CASE REPORT
General Urology

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Robot-assisted Management of Anterior Calyceal Diverticular Calculi

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Abstract

Calyceal diverticula are rare outpouchings of the upper collecting system that likely have a congenital origin. The incidence of the stone formation in the calyceal diverticula is up to 50%. The most effective diagnostic method is the computed tomography urogram. Treatment options for symptomatic patients include shock -wave lithotripsy, ureteroscopic or percutaneous methods, and laparoscopic surgery. The treatment option should be selected based on the basis of the diverticulum location and stone burden. This paper reports an interesting case of a 19-year-old boy with a stone burden of 1.663 mm^3 in the calyceal diverticula of the right kidney. The patient underwent a robot-assisted procedure using the daVinci© Xi system.

Keywords: Robot assisted surgery, calyceal diverticular calculi, robotic therapy

Introduction

Calyceal diverticula are rare eventrations of the upper collecting system lying within the renal parenchyma, and stones have reportedly been found in 9.5% to 50% of cases (1,2). They were first described as cysts more than 180 years ago (3), with more similar definitions to follow (4-6) until finally, the term calyceal diverticula was first mentioned (7). The majority of authors favor congenital over acquired origin regarding the cause of calyceal diverticula, although there is no consensus about the timing of the anomaly relative to birth (8,9). Some authors have reported approximately 35 days as the time when the ureteric bud develops (10), whereas others have supported a timeline that places the formation of the calyceal diverticula just before birth (11). The condition affects approximately 63% of women and approximately 37% of men, and has no predilection toward a particular side of the body, with the average diverticulum size being 1.72 cm ranging from 0.5 to 7.5 cm, and the average stone size is 12.1 mm and ranges from 1 to 30 mm (12). Asymptomatic calyceal diverticular calculi with no signs of infection can be managed just with surveillance. For symptomatic patients, the treatment choice mainly depends on the location of the calyceal diverticular calculi, stone burden, and patient preference. Several therapeutic options for managing symptomatic caliceal diverticular calculi are available, varying from extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), ureterorenoscopy (URS), and retroperitoneal laparoscopic approach for stone extraction. With the introduction of the robotic system, this minimal invasive treatment can be added in selected cases.

Case Presentation

A 19-year-old boy, with an unremarkable medical history, was initially examined for persistent discomfort in the right lumbar region, lasting more than a year. The physical examination was age-appropriate, without any signs of infection. Vital signs and the laboratory test results were within the normal range. The urine tests were sterile and without signs of micro- and gross hematuria. The body mass index was 23 kg/m^2. The initial ultrasound examination discovered a stone formation of 2 cm in diameter in the middle calyces of the right kidney. For further clarification, a computed tomography (CT) urogram was performed, which confirmed the diagnosis of 2 cm stone formation in the anterior diverticula with a narrow neck, thin overlying parenchyma, and stone density of 1.035 Hounsfield

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units. No further abnormalities were found except for proximal ureter kinking (Figure 1). The patient had no previous cases of urolithiasis. Conservative versus operative options were discussed with the patient. The chosen form of treatment, which was assumed to be definitive, involved surgery due to persistent discomfort and occasional pain in the right lumbar region. The following therapy options were discussed: ESWL, PCNL with possibly a simultaneous ureteroscopic approach, retroperitoneal-laparoscopic, and finally transperitoneal robot-assisted surgery. Ultimately, the patient decided to undergo a robot-assisted definitive treatment. A four-port setting was used. The procedure lasted 63 min and was performed in several steps. After identifying the diverticulum, the parenchyma overlying the lesion was incised. Although one solitary stone of 2 cm in diameter was described in CT, there were actually at least 5 separate stones of different sizes, ranging from 3-5 mm. The laser usage was not necessary, and all stones could be removed using a grasped (Figure 2). The remaining sand-like material was aspirated. Blood loss was 15 mL. The calyx neck was closed using a 2/0 monofilament, non-nonabsorbable polypropylene suture for hemostasis. The renal defect, renal fascia, and peritoneum were then also sutured. No drain was placed. Postoperative laboratory tests were within the normal range. The ultrasound examination performed after the surgery was unobtrusive. Metamizole was administered for 2 days, and the patient was discharged on the 3rd postoperative day. The one-month follow-up was without any deviation from the normal postoperative course. The discomfort in the right lumbar region has disappeared.

Figure 1. Computerized tomography urogram (left), size and density of the stone (right)

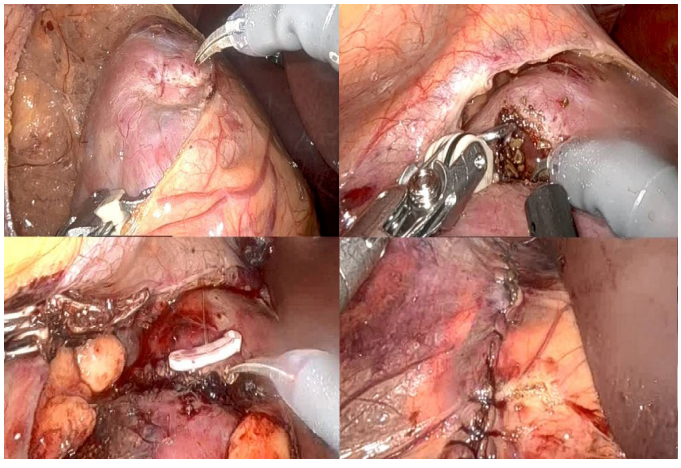

Figure 2. Main steps during the surgical procedure

Discussion

The majority of patients with calyceal diverticula are asymptomatic before stone formation, the condition occurs equally in both sexes, and the diagnosis is usually made on imaging performed for other reasons (13). For asymptomatic calyceal diverticular calculi with no signs of infection, regular follow-up is indicated. Once the patient becomes symptomatic in any way (14), several treatment options, mainly dependant on the location of the calyceal diverticular calculi and stone burden, are available (15).

The principal minimally invasive modalities, including ESWL, PCNL, URS and laparoscopy are well-documented (16). Although ESWL can be offered as the first-line, non-invasive treatment option for all diverticular calculi, the relatively low stone-free rates (4-20%) could be a setback (17). ESWL can also cause symptomatic ease in 36-70% of patients (18). PCNL produces better results compared with ESWL monotherapy (12). Nevertheless, the percutaneous approach can be challenging because of the small cavity and difficult diverticular neck identification (19). The stone-free rates after PCNL are approximately 80%, and some authors have reported complication rates of 54% (20). Some other authors have reported complications such as severe hemorrhage, damage to the surrounding organs, or the kidney parenchyma, partly due to the anatomical position of the diverticulum, sepsis, or even death (15). Our blood loss was 15 mL. With the advancement of URS, the introduction of flexible instruments with excellent picture quality and laser devices, this technique can be used for stones in the upper and middle calyces and produces durable results with low morbidity. However, the calyceal neck cannot be identified during a retrograde approach in up to 30% of patients (21). During our procedure, the calyceal neck was good visualized. Some authors have reported a symptom-free rate of just 35% after 6 weeks and stone-free rates of just 19% (22). Even so, URS has enough advantages with a short duration of hospitalization and low risk of complications (23). All the above-mentioned procedures carry the burden of radiation exposure, which is also an important aspect of therapy selection. Compared to other methods, retroperitoneal laparoscopy is considered the most invasive approach and is usually reserved for cases with large stones in the anterior diverticula, with a narrow neck and complex branched calculi, with thin overlying parenchyma (21).

Perioperative outcomes of laparoscopic surgery for calyceal diverticula are encouraging, and its long-term results appear to be durable (12).

The introduction and further development of robotic systems, three-dimensional vision, magnification, dexterity, and ergonomic comfort have been added to the laparoscopic approach. However, the literature about robot-assisted treatment is scarce, with just a handful of reports published (24,25). Nonetheless, this paper demonstrates that the robot-assisted treatment is effective and safe with good short -term stone-free results.

Conclusion

The robot-assisted laparoscopic technique is a legitimate therapy option and should be added to other treatment options for caliceal diverticular calculi in the robotic era. The procedure is technically well feasible with minimal morbidity, an excellent stone-free rate, and a short hospital stay. More extensive series on robot-assisted techniques, which may require a multi-institutional effort due to the relative rarity of the disease, are needed.

Ethics

Informed Consent: Informed consent was obtained from the patient.

Peer-review: Externally peer-reviewed.

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