissor in the right arm. Once the pelvis was adequately dissected, a hitch stitch was taken to lift up the renal pelvis with stone (to facilitate dissection). A curvilinear pyelotomy incision was made away from pelvi-ureteric junction. The stone was mobilized with assistance from laparoscopic instrument and then retrieved under vision using bipolar forceps. The calyces were flushed with saline directed through an irrigation suction device. A 6Fr/26 cm double-J stent was placed in anterograde fashion. The pyelotomy incision was sutured with 4-0 PDS. The Gerota's fascia was also approximated to close off the perinephric space from the peritoneal cavity. The stone was placed in a bag and kept aside. After satisfactory completion of the procedure on right side, the patient was repositioned (left lateral decubitus) for left side surgery. Another robotic 7 mm port was placed in left lower quadrant in midclavicular line. On inspection, a bulge corresponding to the left renal pelvis was easily identified in the left mesocolon. Incision was made through the mesocolon parallel to the vascular arcades (transmesocolic approach). The renal pelvis was dissected and a curvilinear pyelotomy was made directly on the stone. Robotic forceps was used to

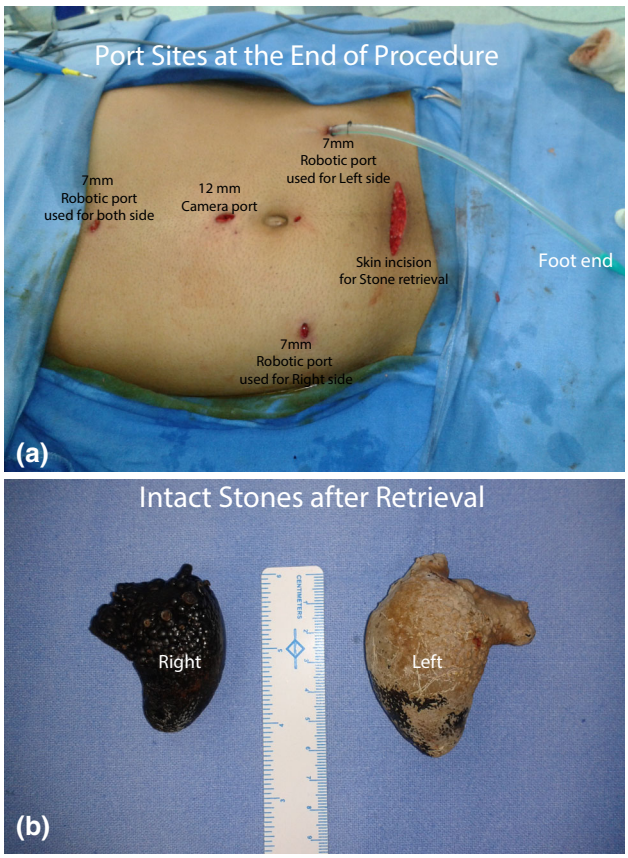

Fig. 2 **a** Final port placement site. 12-mm port in midline near umbilicus for camera. Two 8-mm robotic working ports in right and left iliac fossa. Another 8-mm robotic working port in epigastrium in midline to be used on both sides. Pfannenstiel incision was given for removal of stones kept in bag. **b** Final specimen (stones)

manipulate the stone into the retrieval bag. The renal pelvis and calyces were irrigated and pyelotomy was closed with continuous 4-0 PDS suture, after placing DJ stent. The mesocolon was re-approximated with 4-0 PDS suture. Both specimen/stone were retrieved through a small Pfannenstiel incision (Fig. 2a, b). A drain was placed into the peritoneal cavity via a lateralmost robotic port. Total procedure time was 110 min with 90 min of console time. Total estimated blood loss was less than 20 ml. A post-operative X-ray confirmed position of double-J stents and documented complete stone clearance. Post-operative recovery was uneventful. The Foley catheter and drain were removed on post-operative day 1 and he was discharged on post-operative day 2. Both double-J stents were removed 4 weeks after surgery. Stone analysis showed calcium oxalate monohydrate. Metabolic work-up did not reveal any specific abnormality. At 2-year follow-up, patient is asymptomatic and there was no recurrence of stone. Diuretic DTPA done during follow-up shows normal kidney function and drainage.

The study is in compliance with the institutional ethical guidelines. Written informed consent was obtained from patient for publication for this case report. A copy of the written consent is available for review by the Editor-in-Chief.

Discussion

Safety and efficacy of bilateral simultaneous PCNL for management of bilateral kidney stones has been reported. However, in all such situations where bilateral simultaneous endourological procedure is contemplated, a major limitation is related to the stone bulk. In most of the these studies, operating time and estimated blood loss during the side operated first are the deciding factors before proceeding with contralateral stone surgery [6]. Large stone bulk often requires longer nephroscopy leading to potential risk for absorption of large volume of fluids and sometimes even hypothermia [7]. In many cases of large stone bulk, multiple punctures are required which result in greater risk for renal parenchymal injury or excessive perioperative bleeding [8]. Because of all the above safety concerns, staged procedure is often performed in patients with large stone bulk in the kidney.

Laparoscopic pyelolithotomy (LPL) is more advantageous in certain cases of solitary large stone in extrarenal pelvis. Even minor extensions of stone into the calyces can be dealt with by extending the incision, thus removing the stone intact and preventing possible recurrence due to clinically insignificant residual fragment. In case of any secondary stones in minor calyces, flexible instruments can be used through the laparoscopic port and calyceal stones can be retrieved using grasper or stone basket [9].

When compared with PCNL, one outstanding advantage of LPL is that it is harmless to the parenchyma; therefore, lesser risk of bleeding compared to PCNL. This is particularly advantageous in dealing with bulky stone in solitary functioning kidney or in kidneys with compromised renal functions [10]. Also, PCNL requires disintegration of the stone, which may leave some residual fragment and subsequently require secondary procedures (relook PCNL, ESWL) for complete clearance. Multiple procedures not only increase the morbidity but also have cost implications. Wang et al. [11] in a meta-analysis assessed the effectiveness and safety of LPL for surgical management of solitary large renal pelvic calculi and found it more advantageous in terms of bleeding, post-operative fever, hemoglobin level and stone-free rates compared to PCNL. LPL definitely has a role in patients with morbid obesity who could not be positioned in prone position [11]. Given the known advantages that the robotic system affords, robotic stone surgery may extend a role to more patients with staghorn renal calculi as a minimally invasive alternative to percutaneous technique [5]. Spectrum of robotics is further increased with the utilization of robotic ultrasound probe as an aid to identify calculi within the kidney or with the use of flexible cysto-nephroscope through the working ports to explore the entire pelvicalyceal system [12, 13]. Simultaneous bilateral robotic procedures on kidney have been described earlier, both in children and adults [14, 15]. Frileich et al. [15] utilized robotic-assisted laparoscopic surgery in children with bilateral pelvi-ureteric junction obstruction utilizing four ports only. They concluded that it provides an effective method of managing patients with bilateral UPJ obstruction avoiding the burden and morbidity of performing stage surgeries.

In consonance with the above facts we performed bilateral robotic-assisted pyelolithotomy and found it to be feasible with good results. The simultaneous surgery on both sides with minimal morbidity, hospital stay and avoidance of adjuvant procedures somewhat compensated the cost involved which is a major consideration in robotic surgery.

Conclusion

Simultaneous bilateral robot-assisted laparoscopic pyelolithotomy provides an excellent alternative to percutaneous nephrolithotomy for management of large kidney stone where the stone is predominantly occupying the renal pelvis.

Compliance with ethical standards

Conflict of interest All authors, Dr. Rajiv Yadav, Dr. Abhay kumar Gupta and Dr. Poonam Yadav declare that they have no conflict of interest.

Informed consent Written informed consent was obtained from patient for publication of this case report. A copy of the written consent is available for review by the Editor-in-Chief.

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