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The Outcome of supine versus prone percutaneous nephrolithotomy in multiple renal stones

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ABSTRACT

Purpose: To differentiate the outcomes of percutaneous nephrolithotomy (PCNL) discharged in the prone posture versus the supine posture in multiple renal stones.

Materials and Methods:-Comparative prospective randomized study of 30 cases divided into two sectors sector A included 15 cases in the supine posture and sector B included 15 cases in the prone posture. The outcomes of a period of exposure to radiation, renal stone-free rate, body mass index (BMI), size of the stone, period of operation, hold up in the hospital, and complications were compared.

Results:-There were no differences in age, gender, site of stone, body mass index, size of the stone, and the presence of hydronephrosis between the two sectors. The supine sector had a little mean surgical period (93 minutes vs. 123 minutes, $p<0.001$), shorter mean to hold up in hospital (2 days vs. 3 days, $p=0.005$), and stone-free rate (70% vs. 50%, $p=0.271$). There were no variance in infection or bleeding complications but the prone sector had a forceful ratio of complications.

Conclusions:-In cases with multiple renal stones with a stone size of more than 2 cm, the supine PCNL has an issue to the prone PCNL concerning the operative period, holding up in a hospital with a similar rate of complications with the prone PCNL.

INTRODUCTION

Profitable moving of the first renal stones through a nephrostomy tract in 1976, percutaneous nephrolithotomy (PCNL) has enhanced the favorite technique of managing cases with sizable or complex stones (1).

The majority of urologists preferred prone posture due to knowing with the technique, more surface area for a choice of the puncture site, and a more direct approach to the kidney (2). However, the prone posture is related to different anesthetics, surgical, and procedural disbenefits(3). As a result, some different postures are increasingly being used including complete supine, modified supine, or flank posture (4-9).

The supine posture has various benefits (10-12). Due to greater alleviation, the posture has a low influence on a case's blood circulation and respiratory system. For high-risk cases, the supine posture can be modified to promote endotracheal intubation anesthesia when required.

This posture produces it easier for the anesthetist to check on the case, and it may decrease the use of anesthetics. Besides, the lesser angle between the vision and the operating channel enhances the removal of crushed stones.

This posture also helped concurrent ureteroscope access when needed, enabling the combination of PCNL and the ureteroscope in the managing of complex stone diseases.

The main drawback of the supine posture is that the kidney is more pushed forward by the puncture needle and the fascial dilators, leading to the formation of a big channel (12-14). Therefore, we differentiate the efficacy and safety of PCNL in the traditional prone and supine postures. The supine posture improved by using flexible ureteroscopy and a ureteroscope to extract ureteral and kidney stones at the same period (15).

MATERIALS AND METHODS

A comparative Prospective randomized double-blinded study was conducted on 30 cases divided into two sectors; sector A included 15 cases in a supine posture (11 males and 4 females) with the mean age of 37.5 years (range 13 to 59 years); sector B included 15 cases in a prone posture (12 males and 3 females) with the mean age of 41.27 (range 21 to 58 years). Each case will be numbered randomly by sealed (closed) envelope method either 1, 2 to issue which technique was to be used for them, case number 1 was treated by supine PCNL (Sector A), case number 2 was treated by prone PCNL (Sector B). Each case has the same opportunity to be included in both sectors. Cases were included if they had renal stones that employ the renal pelvis and one or more of the renal major calyces and if they did not have an important cardiovascular, cerebro vascular disease, or bleeding tendency. Plain film X-rays, intravenous pyelo-grams, ultrasonography, or CT plain scans were done in all cases preope-ratively.

All cases had written informed consent, The Ethics Committee at Sohag University Hospital approved this study. All cases were evaluated according to clinical and laboratory investigations.

PCNL procedure

Prophylactic antibiotic before the begining of the procedure. General anesthesia has taken. Ureteric catheter 7 Fr is inserted by the ureteroscope and the retrograde evaluation was done to determine the patency of the ureter and plan the appropriate calyx to puncture. Opacification of the renal collecting system by iodinated contrast in a retrograde fashion under fluoroscopy in a supine and prone posture, then puncture site selection (fig.1). In the prone posture, PCNL puncture was done through the posterior division of the lower or middle calyx. In the supine posture, the flank to be operated upon was raised slightly by putting a single underlying rolled towel and puncture was done at the midaxillary line and access through the anterior division of the lower or middle calyx and if possible the posterior division of the lower calyx. Once the puncture is successful apply a curved tip guidewire until reach the upper calyx of the ureter. Dilatation of the tract by Teflon dilators (acute dilatation by 26 French). Acute dilatetion is defined as one-shot dilatation of 24 or 26 Fr (Tufan S., et al 2016). Adult nephroscope 22 Fr (sheathes Wolf nephronscope) and pneumatic disintegrator were used for all cases.

Nephrostomy tube and ureteric catheter were inserted. A ureteric catheter was put back by Double J stent in cases of pelvicalyceal system (PCS) perforation, residual stones, bilateral renal stones, or impacted pelvic stones.


Fig.1-supine position for percutaneous nephrolithotomy.

Follow up procedure

Cases were followed up for three months by CBC, PUT, abdominal Ultrasound, and CTU if there were radiolucent stones or ureteral stones in the first and third months.

Complications were categorized according to the Clavien–Dindo classification system.

Statistical analysis

Statistics were analyzed using SPSS inter-coded version 16.0 Quantitative data were represented as mean, standard deviation, and range. Statistics were analyzed using an independent T-test to compare data between supine and prone cases. Graphics were produced by using Excel or SPSS program. P-value was perceived substantial if it was less than 0.05

RESULTS

The sample size is small and this may impose difficulties in the extraction of significant differences between the two sectors.

The study sector included 30 cases divided into two sectors; sector A included 15 cases in a supine posture (11 males and 4 females) with the mean age of 37.5 years (range 13 to 59 years) sector B included 15 cases in a prone posture (12 males and 3 females) with the mean age of 41.27 (range 21 to 58 years) **Table (1)**

Regarding stone criteria; Stones were radio-opaque in 12 cases (80%) and radiolucent in 3 cases (20%) of the supine posture. Stones were radio-opaque in 11 cases (73.3%) and radiolucent in 4 cases (26.6%) of the prone posture. Low stone density (< 1000 Hounsfield Unit) was in 8 cases (53.3%) and high stone density (> 1000 Hounsfield Unit) was in 7 cases (46.6%) of the supine posture. In the prone posture, it was low stone density in 7 cases (46.6%) and high stone density in 8 cases (53.3%). Renal stones were on the right side in 10 cases (66.6%) and on the left side in 3 cases (33.3%) in a supine posture while in prone posture renal stones were on the right side in 8 (53%), and on the left side in 7 cases (46%) **Table (2)**

The Mean stone size was 1.7 cm which 12 cases in GSS2 and 3 cases in GSS3 in a supine posture while prone posture the mean stone size was 1.85 cm which 11 cases in GSS2 and 4 cases in GSS3. Cases with nil to mild hydronephrosis were 9 cases (60%), 2 cases (13.3%) with moderate to severe hydronephrosis while calyceal dilation were 4 cases (26.6%) in a supine posture. Cases with nil to mild hydronephrosis were 10 cases (66.6%), 3 cases (20%) with moderate to severe hydronephrosis while calyceal dilation were 2 cases (13.3%) in a prone posture. The Lower calyceal puncture was done in 8 cases (53.3%), a middle calyceal puncture in 3 cases (20%), and combined lower and middle calyceal punctures in 3 cases (20%) in a supine posture. The Lower calyceal puncture was done in 12 cases (80%), an upper calyceal puncture in 2 cases (13.3%), and combined lower and upper calyceal punctures in 2 cases (13.3%) in a prone posture.

In our study, we did acute dilatation in all cases (100%) which was due to a reduction in the operative period, and radiation exposure. The ureteric catheter was used as a ureteric stent in 11 cases (73.3%) and double J stent in 4 cases (26.6%) due to bilateral multiple stones in both kidneys in the supine posture the ureteric catheter was used as a ureteric stent in 12 cases (80%) and double J stent in 3 cases (20%) due to perforation in the pelvicalyceal system in a prone posture ureteric catheters were removed after 24 hours except in 1 case (6.6%) in whom catheters were removed after 48 hours due to suspicion of small perforation in the pelvicalyceal system in a supine posture while in a prone posture ureteric catheter was removed after 24 hours except in 5 cases (33.3%) due to residual of stone in 3 cases (20%) for 2nd look PCNL and 2 cases of perforation in the pelvicalyceal system.

Nephrostomy tubes were removed after 24 hours except in 3 cases (20%) in 5 days due to 2nd look PCNL in a prone posture. The mean operative period was 17+-(7.97) minutes (range: 10 to 30). In supine posture, then the stone-free rate was achieved in 11 cases (73.3 %) of cases, while residual stones were detected in 4 cases (26, 6%); all of them were less than 10 mm. Two cases were upper calyceal stone which was difficult to remove and the other two cases had small calyceal stones. However, in a prone posture, there was no residual in upper calyx which easies to remove. Stone free rate was achieved in 7 cases (46.6%); eight patients residual stones were detected (53.3%) three of them were done 2nd look PCNL. One ICU admission and four cases there is residual in lower calyx for ESWL.

In the study, 9 (60%) cases had complications which were intraoperative complications 1 case (6.7%) in supine posture and 3 cases (20%) in prone posture. As regards early complications, it was 1 case (6.7%) in supine posture and 1 case (6.7%) in prone posture. Besides, late complications requiring intervention occurred in 2 cases (13.3%) in supine posture in which one required DJ insertion as the case was anuric and serum creatinine was 2 mg/dL. However, in a prone posture, it happened in 1 case (6.7%) as he needed ICU admission. Intraoperative complications were reported in 1 case (6.7%) in a supine pos-ture which is intraoperative bleeding which requiring one unit of blood.

However, in a prone posture in which 3 cases (20%) two of them were pleural injury, they were needed ICU admission and intrathoracic tube, the other was an intraoperative collection for follow up. Fever was encountered in one case (6.66 %); fever was controlled by antipyretic and antibiotics. **table (3)**. In our study, the operating period was shorter in the supine sector than the prone sector. The mean period in the supine sector was 17±7.97 min and in the prone sector was 33.6±9.34 min with p-value = 0.01 with a highly significant difference.

In this study, the mean hospital stay in the supine sector was 2.33±1.05 with a range of 2-4 days and in the prone sector was 5.4±1.03 with a range of 2-10 days. There is a statistically significant difference with p-value = 0.012 Stated that the supine sector (2days) stayed on average a day shorter in hospital than the prone sector (3 days). With the highly significant difference with p value=0.005.

Our study showed that the percentage of hemoglobin drop was 6.7 % in the prone posture and 6.7% in the supine posture. In the supine sector, one case compared to one case in the prone sector required

blood transfusion with a p-value 1.0. There was no significant difference.

In our study 3 cases (20%) required a 2nd look PCNL in the prone posture one due to failure to reach the upper calyx, the second case due to severe bleeding and the last was decreased level of oxygen saturation. Two cases (13.3%) in the supine posture required 2nd look PCNL stones due to failure to reach the upper calyx these cases needed a combined flexible ureteroscopy.

No cases have experienced fever or urinary leakage in either sector. There were no major complications in either sector. There was no statistically significant difference regarding complications.

In our study residual stones, more than 10 mm were 20% (3 cases) in the supine sector and 47% (7 cases) in the prone sector with no significant difference p=0,271 between the two sectors. There is a high prevalence in the stone-free rate for the supine posture than for the prone (70% supine vs. 50% prone, p=0.005). All cases were completed endo-urologically. There was no conversion to open surgery.

Variables	Frequency and percentage Number (15) of the supine position	Frequency and percentage Number (15) of the prone position
Age (years): Mean ± SD Median (Range)	37.53 ± 0.428 8.8 (13 – 59)	41.27±0.428 (21-58)
Gender : Male Female	 11(73%) 4 (26%)	 12 (80%) 3 (20%
Previous surgical intervention : No Yes	 11(73%) 4 (26%)	 8(53%) 7(46%)

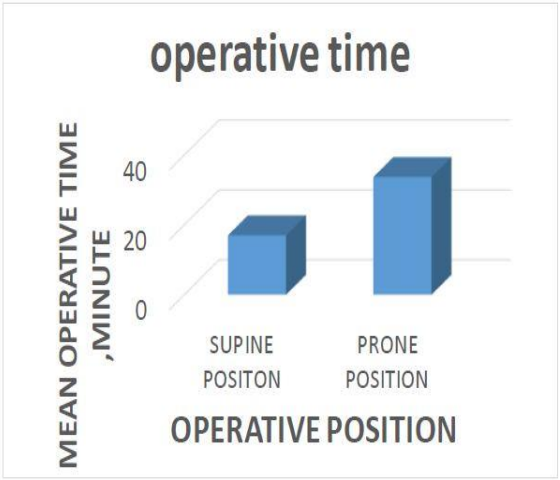
Table (1): Patients demographic data

Variables	**Frequency and percentage number (15) of the supine position**	**Frequency and percentage number (15) of prone position**
Laterality: Right side **Left side**	**10 (66.6%)** **5 (33.3%)**	**8 (53%)** **7(46%)**
Opacity : Radio-opaque **Radiolucent**	**12 (80%)** **3 (20%)**	**11 (73.3%)** **4 (26.6%)**
Stone size in cm: **Mean± SD** **Median (Range)**	 **1.75 ± 0.854** **2 (0.5 -3.5)**	 **1.85 ± 0.866** **2 (0.8 -2.5)**
Degree of hydronephrosis: **Nil to mild** **Moderate to severe** **Caleceal dilatation**	 **9** **2** **4**	 **10** **3** **2**
Guy's Scoring System : **GSS2 andGSS3**	 **12,3respectively**	 **11,4respectively**
Stone hardness (HFU): **≤ 1000 HFU** **> 1000 HFU**	 **8** **7**	 **7** **8**

Table (2): Stone characteristics

	Sector A (Supine;n=15)	Sector B (Prone;n=15)	P-Value
Mean operating room period, min (range)	**17+- (7.97)(10-30)**	**33.6+- (9.43)(20-45)**	**.001**
Stone-free rate, %	**11(73.3%)**	**8(53.3%)**	**.271**
Residual Rate	**2.33(2-4%)**	**5.4**	**.271**
Mean hospital stay, d (range)	**11(73.3%)**	**11(73.3%)**	**.012**
Blood Transfusion, NO of cases	**1(6.7%)**	**1(6.7%)**	**1.0**
Intra operative complications, no. of cases	**1(6.7%)**	**3(20%)**	**.299**
Early post operative complications, no. of cases	**1(6.7%)**	**1(6.7%)**	**1.0**
Post operative complications, no. of cases	**2(13.3%)**	**1(6.7%)**	**.559**

Table (3): Intraoperative and postoperative data:



DISCUSSION:

PCNL is currently a common treating kidney stone. It is safe and easy by various techniques. Clinical Research Office of the Endourology Society (CROES) PCNL global study and a rece-nt meta-analysis by Yuan and colleagues published data about the better stone-free rate of prone PCNL. They have stated some benefits of the supine posture. However, they mentioned that the technique should be personalized for each case. Until now, there has been no consensus on the best posture**.**

As pointed out by Jones et al, performed on 236 cases. The supine sector was 160 cases. The types of stones were multiple stones (49 cases), staghorn stones (17 cases), and stones more than 2 cm (94 cases). While the prone sector was 76 cases, the types of stones were multiple stones (18 cases) and staghorn stones (15 cases), and stones more than 2 cm (43 cases). We Found a shorter operative period in the supine sector compared with the prone sector. Also, familiarity with the technique achieved in the supine posture may impress the success and efficiency of the operation. The mean period difference in the supine sector was 93±45.5 min and in the prone sector was 123±49.5 min with a p-value <0.01. This agrees with our study repositioning of the case takes a long period in prone posture rather than in a

supine posture. There was a significantly higher rate of overall complications seen in the prone sector compared with the supine sector. In the prone sector, major complications (haemothorax) occurred which required drainage (16).

As the point of Sohil et al demonstrated a significant reduction in the operation period in the supine sector with P-value 0.001. The mean period for the supine sector was 98 min. The mean period for the prone sector was 130 min. This agrees with our study demonstrated a significant difference regarding the hospital stay, which has a mean (SD) of 1.2 (0.75) days shorter in the supine sector 2.7 (2-5 days) vs the prone sector 3.9 (2-8 days) ($P < 0.001$). This agrees with our study that demonstrating a 79.2 % stone-free rate in the prone sector and an 85 % stone-free rate in the supine sector with no significant difference between the two sectors. This agrees with our study according to the percentage of hemoglobin drop was 2.9 % in the prone sector and no record of hemoglobin drop in the supine sector demonstrating that in the prone sector, 14 (13.9%) cases had a persistent urine leakage, and one case (1%) had a fever >38°C. Whilst in the supine sector, five (5.2%) cases had persistent urinary leakage and two cases (2.1%) had a fever of >38°C. There were no severe complications, e.g. arteriovenous fistula, pneumothorax adjacent, visceral injury, or death in either sector. There was no statistically significant difference and this was in agreement with our study (17).

Wang et al found that the operation period was much shorter in the prone than in the modified supine posture sector. The mean period was 78 min in the prone sector vs 88 min in the supine sector with p-value 0.03. This may be due to the steep learning curve with the supine posture which leads to a longer period in the supine sector. This was in disagreement with our study. Demonstrating a hemoglobin drop in the prone sector 2.2% and the supine sector 2.4% with p-value =0.23, with a statistically insignificant difference. This agrees with our study(18).

However, the sample size is small and this may impose difficulties in the extraction of significant differences between the two sectors. Also, the study is not powered. In future studies, large samples of cases are needed to prove or disprove our results.

CONCLUSIONS

In cases with multiple renal stones with a stone size of more than 2 cm, supine PCNL has proved to be superior to prone PCNL as regard operative period and hospital stay with a comparable rate of complications with prone PCNL. However, surgeons must be familiar with that posture to avoid serious complications that may occur. Finally, more studies are needed with a larger population to evaluate which posture is better in the treatment of large renal stones. In the supine posture, there is more difficult to remove the upper calyceal stone which requires 2nd look prone PCNL or combined supine with flexible ureteroscopy.

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