

Research Article

Percutaneous Nephrolithotomy with the Patient in Half Jackknife Position

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Abstract

Background and Purpose: Percutaneous nephrolithotomy (PNL) is the standard therapy for large upper urinary tract stones. The optimal patient position remains controversial. The purpose of this prospective study is to investigate PNL safety, success, and complications using half jackknife position.

Patients and methods: Between October 2015 to January 2017, 55 patients underwent PCNL in half jackknife position. Inclusion criteria were single or multiple renal stones, stone diameter ≥ 2 cm, body mass index (BMI) above 25 kg/m², and no contraindications to performing the operation in the prone position. Exclusion criteria were active urinary tract infection, pregnancy, bleeding and coexisting renal anomalies. Perioperative data, patient's demographic, stone, operative, postoperative and follow-up data were recorded. Successful treatment was defined as stone free or stones (≤ 4 mm) visible on NCCT scan at 3months.

Results: A total of 55 patients, with a mean age of 37.3 (range 24–70 year) years and mean body mass index of 31 kg/m², underwent PCNL in the half jackknife position, male-to-female ratio 13:42. Mean stone size was 3.6 cm; a single puncture was needed in 51 (92.7%) only 4 patients needed 2 punctures (7.3%). A tubeless procedure was done in 48 patients (87.27%). Stone-free rate was 92.7%. Hospital stay was 2.3 days. An overall complication rate was 7 patients (12.7%).

Conclusion: PNL in half jackknife position is safe and effective in a short obese patient; it is more comfortable for the surgeon without challenges added in the puncture and no significant difference in hemodynamic and ventilator changes between prone and half jackknife positions.

Keywords

- Percutaneous nephrolithotomy
- PNL
- PCNL
- Position
- Renal stones
- Half jackknife position

ABBREVIATIONS

BMI: Body Mass Index; Hb: Hemoglobin; HR: Heart Rate; KUB: Kidney Ureter and Bladder; MBP: Mean Blood Pressure; NCCT: Noncontrast Computed Tomography; PAP: Peak Air Way Pressure; PNL: Percutaneous Nephrolithotomy; SWL: Extracorporeal Shock Wave Lithotripsy; US: Abdominal– Pelvic Ultrasound

INTRODUCTION

Percutaneous nephrolithotomy (PNL) has been confirmed to be the gold standard for management of large and complex upper urinary tract stones [1]. The optimal position for this procedure still under continuous evaluation, the different positions for PCNL were prone position, and its modifications include (the reverse lithotomy position, split-leg, and prone-flexed positions), lateral decubitus Flank position, Galdakao-modified Valdivia supine position, Barts technique Flank position and complete

supine; however some of these were not widely accepted in the urological community [2]. So far, neither the American Urological Association nor the European Association of Urology guidelines gives recommendations on the best PNL position [3]. PNL has traditionally been done with the patient in the prone position, therefore various supporting equipment have been developed to minimize the risk of pressure injury and improve ventilation. For example, the rolled supports can be replaced by the Cloward surgical saddle or the Montreal mattress [4]. For a safe head positioning, the Proneview protective helmet system was developed, which protects the critical cephalic pressure points and the airways [5]. The prone position still the most widely used position for PNL [6]. The main advantage of prone position is that it exposes completely the lumbar area which gives the surgeon ample space to place several accesses and provides enough space for manipulation with the instruments [7]. The half jackknife position was described in retroperitoneoscopic adrenal surgery.

This study investigates this position as a modification of classic prone position in PNL in short obese patients, regarding safety, efficacy, and complications.

PATIENTS AND METHODS

The Institutional review board of Faculty of Medicine, Beni-Suef University approval was obtained before undertaking the study and informed consent was signed by all enrolled patients who prospectively enrolled from October 2015 to January 2017.

Study population

Inclusion criteria were single or multiple renal stones, stone diameter ≥ 2 cm, short obese patients with body mass index (BMI) > 25 kg/m² and < 40 kg/m², and no contraindications to perform the operation in the prone position. Exclusion criteria were active urinary tract infection, pregnancy, uncorrectable bleeding disorders, morbidly obese patients or coexisting renal anomalies. Before PNL, urine cultures and sensitivity were obtained, and, when positive, antibiotics were prescribed for 1 week. Preoperative assessment included history, physical examination, and laboratory investigations (urine analysis, culture and sensitivity, full coagulation profile, complete blood count, serum urea, and creatinine). Imaging included abdominal-pelvic ultrasound (US), kidney, ureter, and bladder (KUB), and noncontrast computed tomography (NCCT).

Operative technique

All procedures were done under general anesthesia. With the patient within the lithotomy position, cystoscopy was done, then a ureteral catheter was fixed and the Foley's catheter was inserted alongside the ureteral catheter. The patient was then repositioned into the half jackknife position with the hip joints bent at 45–60 degrees, knee joints at 60–90 degrees and the rest of table at about 20 degrees (shoulders, iliac bones, knees, ankles, and feet were padded, supported, and secured) (Figure 1). Retrograde pyelography was done, and the skin incision was made medial to the posterior axillary line and an 18-gauge nephrostomy needle was passed into the desired calyx, then a guide wire was passed across the renal pelvis and into the ureter, upper or lower calyx. Following this, a second safety guide wire 0.038 was passed into the system. Dilatation was done using metal coaxial dilators or malleable dilators (Amplatz dilators). A rigid 26F KARL STORZ nephroscope was used, stones were fragmented using Swiss Lithoclast. At the end of the procedure, if irrigant fluid was returning clear a tubeless PNL was done, with or without the Double-J stent; otherwise, a nephrostomy tube is left in place. If urine was clear on the first day postoperatively, the Foley's and ureteral catheters were removed and KUB was obtained. The nephrostomy tube was removed the next day in the absence of significant residual stones and the patient was discharged. Blood loss, mean blood pressure (MBP), heart rate (HR), peak airway pressure (PAP) were recorded after positioning the patient into prone position and after repositioning into half jackknife position. Operative time (end of anesthesia to the placement of nephrostomy tube), stone-free rate, complications, and hospital stay were recorded. Blood loss was calculated as changes in hemoglobin (Hb) and need for blood transfusion. KUB and US were performed on day 1 postoperatively. Follow up of all



Figure 1 Patient position into half jackknife.

Table 1: Patient characteristics.

| | |
|--|----------------|
| Total patients, n | 55 |
| Male-to-female ratio | 13:42 |
| Mean age, yr (range) | 37.3 (24–70) |
| Mean BMI, kg/m ² (range) | 31 (28–36) |
| Mean height, cm mean(range) | 147(142–154) |
| Mean Weight in kg | 91(80– 107) |
| Mean maximum stone diameter, cm (range) | 3.6 (2.2–5.1). |
| Side, right/left, n Previous open or pcnl, n | 28 /27 |
| | 8 (14.5%) |

Table 2: Hemodynamic and Ventilatory Changes.

Variables Prone half jackknife p-Value

| | |
|--|-------|
| MBP change (mm Hg) | |
| Mean (STD) - 10.06(3.72) - 11.03 (2.93) | 0.132 |
| HR change (Beat/minute) | |
| Mean (STD) 4.21(5.26) 4.88 (5.278) | 0.112 |
| PAP change (cm H2O) | |
| Mean (STD) 6.56 (1.84) 7.16 (1.53) | 0.123 |
| Mean blood pressure (MBP), heart rate (HR), and peak airway pressure (PAP) | |
| STD standard deviation | |

Table 3: Intraoperative and postoperative parameters

Variables n (%)

| | |
|---|--|
| Calyx puncture | |
| Lower, n (%) 50(90%) | |
| Middle, n (%) 5(10%) | |
| Mean operating room time, min (range) 73(62– 133) | |
| Stone-free rate, 92.7% | |
| Mean blood loss g/dl (range) 2.3 (0.4– 3.5) | |
| JJ Stent 6(10.9%) | |
| Mean hospital stay, day (range) 2.3 (2.2–4.4) | |
| Overall complications, no. of patients 7 (12.7%) | |
| Fever (Clavein G II) 5(9%) | |
| Urinary leakage (Clavein G III) 2 (3.63%) | |
| Blood transfusion 0 | |
| Colonic perforation 0 | |
| n: number | |

patients continued for 3 months, Patients were considered stone free when no stone > 4 mm was visualized in NCCT at 3 months,. Residual fragments of > 4 mm in diameter were treated with extracorporeal shock wave lithotripsy (SWL).

RESULTS

Fifty-five patients (13 men and 42 women) with mean age of 37.3 years (range 24–70 year) were enrolled. Mean maximum

stone diameter was 3.6 cm (range 2.2–5.1), the mean BMI was 31 kg/m² (range 28–36 kg/m²). Mean height was 147 (range, 142–154 cm) and mean Weight was 91 kg (range, 80–107 kg). Patient's baseline characteristics were summarized in (Table 1). The mean hemodynamic and ventilator changes between prone and half jackknife positions were summarized in (Table 2) which shows no significant difference between pre and post positioning. A single puncture was needed in 51 (92.7%), only 4 patients needed 2 punctures (7.3%). All patients were accomplished in a single session. A tubeless procedure was done in 48 patients (87.27%). The mean intraoperative and postoperative parameters are summarized in Table 3. Postoperative assessment with NCCT at 3 months showed a stone-free rate of 92.7%. The mean operative time was 68 mints; Mean postoperative hospital stay was 2.3 days. Four patients had residual fragments required SWL, 3 patients required single session the last patient required 2 sessions of SWL. No blood transfusion was required and no abdominal organ injuries occurred. A JJ Stent was positioned in 6 patients, four of them because of residual fragments and two patients because of prolonged urinary leakage (more than two weeks) from the percutaneous access. Transient fever in five patients occurred necessitating medical treatment with antipyretic.

DISCUSSION

PNL approach for stone removal is superior to the open approach in terms of morbidity, convalescence, and almost completely replaced open surgery for removal of complex upper urinary tract stones, failed SWL stones and stones in kidneys with an abnormal anatomy [8]. PNL in the prone position became the conventional one as most urologists are familiar with this position and it exposes completely the lumbar area this gives the surgeon ample room to place several accesses and provides enough space for manipulation with the instruments. Recent meta-analysis has shown a superior stone-free rate in the prone position and comparable complication rates to the supine position [6], this similar outcome also has been confirmed in obese patients (body mass index >30) between the prone and the complete supine position [9]. The supine position is more comfortable for patients and anesthesiologists especially in respiratory and cardiovascular comorbidity (10). The main drawback of the supine position is that less availability for multiple accesses. Moreover, the operating table and the patient's hips might also restrict instrument manipulation which is more prominent in short obese patients, the exaggerated mobility of the kidney during puncture and dilation and the low intrarenal pressure leaves the collecting system less partially filled resulting in difficult nephroscopy [11]. Both prone and supine positions don't solve the problem of narrow space between the last rib and iliac crest, interference of the buttock and the presence of folds of adipose tissue, especially in short obese patient. The advantages of half jackknife position are the creation of access tract with no added challenges to the surgeon, significantly increasing the operating field, the flexion of the operating table widens the space between the 12th rib and the iliac crest [12], flattening the folds of adipose tissue and facilitating percutaneous access working space, potential interference from the buttock during rigid nephroscopy through the lower pole is minimized this facilitate PNL in short obese patients without significant changes in haemodynamic or ventilatory parameters (MBP, HR, and PAP) over prone position

p value 0.132, 0.112, 0.123 respectively. The stone free rate in this study was 92.7% which is comparable to previous studies, in 2014 Al-Dessoukey and associate reported stone free rate 88.1% in the supine position and 87.3% in the prone position [13], and in 2008 De Sio and associate reported stone free rates 88.7 and 91.6 in supine and prone positions respectively [4] the overall complication rate of this study was 7 (12.7%) which was comparable to previous studies in Al-Dessoukey and associate, 2014 who reported 10% and 15.7% complication rates in the supine and prone positions respectively [13]. In the study of De Sio and associate, 2008 complication rate were 20.5% and 13.9% in supine and prone positions respectively [14]. In contrast with other modifications of the prone position, for example, the prone-flexed position, after the patient is turned to prone position the table is flexed 30–40 degrees to open the space between the 12th rib and the posterior iliac crest [7]. This flexion prevents the exaggeration of the anterior lordosis that occurs in the classic prone position. However, this position impairs, even more, the patient's respiration and circulation. Airway pressures are increased, the cardiac index is decreased and the inferior vena cava can be transiently obstructed [2]. The reverse lithotomy position doesn't gain popularity among urologist as a modification of prone position which was first described for females then modified by same authors into split leg position [2,15], the demand for flexible instrument and the challenging access limit the popularity of this position [2]. To my knowledge this study is the only one describe PNL in the half jackknife position, however, Hisano and associate used this position in retroperitoneoscopic adrenalectomy in Pheochromocytoma, they claimed that this position increases the space between the last rib and the iliac crest [12]. Limitations of half jackknife were anaesthetic concerns because turning a patient into the prone position has measurable effects on cardiovascular physiology, the most consistent of which is a reduction in cardiac index [16] especially in the morbidly obese or other high-risk patients who were initially excluded from this study. Another limitation of this position is the need to reposition the patient during the procedure;

The limitations of this study include that it isn't a comparative study, the limited numbers of cases, and lack of exploring the ability to combine simultaneous antegrade and retrograde endoscopic access to the urinary tract.

CONCLUSION

PNL in half jackknife position is safe and effective in short obese patients. It is more comfortable for the surgeon with no challenges added during the puncture and no significant difference in hemodynamic and ventilator changes between prone and half jackknife positions.

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