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Triggers of Blood Transfusion in Percutaneous Nephrolithotomy

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ABSTRACT

Objective: To determine the triggers of blood transfusion in patients undergoing percutaneous nephrolithotomy (PCNL).

Study Design: Observational study.

Place and Duration of Study: The Aga Khan University Hospital, Karachi, from 1988 to 2007.

Methodology: The percutaneous surgery database was retrospectively reviewed to identify patients with postoperative haemorrhage and need for blood transfusion. Blood loss was estimated by the postoperative drop in haemoglobin factored by the quantity of any blood transfusion. Various patients and procedure-related factors were assessed for association with total blood loss or blood transfusion requirement using stepwise univariate, forward multivariate regression analysis.

Results: A total of 326 procedures were performed in 316 patients. Two hundred and thirty two procedures were included in the study. There were 167 males and 65 females. The mean age was 41 ± 14 years. The mean haemoglobin drop was 1.68 ± 1.3 gm/dL. The overall blood transfusion rate was 14.2%. Stepwise multivariate regression analysis showed that female gender ($p = 0.003$), staghorn stone ($p = 0.023$), stone fragmentation with ultrasound ($p = 0.054$) and chronic renal failure ($p = 0.001$) were significantly predictive of the need for blood transfusion.

Conclusion: Chronic renal failure, female gender, presence of staghorn calculi and stone fragmentation using ultrasonic device were predictive of blood transfusion in this cohort of patients.

Key words: *Percutaneous nephrolithotomy. Blood transfusion. Staghorn stone. Stone fragmentation. Nephrolithiasis.*

INTRODUCTION

The risk of transfusion related diseases in the post-operative period remains a critical issue. It is an assumption that the open surgery for renal calculi is associated with a greater blood loss and consequently higher transfusion rate. PCNL as monotherapy, sandwich therapy or with adjuvant treatment modalities, is an accepted minimally invasive surgical treatment for renal calculi.¹ Blood loss during PCNL is assumed to be less as compared to open surgery. The procedure entails access and manipulation through the pelvicalyceal system with potentials for trauma to the segmental and interlobar renal vessels and thus results in haemorrhage.² The kidneys are highly vascular organs and are supplied by 20% of the cardiac output. The stones could be infected, the renal function compromised and large stone bulk could prolong the operative time and consequently blood loss. Although technological refinements and increased surgical experience have ensured the procedure's successful execution, complications including; bleeding, collecting system injuries, adjacent structure injuries, intraoperative technical complications, hypothermia, fluid overload, sepsis, stricture formation, nephrocutaneous fistula, kidney loss, and even mortality,

can still occur.^{3,4} Renal haemorrhage is one of the most common and worrisome complications of percutaneous renal surgery.^{5,6} Although most bleeding associated with PCNL can be managed conservatively, approximately 0.8-1% of patients require angioembolization to control intractable bleeding.^{7,8}

The aim of this study was to evaluate the blood loss and the effect of some variables as possible triggers for blood transfusion in patients undergoing PCNL.

METHODOLOGY

From January 1988 to May 2007, 316 patients underwent percutaneous renal surgery at The Aga Khan University Hospital, Karachi, Pakistan. The percutaneous surgery database was retrospectively reviewed to identify patients with postoperative haemorrhage and need for blood transfusion. Patients who had missing data and scanned files were excluded from the study.

The details of demographics and clinical data were retrieved. A plain X-ray of kidney, ureters and bladder (KUB), ultrasound or intravenous urography (IVU)/ unenhanced helical computed tomography (CT) of the KUB were performed to image the stones. Serum creatinine and urine culture was performed on all patients. Prior urinary tract infection was analyzed as a factor contributing to the need for blood transfusion. All patients with urinary tract infection received full therapy of antibiotics and demonstrated no bacterial growth pre-operatively. Stone burden was calculated in cm^2 by the product of longest dimension and the one perpendicular to it.⁹

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Haemoglobin and hematocrit were done pre-operatively and in the postoperative period. Considering the approximation that 1 unit of blood transfused, increases the haemoglobin level by, about 1.0 gm%, taking into account the number of units transfused, the total blood loss was calculated using the formula:

$$(\text{Preoperative blood Hb} - \text{postoperative Hb}) + (\text{number of units transfused} \times 1 \text{ g/dL per unit transfused}).^{9,10}$$

All percutaneous punctures were performed by the Urologists under fluoroscopic guidance. A ureteric catheter was introduced in the upper pole calyx at an initial cystoscopy to delineate the system. The approach to the calyx depended on the stone bulk and location. The tracts were dilated using Alken dilators in all cases. The size of the Amplatz sheath used depended on the pelvicalyceal anatomy, stone bulk and approach.

The stones were fragmented using either Pneumatic lithotripsy (Swiss lithoclast, EMSTTM), ultrasonic lithotripter (Richard WolfTM, Germany) or both. The operative time was defined as time from percutaneous puncture of calyx to placement of nephrostomy at the conclusion of procedure.

All patients had a 24 Fr postoperative nephrostomy tube insertion at the end of the operation which was subsequently removed in 24-48 hours postoperatively.

The data were analyzed by SPSS Version 16.0 and Chi-square tests was applied to determine the statistical significance and need for transfusion with the following variables: age, gender, Diabetes, hypertension, chronic renal failure, ischemic heart failure, pre-operative haemoglobin, serum creatinine, stone burden, urinary infection, operative time, stone fragmentation, size of Amplatz, number of punctures and Calyx of puncture. Stepwise multivariate regression analysis was done to correlate with need for blood transfusion. P-value < 0.05 was considered statistically significant.

RESULTS

A total of 326 procedures were performed in 316 patients. After exclusion of 94 patients on the basis of missing data, 232 procedures were included in the study. There were 167 males and 65 females. The mean age was 41±14 years. Nine patients underwent bilateral PCNL. Ninety six percent of patients underwent the procedure with a single puncture. The most common route of access was lower pole calyx (84%), 14% of patients had middle polar puncture and 2% had upper polar puncture. Twenty eight French (28 Fr.) Amplatz sheath was used in 52.6% of patients, 26 Fr. in 32.3% and 30 Fr. in 15.1% of patients. The mean stone area was 6.1 ± 4.5 cm², whereas 22% of patients had partial staghorn stone, 14.2% complete staghorn stone and rest had multiple stones (63.8%). The mean operative time was 126 ± 48 minutes. Lithoclast was used as

stone fragmentation device in 56% and both ultrasound and lithoclast were used in 44% of patients.

The mean ±SD haemoglobin drop for all the procedures was 1.68 ±1.3 gm/dL.

The mean pre-operative haemoglobin concentration in males was 13.86 gm/dl (range: 8.70-16.90) and in females it was 11.65 gm/dl (range: 8.1-14.0).

Female gender (p=0.0001), pre-operative haemoglobin (p=0.002), chronic renal failure (p=0.0001), staghorn stone (p=0.0001), stone fragmentation with ultrasound (p=0.0001) and operative time (p=0.0001) were significant predictors of blood loss on univariate analysis.

Multivariate logistic regression analysis revealed that female gender (p=0.003), staghorn stone (p=0.023), stone fragmentation with ultrasound (p=0.054) and chronic renal failure (p=0.0001) were predictive of blood transfusion (Table I).

Table I: Factors predictive of need for transfusion in a multivariate logistic regression analysis.

Factors	Confidence interval	(p-value)
Gender (female)	1.799 - 9.577	.003
Staghorn stone	1.165 - 7.553	.023
Stone fragmentation (using ultrasonic and pneumatic lithotripsy)	0.679 - 2.681	.054
CRF	0.000 - 17.731	< 0.0001

Age, hypertension, presence of urinary infection, Diabetes mellitus, calyx of puncture, tract size, size of Amplatz, multiple puncture, serum creatinine, ischemic heart disease, did not correlate with bleeding. Of the technical factors, the experience of the operating endourologist, the calyx of access, number of attempts required for a successful puncture, and return of haemorrhagic urine from the puncture needle did not correlate with the degree of bleeding. Overall blood transfusion rate for all patients who underwent percutaneous nephrolithotomy was 14.2%. The trans-fusion rate was 27.7% in females and 9% in males (p=0.001).

DISCUSSION

Significant bleeding is an uncommon but dreadful complication of PCNL. The incidence of significant haemorrhage requiring blood transfusion after PCNL had been variably reported between 2-45%.¹¹⁻¹⁶ Commonly known factors that cause bleeding after PCNL include multiple punctures, hypertension, diabetes, presence of chronic renal failure, prolongation of operation, number of tracts, stone type. Factors which are associated with less bleeding include atrophic parenchyma, previous surgery, previous nephrostomy tube placement and tract dilatation with balloon dilatation. The largest series looking at variables affecting haemorrhage has revealed stone size as the single most important factor predicting bleeding after surgery requiring transfusion and intervention.¹² The

incidence of blood transfusion was 12.3% but significant haemorrhage requiring intervention and need for percutaneous embolization was 1.4%.¹⁷ Two studies from Pakistan have reported the overall blood transfusion rate of 6.8% and 4% respectively. They however, have not addressed the issue of the factors triggering blood transfusion in their patients.^{18,19} In these patients the blood transfusion rate was 14.2%. In the current series only one patient required angioembolization for control of haemorrhage.

In the current work, in female population, the transfusion rate was 18.7% higher as compared to males. Female gender has not been found to be a significant factor in any of the other studies. One explanation could be the low pre-operative haemoglobin in our female patient population, which consequently affect the trigger for transfusion.

The stone size and the presence of staghorn stones is considered to be an important risk factor for transfusion. The reason suggested is that larger stone burden requires prolonged maneuvering within the pelvicalyceal system which in turn leads to increased incidence of injury to the parenchyma.^{20,21} Thirty six percent of these patients had either partial or complete staghorn stones. This may account for the slightly higher transfusion rate in the current series. Similar results shown by Turna *et al.*, that staghorn stones, the presence of diabetes, the use of multiple tracts, and large stones were associated with increased bleeding during PCNL on multivariate analysis.²²

Surgical expertise is expected to be a relevant factor but in this study, 91% of the procedures were performed by two surgeons who had done a minimum of 70 procedures therefore, this variable was not evaluated.

Majority of the patients were treated with a single and lower polar puncture. These factors are therefore not significant in this analysis. Nine patients, treated by two punctures, did not require a blood transfusion.

The limitations of this study, in addition to being retrospective study design, include the lack of inclusion of cortical width as a study variable. However, since unenhanced single-slice CT was used as an imaging modality in a number of patients, accurate measurement of the cortical thickness was not considered reliable with this modality.

The presence of renal insufficiency was a risk factor for transfusion in our group. There is a general tendency of bleeding in patients with renal failure, the cause of which has been reported as decreased platelet aggregation,²³ and low levels of the Von Willibrand factor. Though this was a significant risk factor in our patients, this has not been consistently found to cause increased risk for bleeding after PCNL in the studies quoted earlier.

CONCLUSION

The transfusion rate in this group of patients is 14.2%. Multivariate analysis identified chronic renal failure, female gender, the presence of staghorn calculi and stone fragmentation using ultrasonic device as predictive of blood transfusion. Other factors such as age, hypertension, previously treated urinary tract infection, Diabetes mellitus, ischemic heart disease, size of the Amplatz, multiple punctures, were not significant and did not correlate with bleeding.

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