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ORIGINAL ARTICLE

Free-flank modified supine vs. prone position in percutaneous nephrolithotomy: A prospective randomised trial

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Stones;
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ABBREVIATIONS

FFMSP, free-flank modified supine posi-

Abstract ***Objective:*** To compare the technical aspects, operative time, safety and effectiveness of percutaneous nephrolithotomy (PCNL) in the free-flank modified supine position (FFMSP) vs. the standard prone position (SPP).

Patients and methods: Seventy-seven patients (47 men and 30 women) with renal stones were enrolled and systematically randomised into two groups, A (39 patients) treated using the FFMSP, and B (38 patients) in the SPP. The outcome was considered as a cure (successful procedure) if the patient became stone-free or had residual fragments of <4 mm in diameter. The operative time (from the induction of anaesthesia to the removal of the endotracheal tube) was measured and any operative complications or conflicts were recorded. The different variables were compared and analysed between the groups.

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tion; SPP, standard prone position; PCNL, percutaneous nephrolithotomy; BMI, body mass index

Results: Patients in both groups had comparable preoperative clinical data and there were no significant differences in the preoperative clinical characteristics. The procedure was successful in 84.6% and 84% of group A and B, respectively. The operative time was significantly longer in group B (SPP) than A (FFMSP). There was no significant difference between the groups in fluoroscopy time and patients' outcome.

Conclusions: The FFMSP (with a cushion under the ipsilateral shoulder) has similar efficacy and safety as the SPP for PCNL and is associated with a significantly quicker operation.

Introduction

The treatment of renal stones has changed dramatically over the past few years. In 1981, Alken et al. [1] popularised percutaneous nephrolithotomy (PCNL), which has a high success rate, and since then PCNL has been widely accepted. PCNL is usually done with the patient lying prone [2]. Many drawbacks of this position have been described by several authors [3–6], including a prolonged operative time due to positional changes, adverse effects on ventilation and blood circulation, especially in obese patients, and exposure of the surgical team to radiation. These difficulties encouraged many urologists to try other positions for PCNL [7–10]. The supine position was popularised in 1998 by Valdivia Uria et al. [9]. They found that the colon tends to rise away from the kidney when the patient is supine, which makes the colon less likely to be injured. They described many merits of the supine position, including ease of patient positioning, being more comfortable for the patient, a dependant Amplatz sheath, and easy control of the airways. The supine position has mechanical limitations. Desoky et al. [11] described the free-flank modified supine position (FFMSP) and assumed that this position overcomes the mechanical limitation by providing ample space for PCNL. In the present study we compared PCNL in both the FFMSP and the standard prone position (SPP) for the technical aspects, safety, stone-free rate, operative time, X-ray exposure, complications, and the need for a second PCNL and/or ESWL.

Patients and methods

This prospective randomised comparative study was conducted in the Urology Department of Zagazig University hospitals, from October 2008 to March 2010. An informed consent was obtained from all patients who participated. The study design was approved by the ethics committee of our hospital.

The sample size for the study was calculated using Epi Info 6 version 6.04d software (WHO, Geneva) and a difference in operative time of 25% between the groups was considered as clinical equivalence, with a confidence of 95%, power of 80%, and odds ratio 4.5, using the data from De Sio et al. [6]. The sample size analysis showed that at least 36 patients were required for each group; thus 77 patients (47 men and 30 women) with renal stones were enrolled and systematically randomised into two groups (one patient was allocated to one treatment arm and the next to the other, the patients being unaware of the selection).

Group A (FFMSP) included 39 patients and group B (SPP) included 38. Included were patients with an indication for PCNL and who had no contraindications for an operation in the prone position. Excluded were patients with intrarenal anomalies, uncorrectable bleeding disorders, a body mass index (BMI) of >40 kg/m^2, and pregnancy. The preoperative evaluation included a thorough medical history, physical examination, laboratory investigations (urine analysis, urine culture/sensitivity, complete blood count, coagulation profile, blood urea nitrogen and serum creatinine) and radiological investigations (plain abdominal film, abdominal ultrasonography, IVU and non-contrast spiral CT for radiolucent stones). If the urine culture was positive an appropriate antibiotic was prescribed for 1 week and the urine culture repeated to verify urinary sterility before the intervention. Informed consent was signed by all enrolled patients.

Operative technique

With the patient supine, cystoscopy was performed and a 6 F open-tip ureteric catheter was introduced and fixed with plaster tape to the indwelling Foley catheter. In group A the patients were placed in the FFMSP by putting a suitable cushion (a 3-L water bag, or less according to body mass) under the ipsilateral shoulder, having the ipsilateral arm bent over the thorax, and extending and crossing the patient's ipsilateral leg over the flexed contralateral leg (Fig. 1). This modification increased the distance between the last rib and iliac crest, and moving the cushion from under the flank (as in the original Valdivia position) to under the shoulder provided ample free flank space for the puncture, dilatation and manipulation of the stone. This manoeuvre also allowed easy access to the posterior calyx. In group B, the patients

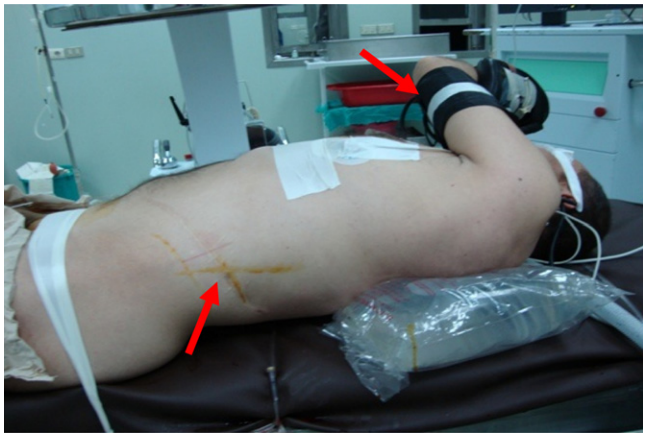

Figure 1 (A, B) A patient in the FFMSP, with a water bag under his ipsilateral shoulder and his arm over the thorax.

were turned prone (SPP) and renal access was achieved under fluoroscopic guidance through the posterior axillary line.

Coaxial dilators of the Alken type were used for tract dilatation. A 30 F Amplatz sheath was positioned, allowing the introduction of a 26 F nephroscope. A pneumatic lithotripsy device was used to fragment the stone. Fragments were retrieved through the Amplatz sheath. At the end of the procedure, an 18–22 F nephrostomy catheter was inserted.

Outcome

At 2 days after surgery the patients were assessed with ultrasonography, a plain abdominal film and antegrade pyelography, to evaluate residual fragments and ureteric patency. The nephrostomy tube was removed 2–3 days after PCNL. Prophylactic parenteral broad-spectrum antibiotics were continued until all tubes were removed. The patients were considered 'cured' (a successful procedure) if they became stone-free or had asymptomatic residual fragments of <4 mm in diameter. Patients with residual stones were scheduled for either a second PCNL (7 days after the initial procedure) or ESWL. The operative time (from the induction of anaesthesia to the removal of endotracheal tube) was measured and any operative complications or conflicts were recorded.

Data were analysed using Student's *t*-test to compare means, with $P < 0.05$ considered to indicate a significant difference.

Results

Patients in both groups had comparable preoperative clinical data and there was no significant difference in clinical characteristics between the groups for patient gender, age, BMI, history of previous ipsilateral renal surgery, ESWL for ipsilateral renal stones, stone location, and stone burden (Table 1). The procedure was successful for all patients in both groups. A second PCNL was needed in four patients in group A and five in group B. After surgery ESWL was applied to two patients in group A and one in group B. The operative time was significantly longer in group B than group A ($P = 0.001$). There was no significant difference between the groups in fluoroscopy time and patient outcome (Table 1). One patient had a urine leakage (>1 week) in group A that necessitated a JJ stent, as did two in group B; Table 1 also summarises the postoperative complications in both groups.

Table 1 The patients' demographics and clinical characteristics, operative data, outcome and complications.

Variable	Group A	Group B	*P*
N patients	39	38	
Male/female	24/15	23/15	0.92
Mean (SD)			
Age (years)	40.8 (10.5)	44.2 (10.4)	0.16
BMI (kg/m^2)	28.8 (4.7)	29.2 (3.8)	0.73
History of ipsilateral renal surgery (n)	19	15	0.29
ESWL for renal stone (n)	5	6	0.75
Stone side, R/L (n)	17/22	20/18	0.43
Stone location (n)			0.79
Pelvis	15	12	
Calyces	7	10	
Both	17	16	
Mean (SD)			
Stone diameter (cm)	3.4 (0.7)	3.4 (0.8)	0.9
Stone opacity (n)			
Radio-opaque/radiolucent	29/10	31/7	0.71
Operative data and outcome			
Mean (SD)			
Fluoroscopy time (min)	6.5 (1.7)	6.5 (2)	0.88
Operative time (min)	88 (16)	104 (25)	0.001
Successful, n (%)	33 (84.6)	32(84)	0.74
Second PCNL (n)	4	5	
Postoperative ESWL (n)	2	1	
Complications			
Blood transfusion	1	1	0.67
Urine leakage	1	2	0.98
Fever (>38 °C)	5	4	0.59
Colonic injury	None	None	

Discussion

For decades endourologists had placed patients prone during PCNL because they tried to avoid colonic injury, until Valdivia Uria et al. [9], in their study of 557 patients, popularised PCNL with the patient supine. They showed that there was no damage to colon, as it moves away from the kidney when the patient is supine rather than prone. The supine position has several advantages, i.e. free ventilation and less time needed to turn the patient after inducing anaesthesia. Our modification (FFMSP) of the position has the same advantages of decreasing the operative time and avoiding the mechanical limitations of the supine position.

Several authors [6,9,11,12] favour the supine position as far as recommending that it replaces the SPP. Despite these reports, the supine position has not become popular, which might be attributed to the limited freedom in manipulating the access and the stone with a 3-L water bag under the flank, as described by Valdivia Uria et al. [9]. However, we modified the position by putting a suitable cushion (a 3-L water bag or less, according to body mass) under the ipsilateral shoulder instead of under the flank, and extending the ipsilateral leg over the flexed contralateral leg. This modification increases the distance between the last rib and iliac crest, which together with having no cushion under the flank provides ample space for puncture, dilatation and stone manipulation.

We became accustomed to doing PCNL using the SPP for several years, then started to use the FFMSP over the last few years, and then planned the present randomised comparative study. We accessed the kidney through the posterior axillary line, as described by Valdivia Uria et al. [9]. This is in contrast to Ng et al. [12], who accessed the kidney through the anterior axillary line, and in that study the nephrostomy tract was created by radiologists. In both positions we preferred to access the kidney through the posterior calyx, while Valdivia Uria et al. [9] gained access through the anterior calyx. We assume that the cushion under the flank, as described by Valdivia Uria et al. [9], makes it technically difficult to access the posterior calyx. Placing the cushion under the shoulder provides ample free space under the flank, so the posterior calyx is accessed easily. Also, we preferred to access the kidney through the lower calyx in both the SPP and FMMSP because it is safer in terms of thoracic complications, and we could reach the upper calyx easily. Nevertheless, the middle and upper calyces could be accessed when necessary. In the series of Neto et al. [13], the upper calyx was accessed in 5.7% of their patients. One of the disadvantages of the FMMSP is that it does not allow simultaneous retrograde access to the urinary tract, by contrast with the modified supine position of Ibarluzea et al. [10].

In the present study the success rate for PCNL was high in both groups (84.6% and 84% for group A and B, respectively, $P = 0.74$). De Sio et al. [6] and Shoma et al. [14] reported a stone-free rate close to 90%, with no statistically significant difference between the prone and supine positions. Manohar et al. [15] reported a stone-free rate of 95% by initial PCNL with or without ureteroscopy. Neto et al. [13] reported a stone-free rate of 70.5% in their series of 88 patients. Thus in the present study the stone-free rate is similar to those reported by others, and there was no significant difference between the groups in patient outcome, complications and stone-free rate [15,16].

Only the operative time was statistically significantly different ($P < 0.001$). This is in accordance with the findings of many urologists [6,9,11,12,17], and it reflects the time lost when turning the patient at the beginning and the end of the procedure in group B. This position also does not allow simultaneous antegrade and retrograde endourological access [18].

In conclusion, the FFMSP, with a suitable cushion under the ipsilateral shoulder, has a similar efficacy and safety to the SPP for PCNL and offers a significantly quicker operation. Further studies are needed to confirm the anaesthesiological advantages of the FMMSP.

Conflict of interest

No conflict of interest.

Source of funding

None.

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