Urologia Internationalis

Original Paper

Urol Int 2021;105:59–63
DOI: 10.1159/000509564

Received: May 6, 2020
Accepted: June 19, 2020
Published online: July 28, 2020

A Different and Novel Alternative (ADANA) Renal Access Technique when CT or USG Guidance Is Inadequate in Case of Retro-Renal Colon

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Keywords
Renal access · Percutaneous nephrolithotomy · Retro-renal colon · Stone treatment · Colon perforation

Abstract
Introduction: Computed tomography (CT) or ultrasonography (USG)-guided renal access for percutaneous nephrolithotomy (PNL) is not suitable in all cases with retro-renal colon (RRC) due to anatomical and technical restrictions. We would like to describe our novel technique that permits standard subcostal renal access with a small incision for these patients. ***Methods:*** This method was performed on adult patients with severe RRC and complex renal stones who were not suitable for renal access with CT or USG guidance. Time from skin incision to puncture needle insertion, incision length, stone-free rate (SFR), and complications were evaluated. ***Surgical Technique:*** The appropriate renal calyx for renal access was identified with retrograde pyelography. The skin closest to the identified calyx was incised and retroperitoneum visualized. The RRC was swept laterally by blunt dissection to obtain a safe puncture line. The retractors were placed to keep the colon away from the incision. Then, the puncture needle was placed over Gerota's fascia. After this, the puncture needle was inserted into the targeted calyx under fluoroscopic guidance. The insertion of guidewire and the rest of the procedure such as dilatation and insertion of Amplatz sheath were performed under same maneuver. ***Results:*** A total of 1,348 patients were treated with PNL between January 2016 and November 2019. Our group consisted of 16 adult patients with a median age of 44.8 years (7 females and 9 males) who underwent PNL with our new access technique. SFR and clinically insignificant residual fragment (CIRF) rate were 72.5 and 14.2%, respectively. The median access time was 22.2 min (range: 15–30 min). The median skin incision length was 3.7 (range: 3.0–4.5) cm. The average skin incision length was 3.7 cm. The SFR and CIRF rate were 72.5 and 14.2%, respectively. We did not observe any complication related to our access technique. ***Conclusion:*** Our novel access technique created a safe anatomical route for standard subcostal renal access with acceptable incision length and very low complication rate.

Introduction

Retro-renal colon (RRC) is found in 2% patients in supine and 6.8% patients in prone position [1]. RRC is one of the most important risk factors for colon perforation

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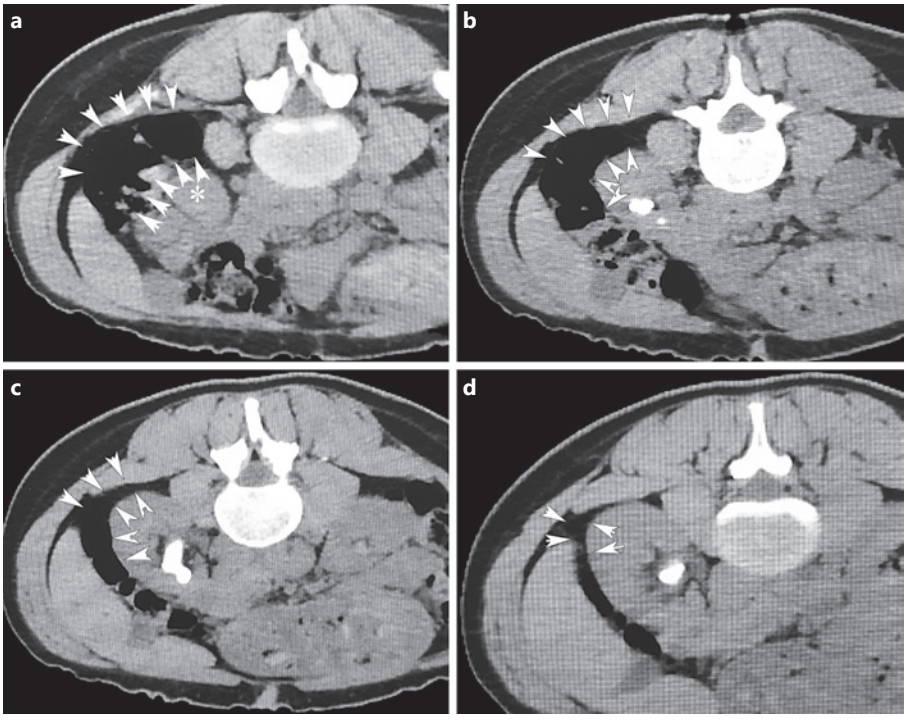

Fig. 1. Computed tomography images of a patient with severe RRC. **a** * Lower pole of the left kidney, arrow heads indicate the colon. **b–d** Arrow heads indicate the RRC. RRC, retro-renal colon.

during percutaneous access to the kidney [2]. Sharma et al. [1] estimated that there was a 65% chance of colon injury during percutaneous renal access in cases with RRC detected during computed tomography (CT) evaluation.

To avoid this harmful complication, laparoscopic-assisted, CT- or ultrasonography (USG)-guided access techniques were described [3–6]. Especially, CT guidance is complicated and requires advanced technological devices and skills. In addition, it is more expensive than the other techniques.

Laparoscopic colon re-position and percutaneous renal access is also challenging. This procedure has the disadvantages that urine and/or blood can easily drain into intraperitoneal cavity from the peritoneal opening.

The most important point in percutaneous nephrolithotomy (PNL) is appropriate access to achieve high stone clearance rate and to lower the possibility of hemorrhage. Standard subcostal renal access with CT or USG guidance is not generally possible because of avoiding RRC. Therefore, more medial or upper renal access is used. These types of renal access increase the complication rates. Our access technique easily permitted access to the kidney with subcostal renal access. We aimed to describe a novel access technique with small incision for standard subcostal renal access, when CT or USG guidance is inadequate.

Materials and Methods

All adult patients with renal stones who were treated with PNL between January 2016 and November 2019 were reviewed. The patients with normal kidney anatomy, severe RRC, and complex renal stones according to Guy's nephrolithometry were included in this study. All these patients were re-evaluated by an experienced urologist and radiologist to obtain appropriate renal access with CT and USG guidance (shown in Fig. 1). RRC definition was made according to Prassopoulos et al. [7]. Accordingly, a line was drawn from the anterolateral edge of the vertebral body through the middle of the renal segment, and the presence of colon posterior to this line was regarded as RRC. The patients with Guy's nephrolithometry score ≥3 were included [8]. If there was a high risk of colon injury with fluoroscopic guidance and renal access with CT or USG guidance was inadequate to obtain appropriate renal access for PNL, our novel subcostal renal access technique was offered to these patients. The patients were informed about the new access modification, and written consent was obtained from the patients.

Surgical Technique

In the operating room, an open-end ureteral catheter is placed into the ipsilateral ureter and the patient is placed into prone position. After the drapes are placed, retrograde pyelogram is obtained and intra renal anatomy is observed. The fluoroscopic imaging modality is used to select a proper calyx in lower pole of the kidney which provides a versatile path to provide maximum or complete stone clearance. After the determination of the puncture site in the subcostal area, a transverse incision (about 3.0–4.5 cm) is made over the access site. Using blunt and sharp dissection, we reached

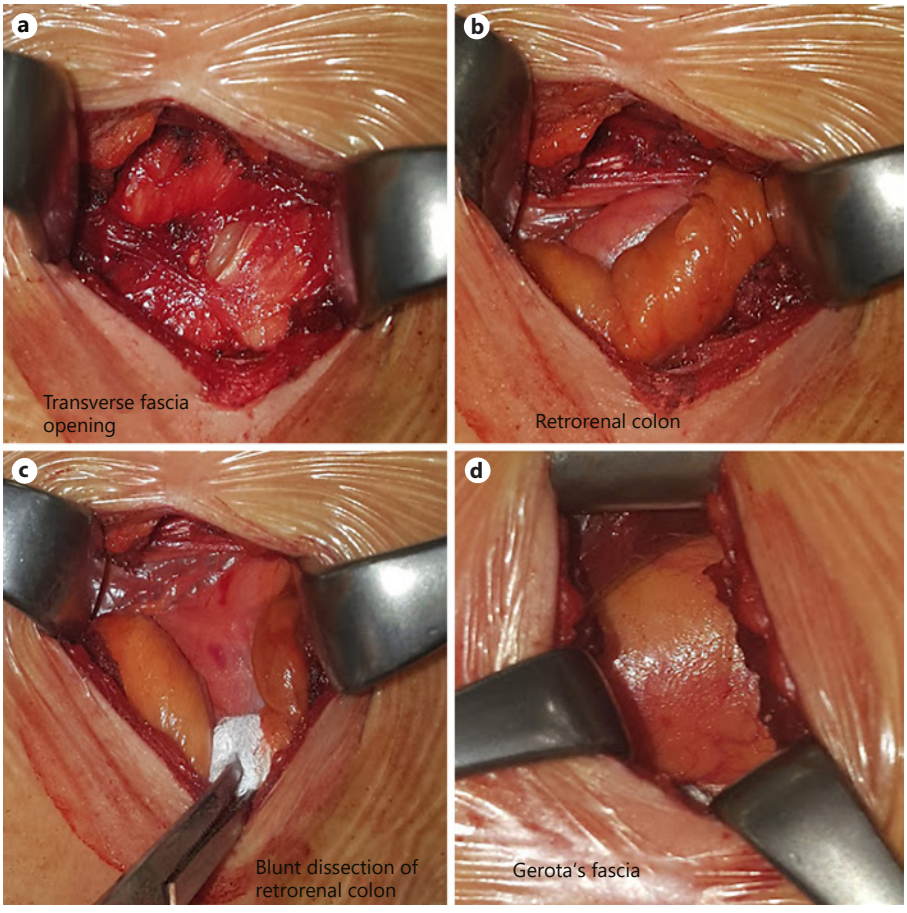

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Fig. 2. Visualization of retro-renal colon through the incision. **a** The opening of transverse fascia. **b** The image of retrorenal colon. **c** Blunt dissection of retrorenal colon. **d** The image of Gerota's fascia.

transverse fascia and opened it. After this, RRC and peritoneum are swept laterally with blunt dissection over Gerota's fascia. After colon mobilization, 2 or 3 retractors are placed for visualization of Gerota's fascia (shown in Fig. 2). At this stage, Gerota's fascia is easily observed and the lower pole of the kidney can be palpated. While Gerota's fascia is explored, the puncture needle is placed over Gerota's fascia. The puncture needle is inserted into the targeted calyx site with the guidance of fluoroscopic imaging. After the puncture, the guidewire is placed into the collecting system. Access dilations are made by Amplatz dilatators. Usually, 26-F Amplatz sheaths are used for lithotripsy. Stone fragmentation is performed with a pneumatic lithotripter through the 24-F rigid nephroscope. Fragments of kidney stones are removed using stone forceps or basket catheter. After stone removal, an antegrade pyelography is performed to detect perforation of the pelvicalyceal system or reno-colic fistula. At the end of the operation, a nephrostomy tube is inserted and the incision is closed.

Access time from the incision of skin to the insertion of the needle into the pelvicalyceal system and incision length was recorded in all cases. After the operation, the patients were routinely evaluated with KUB and complete blood count (CBC) on postoperative day 1. If urine was clear, ureteral and Foley catheters were removed on postoperative day 1. Nephrostomy tube was removed if nephrostomy drainage was clear. One day after removing the nephrostomy tube, the patients were discharged if there was no urinary leakage, renal colic, or bleeding. All patients were evaluated for any complications according to the Clavien-Dindo classification [9]. At the 1-month follow-up appointment, all patients underwent a radiological assessment with KUB, CT, or USG. All patients were also observed for complications of access site during the follow-up.

Results

A total of 1,348 patients were treated with PNL between January 2016 and November 2019. Our group consisted of 16 adult patients (7 females and 9 males) who underwent PNL with our new access technique. The median age was 44.8 (range: 24–80) years and BMI was 24.1 (18.7–32).

In all, 7 procedures were left-sided and 9 procedures were right-sided. The median stone number and stone size were 3 (range: 1–10 stones) and 38.4 (range: 30–65) mm, respectively. The stones were located in the renal pelvis in 6 patients, and the remaining patients' stones were in the pelvis and lower pole.

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Standard lower pole calyx access was successfully performed in all cases with our novel technique. Single access was performed in all of these 16 patients.

Preoperative and postoperative hematocrit levels of patients were 44 ± 1 and 39 ± 3, respectively. None of the patients required any blood transfusions. One patient had a high fever following surgery which was resolved following antibiotic therapy. Stone-free rate and clinically insignificant residual fragment rate were 72.5 and 14.2%, respectively. The median access time was 22.2 min (range: 15–30 min).

The median skin incision length was 3.7 (range: 3.0–4.5) cm. We did not observe wound infection, hematoma, urinary fistula, or dehiscence in the operation site. The data are summarized in Table 1.

Table 1. Demographic, pre- and postoperative data of patients

	Patients
Number of patients	16
Age, years	44.8 (24–80)
Male/female ratio, *n*	9/7
BMI	24.1 (18.7–32)
Stone size, mm	38.4 (30–65)
Laterality (L/R)	7/9
Stone location	
Lower pole	7
Pelvis	6
Multiple	1
Coralliform	2
Operation time, mean±SD, min	107.1±25.2
Duration of pelvicaliceal access (mean± SD), min	22.2 (15–30)
Fluoroscopy time, mean±SD, min	3.5±1.9
Hospital stay, mean±SD, h	58.7±27.9
Nephrostomy stay, mean±SD, h	38.7±25.5
Hemoglobin decrease, mean±SD, g/dL	1.17+1.1
SFR, %	72.5
Skin incision length, mean, cm	3.7 (3.0–4.5)
Complications, *n* (%)	
Clavien – Grade 1	
Fever >38.5°C	1 (7.1)
Clavien – Grade 2	
Blood transfusion	0 (0)
Clavien – Grade 3	
Postoperative DJ insertion	1 (7.1)
Angioembolization	0 (0)

SFR, stone-free rate.

Discussion/Conclusion

In the prone position, RRC is encountered more frequently than in the supine position (6–10% vs. 1.9–2%) [1, 10]. Lower renal pole is usually preferred for renal access. Unfortunately, RRC is observed more at the level of the inferior kidney [1, 11]. Upper pole access seems to be a good choice for RRC to avoid colon injury. However, RRC was observed with upper pole or hilar localization in half of the patients [5]. Additionally, pleural injuries and bleeding occur more frequently with upper pole renal access for PNL [12, 13]. To avoid colon injury during access, CT- or USG-guided puncture of the pelvicalyceal system is generally recommended [14]. In ultrasonic guidance, one can observe the kidney and adjacent organs; therefore, safer access can be performed [3]. However, to the best of our knowledge, there are no articles about USG-guided renal access for cases with RRC. Another option to prevent colon injury in cases with RRC is to puncture the kidney more medially and/or cranially. These accesses increase the risk of vascular injury.

In the most cited report about CT-guided percutaneous renal access in the literature, Matlaga et al. [4] mentioned that CT-guided access was used for only 5 patients who underwent PNL operation and only 2 of them had RRC. Although CT-guided percutaneous renal access was established as a safe and effective technique, extra manipulations, radiation exposure, and increased cost are the limitations of this method. Another disadvantage is that additional operation time is needed for stone surgery (PNL) after CT-guided access. Although CT-guided renal access is offered as a solution for cases with RRC, Tuttle et al. [5] reported that even with the use of 3D-CT, a safe access route could not be found for renal access in all cases. Laparoscopy-assisted percutaneous access and open surgery are also other options. There is only one article reporting laparoscopy-assisted PNL for cases with RRC [6]. Laparoscopic colon repositioning and percutaneous access were performed under direct and fluoroscopic visualization. It is a very complicated procedure and has limited number of cases. This technique requires both laparoscopy and PNL tools at the same time. Repositioning of the colon results in breach of peritoneal barrier between retro- and intra-abdominal spaces. If bleeding or urine extravasation occurs during or after the operation, it might be a more complicated surgery than standard PNL.

Open surgery is the most invasive option for renal stone surgery. It is not an acceptable treatment model except in some very selected cases. However, if percutaneous approaches may not to be successful, or if multiple endourological approaches have failed, open or laparo-

scopic surgery may be a valid treatment option. Open surgery should be considered as the last treatment choice after all other treatment options have been explored [15].

We developed a new access technique to obtain a safe route to perform standard subcostal renal access for cases with severe RRC and complex stones, when CT or USG guidance is inadequate for renal access. This access technique does not need any special equipment, and it can be performed by all urologists.

Disadvantages of our technique are that it requires a longer incision than standard, but it is easy, safe, and cost-effective for renal access in cases with RRC compared to other options. Limitations of our study are that, first, the number of patients is limited; however, this anatomical variation is rare. Second, every patient's anatomical variation was unique, and this might result in alteration of treatment choices both by the patient and the physician.

In conclusion, our technique created a safe route using a simple, easy, and cost-effective procedure with acceptable incision and very minimal complications for standard subcostal renal access when CT or USG guidance is inadequate for appropriate renal access. We described our rather simple, cost-effective and very safe solution for RRC, which we name after our hometown as the "Adana Access Technique."

Statement of Ethics

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for inclusion in the study.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

The authors did not receive any funding.

Author Contributions

Conception and design of the work: Zafer Gokhan Gurbuz. Acquisition, analysis, or interpretation of data for the work: Hakan Ercil, Ediz Vuruskan, Lokman Ayhan, and Umut Unal. Drafting the work: Zafer Gokhan Gurbuz, Hakan Ercil, and Ergun Alma. Final approval of the manuscript: Zafer Gokhan Gurbuz and Hakan Ercil. Data integrity: Ergun Alma.

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