# Percutaneous nephrolithotomy with X-ray free technique in morbidly obese patients

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*To the Editor*: Percutaneous nephrolithotomy (PNL) constitutes the first-line of treatment for complex and staghorn stones. Performing PNL in morbidly obese patients is challenging because of potential risks and higher morbidity rates.[1] Previous literature has confirmed the safety and feasibility of the surgery under fluoroscopy. However, the efficiency of total ultrasound (US)-guided access established procedures in morbidly obese patients has not been proved before, with the traditional view holding that obesity is a risk factor that increases the difficulty of accessing the renal collecting system under US. US is sometimes used to reduce radiation exposure in some Western countries, whereas the spread of X-ray-free technique for PNL in China has been lasting for >10 years. This study aims to investigate the feasibility and safety of total US-guided PNL in morbidly obese patients and to highlight the difficulties and problems, which can be encountered and effectively resolved.

The medical records of 52 cases of obese patients who underwent PNL from October 2013 to March 2020 were reviewed retrospectively. The preoperative demographic data including age, gender, body mass index (BMI), stone size, and operative position were reviewed. The stone size was determined by a computed tomography (CT) scan preoperatively.

All the procedures were performed under general anesthesia. The prone position was preferred, but for patients who could not tolerate the prone position, a lateral position was selected. A retrograde 5 Fr ureteric catheter was first inserted into the renal pelvis in lithotomy position, with a 16-Fr Foley bladder catheter placed as well. Then the patient was placed in a suitable position and appropriate padding of pressure points was ensured. A 3.5 MHz convex abdominal US transducer was used to detect the kidney and surrounding organs. The ideal target calyx was determined totally by US [Figure 1]. Fix the transducer and insert the needle in front of it when the calyx was confirmed. The tract was dilated with either Alken coaxial telescopic dilators or a high-pressure balloon dilator to standard 24 Fr. Stones were disintegrated and suctioned with a combined ultrasonic/pneumatic lithotripter. Additional accesses were established if needed during the operation. US was then used to re-check the collecting system to confirm if residual stones were left. A 6-Fr ureteral stent was placed antegrade routinely and was kept indwelled for 2 to 4 weeks after surgery. A 14-Fr nephrostomy tube was placed routinely at the end of surgery and removed 3 to 4 days later if no complications occurred.

Stone-free status was evaluated 2 to 3 days after surgery with a kidney-ureter-bladder (KUB) radiograph or non-enhanced CT scan. The number of access tract, time for each access establishment, operative duration, postoperative hospital stay time, related complications, stone composition analysis, and auxiliary therapy were recorded. Estimated blood loss was evaluated 24 h postoperatively. The modified Clavien classification system was used to grade the perioperative complications. Stone-free status was defined as residual stone fragments ≤4 mm according to the postoperative KUB or CT scan.

In all, a total of 52 cases were included in our study, with a mean age of 46 years. The mean BMI was 45.5 ± 5.2 kg/m$^2$. The mean stone burden was 2.8 cm. Thirty-two cases were diagnosed with urinary tract infection (UTI) by urine analysis, and *Escherichia coli* and *Proteus mirabilis* were the most common bacteria grown from urine culture. All UTI cases underwent antibiotic therapy before surgery. The mean operative duration was 68 min (range: 38–97 min). A total of 63 tracts were established during the first-stage surgery (single in 42 cases, double in nine cases, and triple in one case), and the meantime for each access establishment was 6.6 min. Six tracts were lost during the primary procedure; re-puncture was needed to find the right way, all of which happened in the second or third

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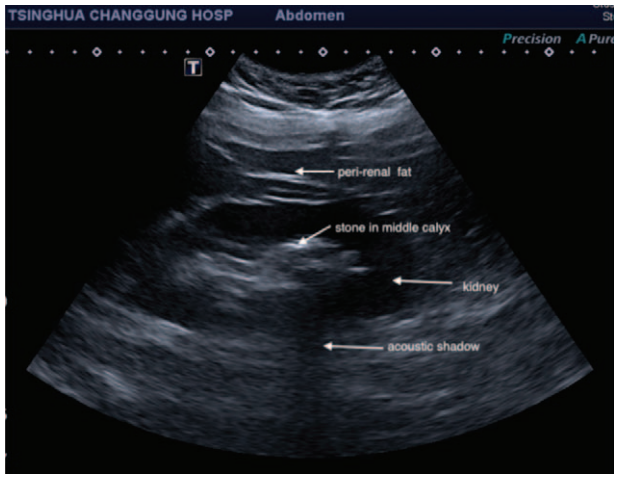


**Figure 1:** Ultrasonic image of a male obese patient (BMI: 37.6 kg/m$^2$). The outline of the kidney is not quite clear, and the stone is located in the middle posterior calyx, with an acoustic shadow below. BMI: Body mass index.

tract establishment. About 48% (25/52) of patients had an upper pole tract to the preferred calyx. No severe complications occurred during the procedures. The mean hemoglobin drop 24 h postoperatively was 1.6 g/dL. The mean postoperative hospital stay time was 6.7 days. The complication rate using the modified Clavien classification system was 25%, including grade I for ten (fever 6, pain 4) and grade II for three (transient bleeding two, subcapsular hematoma one). No septic shock or embolization occurred. The initial stone-free rate was 80.8% (42/52) after the first-stage surgery. Five patients needed a second-look PNL (four additional tracts) and two cases underwent flexible ureteroscopic lithotripsy to remove the residual stones after a 7 days' interval, and three cases with residual stone fragments were observed with medical expulsive therapy. The final stone-free rate was 90.4% (47/52) when the ureteral stent was removed.

The reasons why it is challenging for PNL in morbidly obese patients mainly include poor radiographic and ultrasonic images under unconventional conditions, ambiguous collecting system and stone locations, and sheath not long enough because of excessive fat tissue. Previous literature has proved the safety and efficiency of renal access establishment guided by fluoroscopy in obese patients, with acceptable postoperative complication rate and stone-clearance status. However, when using fluoroscopy, larger radiation doses are often required to penetrate the thick tissue to achieve the same image quality as that of common patients, so both patients and intraoperative staff would be exposed to a much higher level of radiation.[2] Although total US-guided PNL has been proved to be safe and feasible in special cases, its use in morbidly obese patients has rarely been reported. The main concerning problem is that excessive fat tissue surrounding the kidney can reduce the image quality under US, as the distance between puncture point and target calyx is increased, and the US energy is absorbed by adipose tissue along the access route. For beginners, the barriers for successful establishment of renal access are both the difficulty to determine the depth of puncture and the lack of a clear image. Choosing cases with moderate or severe hydronephrosis and using the "two-step" method or balloon technique can improve the success rate. In this study, failure in access obtaining occurred in six cases, all of which happened during the establishment of the second or third tract. This may be attributed to the unclear image caused by fluid extravasation after performing with the first access. In addition, calyx selection might also be a reason for access loss. Lower pole calyx puncture always means a longer distance from skin to the stone, which increases the risks of inaccurate puncture and guidewire displacement during US-guided procedures. As reported in a previous study, lower pole calyx is the preferred calyx under fluoroscopy,[3] but to the opposite, we usually choose the upper calyx as the primary selection, for the upper pole of the kidney is closer to the back and the lower pole is much closer to the ventral side in sagittal view.

Although PNL offers lower mortality compared with open surgery, morbidly obese patients are still at a higher risk of complication compared with patients with normal BMI.[4] Our center has been performing US-guided PNL for >15 years, and tens of thousands of cases including patients with spinal deformity, patients with a solitary kidney, and pediatric patients were safely and efficiently treated by this technique.[5] In this study, no severe complications occurred during the procedures. Perioperative complications were seen in 25% of cases, most of which were mild. The stone-free status was achieved in 42 patients after the first-stage surgery, but the stone-free rate was somewhat lower than what we had previously reported in general cases. This may be attributed to the indistinct image under US, especially during the establishment of multiple tracts. Five patients underwent second-look PNL and two cases with flexible ureteroscopic lithotripsy to remove the residual stones. Five patients had residual stones left until the last follow-up.

## Declaration of patients consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

None.

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