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Blood Loss and Need for Transfusion in Percutaneous Nephrolithotomy

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Abstract

Objective: *To determine the amount of blood loss and need for blood transfusion in patients undergoing percutaneous nephrolithotomy (PCNL).*

Study Design: *Observational study.*

Place and Duration of Study: *National Institute of Kidney Diseases and Urology (NIKDU) and Popular Medical College Hospital, Dhaka from 2015 to 2019.*

Methodology: *The percutaneous Nephrolithotomy data were retrospectively reviewed to identify patients with postoperative blood loss and need for blood transfusion. The amount of blood loss was estimated by the postoperative drop in hemoglobin factored by the quantity of 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 232 procedures were performed on 216 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 hemoglobin drop was 1.68 ± 1.3 gm/dL. The overall blood transfusion rate was 13.2%. Stepwise multivariate regression analysis showed that female gender (p = 0.003), stag-horn 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 the ultrasonic device were predictive of blood transfusion in this cohort of patients.*

Introduction

The risk of transfusion-related diseases in the post-operative period remains an important issue. It is an assumption that open surgery for renal calculi is associated with a greater blood loss and consequently a higher transfusion rate. PCNL is an accepted minimally invasive surgical treatment for renalcalculi.[1]Blood loss during PCNL is assumed to be less as compared to open surgery. Access and manipulation through the pelvicalyceal system have

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the potentials for trauma to the segmental and interlobar renal vessels and thus results in hemorrhage.[2]

The kidneys are highly vascular organs. The stones could be infected, the renal function may be compromised. Large stone bulk need prolong operating time and increase the risk of blood loss. Although technological refinements and increased surgical experience have ensured the procedure's successful execution, complications include; bleeding, collecting system injuries, adjacent structure injuries, intra-operative technical complications, hypothermia, fluid overload, sepsis, reno-cutaneous fistula; and even mortality can still occur.[3,4]

Renal hemorrhage 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 embolization to control intractable bleeding.[7, 8]

This study aimed to evaluate the blood loss and the effect of some variables as possible triggers for blood transfusion in patients undergoing PCNL.

Methodology

From January 2015 to May 2019,216 patients underwent percutaneous renal surgery at the National Institute of Kidney Diseases and Urology and Popular Medical College Hospital, Dhaka, Bangladesh. Data were retrospectively reviewed to identify patients with postoperative hemorrhage and the need for blood transfusion. Patients who had missing data 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)/, Non-contrast CT scan of KUB was performed to image the stones. Serum Creatinine and urine culture were 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. The stone burden was calculated in $cm^2$by the product of the longest dimension and the one perpendicular to it.[9]

Hemoglobin and hematocrit were done preoperatively and in the postoperative period. Considering the approximation that 1 unit of blood transfused, increases the hemoglobin level by, about 1.0 gm%, taking into account the number of units transfused, the total blood loss was calculated using the formula: (Preoperative blood Hb- postoperative Hb) + (number of units transfused x 1 g/dL per unit transfused).[9,10]

All punctures were performed by the Urosurgeon under C-arm guidance. A ureteric catheter was introduced in the pelvicalyceal system at an initial cystoscopy to delineate the system. The puncture to the calyx depended on the stone bulk and location. The tracts were dilated using serial Alken dilators/single step dilator in all cases.

The size of the Amplatz sheath used depended on the pelvicalyceal anatomy and stone bulk.

The stones were fragmented using either Pneumaticlithotripsy (Swiss lithoclast, EMS^{TM}), ultrasonic lithotripter (Wolf^{TM}), or both. The operative time was defined as the time from percutaneous puncture of calyx to the placement of nephrostomy at the end of the procedure.

All patients had a nephrostomy tube insertion at the end of the operation which was subsequently removed in 8-12 hours postoperatively.

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

Results

A total of 326 procedures were performed on 316 patients. After the exclusion of 94 patients based on missing data, 232 procedures were included in the study. There were 167 males and 65 females. The range of age of the patients were 29-55 years and the mean age was 48.5 years. 9 patients underwent bilateral PCNL. 96% of patients underwent the procedure with a single puncture. The most common route of access was lower calyx (74%), 24% of patients had middle calyx puncture and 2% had upper calyx puncture. 26 Fr. Amplatzsheath was used in 52.6% of patients, 24 Fr. in 32.3%, and 22 Fr. in 15.1% of patients. The mean

stone area was 5.1 ±3.5 $cm^{2,}$ whereas 22% of patients had partial stag-horn stone, 14.2% complete stag-horn stone and the rest had multiple stones (63.8%). The mean operative time was 90±38 minutes. Lithoclast was used as a stone fragmentation device in 56% and both ultrasound and lithoclast were used in 44% of patients. The mean +SD hemoglobin drop for all the procedures was 1.68± 1.3gm/dL. The mean pre-operative hemoglobin concentration in males was 13.86 gm/dl (range: 8.70-16.90) and in females it was11.65 gm/dl (range: 8.1-14.0).

Female gender (p=0.0001), pre-operative hemoglobin (p=0.002), chronic renal failure (p=0.0001), stag-horn 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), stag-horn 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
Stag-horn stone	1.165 - 7.553	.023
Stone fragmentation	0.670 - 2.681	.054
(Using ultrasonic and pneumatic lithotripsy)		
CRF	0.000 - 17.731	< 0.0001

Age, hypertension, presence of urinary infection, Diabetes mellitus, ischemic heart disease did not correlate with bleeding. Of the technical factors, the experience of the operating surgeon, the calyx of access, the number of attempts required for a successful puncture, and the return of hemorrhagic 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 13.2%. The trans-fusion rate was 27.7% in females and 9% in males (p=0.001).

Discussion

Significant bleeding is not a common but dreadful complication. The incidence of significant hemorrhage 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 that 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 hemorrhage 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 13.2% but significant hemorrhage requiring intervention and the need for percutaneous embolization was 1.4%.[17]Two other studies 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 this study, the blood transfusion rate was 13.2%. In the current series, only one patient required therapeutic-embolization for control of bleeding. In the current work, in the female population, the transfusion rate was 18.7% higher as compared to males. Female gender is not a significant factor in any of the other studies. One explanation could be the low pre-operative hemoglobin in our female population.

The stone burden and stag-horn stones are considered to be an important risk factor for transfusion.

The reason suggested is that the larger stone burden requires prolonged maneuvering within the pelvicalyceal system which in turn leads to an increased incidence of injury to the parenchyma and bleeding.[20,21]

36% of these patients had either partial or complete stag-horn stones. This is related to the slightly higher transfusion rate in the current series. Similar results were shown by Turna et al, that stag-horn stones, the presence of diabetes, the use of multiple tracts, and large stones were associated with increased bleeding during PCNL on multivariate analysis. [22]

The expertise of the surgeon is expected to be an important factor but in this study, 91% of the procedures were performed by 3 urologists who had done a minimum of 50 procedures therefore, this variable was not evaluated. The majority of the patients were treated with a single lower calyx puncture. These factors are

therefore not significant in this analysis. 10 patients, treated by two punctures, did not require a blood transfusion.

The limitations of this study are retrospective study design, lack of inclusion of cortical thickness as a study variable. However, since plain CT was used as an imaging modality in some patients, accurate measurement of the cortical thickness was not considered reliable with this modality.

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. This was a significant risk factor in our patients but this has not been consistently found to cause an increased risk for bleeding after PCNL in some other studies quoted earlier.

Conclusion

The blood transfusion rate in this study group of patients is 13.2%. Multivariate analysis identified chronic renal failure, female gender, the presence of staghorn calculi, and stone fragmentation using the ultrasonic device as predictive of blood transfusion. Other factors such as age, hypertension, previously treated urinary tract infection, Diabetes mellitus, ischemic heart disease were not significant and did not correlate with bleeding.

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