Objective: Preliminary study to assess the feasibility and safety of percutaneous nephrolithotomy (PCNL) as an ambulatory procedure.

Patients and Methods: Between February 2011 and September 2012, 84 patients with renal calculi fulfilling the inclusion criteria were admitted to the Urology Department of Benha University Hospitals for PCNL. All patients were subjected to a full medical history, clinical, laboratory and radiological examinations. Tubeless PCNLs were done in the supine position, and an antegrade double-J stent was inserted. Operative time and intraoperative complications were recorded. Postoperatively, the hematocrit value, postoperative pain and analgesics, need of blood transfusion, stone-free rate, and length of hospital stay were recorded. Stable patients that could be safely discharged within 24 hours after surgery were considered ambulatory.

Results: All cases of tubeless PCNL were successfully done and no cases converted to open surgery. The overall stone-free rate was 91.7%, the mean postoperative pain score measured by the visual analog scale was 4.4 ± 1.2, the mean overall hematocrit deficit was 4.8 ± 2.2% and the mean hospital stay was 33.4 ± 17.5 hours. Ambulatory PCNL was accomplished in 60 out of 84 patients (71.4%) and double-J stents were removed 7–10 days postoperatively. In the non-ambulatory cases, double-J stents were removed after auxiliary procedures were done according to each case. Results: All cases of tubeless PCNL were successfully done and no cases converted to open surgery. The overall stone-free rate was 91.7%, the mean postoperative pain score measured by the visual analog scale was 4.4 ± 1.2, the mean overall hematocrit deficit was 4.8 ± 2.2% and the mean hospital stay was 33.4 ± 17.5 hours. Ambulatory PCNL was accomplished in 60 out of 84 patients (71.4%) and double-J stents were removed 7–10 days postoperatively. In the non-ambulatory cases, double-J stents were removed after auxiliary procedures were done according to each case. Conclusion: PCNL can be safely done on an ambulatory basis under strict criteria, but further studies are needed to confirm and expand these findings.

Introduction

Percutaneous renal surgery caused a revolution in the treatment of renal stone surgery. It is now considered the first line intervention for management of patients with a significant stone burden [1].

Percutaneous nephrolithotomy (PCNL) in the supine position allows better urethral access to perform lower urinary tract endoscopy during the procedure. Regional anesthesia gives better control of the airway with less hazard to patients with morbid obesity and compromised cardiopulmonary status and reduces overall operative time [2].

The need for the nephrostomy tube after completion of PCNL has recently come into question. In order to shorten the time of hospital stay and to reduce patient discomfort, while at the same time maintaining the same positive outcomes, the tubeless PCNL, described by Bellman and colleagues in 1997, has been used [3, 4].

After several modifications of the original PCNL procedure (tubeless, totally tubeless, and mini PCNL), ambulatory PCNL became the next step to overcome the morbidity of the procedure [5].

Materials and Methods

Between February 2011 and September 2012, 84 patients, who gave written consent, were included in this study from the outpatient clinic, Benha University Hospitals, which was approved by the local ethics and research committee of our college.

All patients were preoperatively subjected to a full medical history, general and local examination, routine preoperative investigations, hematocrit evaluation, coagulation profile, urine analysis with c/s tests, pelvic and abdominal ultrasound, kidneys, ureter...
and bladder, intravenous urography, and non-contrast computed tomography in selected cases.

The cases included 51 (60.7%) males and 33 (39.3%) females: mean patient age was 38.5 ± 9.0 years (range 24–51 years) and mean body mass index (BMI) was 25 ± 2.9 kg/m² (range 20–29 kg/m²) (table 1).

All patients were preoperatively assessed regarding age, sex, BMI, ASA score, serum creatinine, stone burden, and stone location, intraoperatively regarding the number of punctures and tracts, operating time, estimated blood loss, stone-free status, and complications, and postoperatively regarding hematocrit level, pain, the need for analgesics, as well as any complications.

Inclusion criteria included patients more than 18 years old, ASA score 1, BMI less than 30 kg/m², simple isolated renal pelvic or lower pole caliceal stones and mild to moderate stone burden. Exclusion criteria included patients with active urinary tract infection (UTI), previous renal surgery, BMI ≥ 30 kg/m², congenital urinary tract anomalies, a solitary functioning kidney, and patients that had no adequate family support. Intraoperative exclusion criteria were more than one tract or > 3 punctures, pelvicicalical system perforation, residual stones as well as intraoperative complications. Postoperative exclusion criteria were hemodynamically unstable patients and postoperative complications interfering with discharge.

Surgical Technique

All patients were under high subarachnoid spinal anesthesia, in the supine position, after the patients had been well prepped and draped for diagnostic cystoscopy. A retrograde open tip ureteric catheter (6Fr) was inserted, then percutaneous access was obtained (the infracostal approach through the lower calyx was employed in all cases), the tract was dilated to 30Fr using metal Alken dilators, the 30Fr Amplatz working sheath was inserted, and lithotripsy was done using pneumatic lithoclast. After completion of the PCNL an antegrade 6/26–28 double-J stent was inserted in all cases, then the tubeless procedure was chosen if there was no major perforation of the collecting system. If there was no major bleeding and complete stone clearance was ascertained using intraoperative fluoroscopy, an 18Fr Foley catheter was inserted. If there was no postoperative complication, and a stable hematocrit level and the pain were controlled, then the patient was discharged. The patient then returned 10 days later for follow-up and removal of the stent with flexible cystoscopy under local anesthesia.

Results

The results of the routine laboratory assessment which included a complete blood picture, urine analysis and serum creatinine were normal.

Preoperative imaging was done for evaluation of the stone with plain film of the kidneys, ureter and bladder, and intravenous urography and/or non-contrast spiral CT of the abdomen and pelvis.

Preoperative imaging revealed that 66 stones were opaque (78.6%) and 18 (21.4%) were lucent, 54 (64.3%) of the stones were on the right side and 30 (35.7%) on the left side. There were 42 stones (50%) located in the pelvis, 24 (28.6%) in the lower calyx, and 18 (21.4%) in the pelvis and lower calyx, either one stone or two stones. The mean stone burden was 5 ± 1.1 cm² (range 4–8 cm²) and the mean stone number was 1.3 ± 0.45 (range 1–2).

In all cases the procedure was successfully done with the patients in the supine position under high spinal subarachnoid anesthesia, and there was no conversion to open surgery. The puncture was through the lower posterior calyx in 65 patients (77.4%) and through the middle calyx in 19 patients (22.6%). There was no difficult access. Amplatz dilators were used in 74 cases (88.1%) and Alken track dilatation was used in 10 cases (11.9%). Stone delivery was used in 52 cases (61.9%) and lithoclast stone disintegration was performed in 32 cases (38.1%). The intraoperative blood loss did not necessitate blood transfusion, and the mean operative time was 46.6 ± 6.3 minutes (range 38–60 minutes) (table 2).

All patients were successfully operated on with no intraoperative complications. An antegrade double-J stent was inserted in all patients, and the track was closed by a deep mattress suture in a tubeless manner. Patients were followed-up for 15 minutes in the recovery room for pulse, blood pressure and oozing of blood from the track.

All cases developed minimal early postoperative hematuria. Postoperative fever was reported in 10 patients (11.9%) who were managed by antibiotics and antipyretics.

Ultrasoundographic assessment showed significant residual stone fragments in 7 patients (8.3%) Clavien grade 1 and perinephric collection in 4 patients (4.8%), which was mild in 3 (3.6%) Clavien grade 1 and moderate in 1 patient (1.2%) Clavien grade 1. These patients were conservatively treated by complete bed rest, antibiotics and antifibrinolytic agents with follow-up by ultrasonography and hematocrit evaluation, and one unit of blood transfusion was needed for each of these 4 patients with no need for angioembolization or open exploration. There were 2 cases of mild postoperative leakage that resolved within the first 24 hours.

The overall stone-free rate was 91.7%, the mean postoperative pain score on the day of surgery was 4.4 ± 1.2 (ranged 3–7), the mean overall hematocrit deficit was 4.8 ± 2.2 % (range 2–7%), and the mean hospital stay was 33.4 ± 17.5 hours (range 24–96 hours).

Follow-up urine analysis showed postoperative UTI in 5 patients (6%) Clavien grade 1 who were managed with antibiotics and no other major infections were seen. There was no readmission to the hospital due to postoperative problems.
Ambulatory PCNL (patients discharged 24 hours postoperatively) was accomplished in 60 patients (71.4%), while the other 24 patients (28.6%) were not amenable for discharge within 24 hours due to occurrence of postoperative complications that interfered with early discharge.

In the ambulatory patients, the double-J stents were removed 7–10 days under local anesthesia. In the non-ambulatory patients, the double-J stents were removed after the patients were subjected to auxiliary procedures for residual stones. In 2 patients the stone was lodged in the lower ureter on the double-J stent and was removed by semi-rigid ureteroscopy, in 1 case the stone was in the lower calyx and subjected to a session of PCNL 2 weeks later, and the other 4 cases were successfully subjected to extracorporeal shock wave lithotripsy 1 month later and the double-J stent was removed after 1 week.

**Discussion**

Tubeless PCNL is now accepted for a select group of patients with kidney stones. Eleven prospective randomized controlled trials clearly found tubeless PCNL to be equivalent to standard PCNL in terms of disease specific outcome and complication rate. Nine of these studies found it superior in terms of patient comfort [7].

Supine PCNL offers potential advantages including better urethral access, less handling of patients, better control of the airway during procedures, and reduced overall operative time. A surgeon comfortably seated can easily perform cystoscopy or ureteroscopy during the procedure, making it possible to carry out the surgery under spinal anesthesia, with more rapid access to the airway and less hazards especially in patients with compromised cardiopulmonary function and morbid obesity [2].

It is hoped that the present study can combine a decrease in morbidity in tubeless PCNL with the advantages of the supine position under high spinal anesthesia to decrease hospital stay by early ambulation of the patients 24 hours postoperatively (ambulatory PCNL) and hence further decrease the cost of the operation. Our study aimed to evaluate the feasibility and safety of ambulatory PCNL in patients with renal stones.

In this study, the mean operative time was 46.6 minutes which was comparable to 46.3 minutes by Al-Ba’adani et al. [8]. Singh et al. [9] performed 10 cases of ambulatory PCNL with a mean operative time of 48.4 minutes, and Alyami et al. [6] with 45.9 minutes, which was shorter than that in the studies of Shahrour et al. [5] with 83.5 minutes, Rana et al. [10] with 65 minutes and Tefekli et al. [11] with 59.6 minutes. This difference could be explained by the way each study calculated the operative time. In the present study and that of Al-Ba’adani et al. [8] it was calculated from the start of puncturing the pelvic-ocalyceal system to the end of the procedure, but in the others such as Shahrour et al. [5] and Rana et al. [10], it was calculated from the start of the operation until the end of the procedure. However, the larger stone burden in their studies played a role in prolonging the operative time.
There was no significant intraoperative complications and the tubeless technique in the supine position with antegrade insertion of double-J stent at the end of the procedure was employed in all cases.

Sixty cases were discharged from the hospital 24 hours after the procedure (ambulatory) after assurance of adequate pain control and adequate family support, while patients that could not be discharged 24 hours postoperatively (non-ambulatory), were dealt with accordingly.

To minimize or eliminate the risk of bleeding or extravasation after tubeless PCNL, hemostatic agents are used as an adjuvant in tubeless PCNL as in the study of Shah et al. [7]. In the study of Sofer et al. [12], 392 patients underwent tubeless PCNLs with no adjuvant hemostatic measures and simple closure of the tract with a parietal suture that created a closed retroperitoneal compartment, which is ideal for achieving self tamponade, and this corresponds to a clamped nephrostomy tube.

Withdrawal of the nephroscope was at the end of the procedure, as we needed to visualize the tract carefully for any bleeders that had to be cauterized and we did not use any hemostatic agents to seal the track. The tract was closed with a deep mattress suture (silk No. 1) at the end of the procedure as done by Tefekli et al. [11], but differed from that done by Shahrour et al. [5], in which the track was closed in a subcuticular fashion.

In our study, there was no intraoperative blood transfusion and this may be due to the short operative time, short time use of lithotripsy as most stones were removed intact, and direct puncturing of the pelvicalyceal system with no more than one tract, which was comparable to the studies of Shahrour et al. [5] and Al-Ba’adani et al. [8].

Four patients (4.8%) experienced a postoperative drop in hematocrit levels and required blood transfusion (when the hematocrit level dropped to 27 g%), which was found to be due to development of perinephric hematoma. In our study the mean overall decrease in hematocrit level was found to be 4.8 ± 2.2 g% which was comparable to 5.5 g% by Giusti et al. [3], however there was a larger decrease of 6.2 ± 5.1 g% in Shoma et al. [13], which could be explained by their high stone burden and no strict inclusion and exclusion criteria as in our study.

In regard of the need for postoperative blood transfusion, the present results were found to be comparable to 4% by Rana et al. [10] and 4.13% by Al-Ba’adani et al. [8], but higher (10%) in the work of Shoma et al. [13], which may be due to the large stone burden and long operative time in their studies and less (2.02%) in the study done by Giusti et al. [3].

In reviewing complications of PCNL and their prevention and management, Seitz et al. [14] found that postoperative fever in PCNL was 2.8–32.1% and attributed this big difference to many factors such as the duration of the procedure, the amount of the irrigant fluid used, the stone size (≥20 mm), the bacterial urine load, the severity of the obstruction and the presence of bacteria within the stone.

In our study, postoperative fever was 11.9% which was less than the 30% reported by Ni et al. [15] and more than that reported by Al-Ba’adani et al. [8] (3.3%) and Shah et al. [7] (6.2%).

Rana et al. [10] reported that no patients developed postoperative urinary leakage in their study of 184 patients who underwent tubeless supine PCNL, and Giusti et al. [3] also reported the same results in their study of 99 cases of tubeless PCNL with antegrade insertion of a double-J stent at the end of the procedure as in our ambulatory cases. In the present study, there were 2 cases of mild leakage that resolved spontaneously within the early postoperative hours, which was less than that of Shoma et al. [13] who reported 4% postoperative leakage.

The stone-free rate in our study was 91.7% comparable to 92% by Sofer et al. [12] and 92% by Shoma et al. [13]. However, this rate was less than in the studies of Shah et al. [7] (93.3%) and Giusti et al. [3] (95.4%) but greater than in the studies carried out by Alyami et al. [6] (89%), Al-Ba’adani et al. [8] (86.18%) and Rana et al. [10] (84%) owing to the larger stone burden and occasionally the longer operative time in their studies.

The mean pain score in this study measured by VAS was 3.85 ± 0.86 the day of surgery and 1.7 ± 0.64 the first postoperative day. This was comparable to that reported in the study done by Shoma et al. [13] 3.2 ± 1.8 and 1.6 ± 1.9. It was less than that reported of Giusti et al. [3] 3.5 on the first postoperative day, and of Singh et al. [9] at 2.4. Also, the need for analgesics was less than conventional PCNL and this was due to the nephrostomy tube and the mean analgesic requirment was 0.5 mg/kg pethedine.

In this study, the mean hospital stay was 33.4 ± 17.5 hours, comparable to Shah et al. [7] 34 hours, Tefekli et al. [11] 39 hours, Singh et al. [9] 40 hours with their patients discharged at the end of the first postoperative day, and Alyami et al. [6] 41 hours. However, it was shorter in the study by Shahrour et al. [5] 4 hours because of very strict criteria in their work, and longer in the studies by Al-Ba’adani et al. [8] 50.7 hours and Shoma et al. 65 ± 49 hours [13] who stated that tubeless procedures employing external ureteral drainage can prolong the hospital stay 1 day more than internal double-J stentig.
According to the length of the hospital stay, 71.4% of our patients could be safely discharged 24 hours postoperatively.

Alyami et al. [6] reported that 66% of their patients could be discharged after an overnight stay and concluded that an overnight hospital stay after PCNL is safe and represents an effective strategy for improved bed use in selected patients which corresponds to our study and also allows for a decrease in the hospital cost for postoperative care.

Limitations of this study included great selection of patients and stone characteristics, strict inclusion and exclusion criteria, pre-, intra- as well as post-operatively making sure that our patients in this study could be candidates for extracorporeal shock wave lithotripsy.

We recommend that performing tubeless PCNL in the supine position and under regional anesthesia in selected patients be done on an ambulatory basis to obtain good outcomes, but further studies without such strict criteria are needed.

In conclusion, PCNL on an ambulatory basis is a feasible and safe procedure under strict criteria. However, further studies in more groups of patients and stone characteristics are needed to expand our findings.

Acknowledgement

The authors are grateful to all staff members and colleagues at the Urology Department, Benha Faculty of Medicine, Benha, Egypt for their help and support.

References