To Compare the Changes in Hemodynamic Parameters and Blood Loss during Percutaneous Nephrolithotomy – General Anesthesia versus Subarachnoid Block

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Abstract

Background: Percutaneous nephrolithotomy (PCNL) is done under general anesthesia (GA) in most of the centers. However, associated complications and cost are higher for GA than for regional anesthesia. Aim: The aim of the study was to compare the efficacy of GA versus subarachnoid block (SAB) with regard to intraoperative blood loss and postoperative drop in hemoglobin (Hb) in patients undergoing PCNL. Setting and Design: This prospective, randomized, comparative clinical trial was carried out at a tertiary care hospital. After obtaining the institute ethical committee clearance (vide no 57/15), patients were randomly allocated into two groups using table of randomization (n = 30 each), Group A – GA, Group B – SAB. Materials and Methods: Intraoperative blood loss was assessed by measuring the Hb of irrigated fluid and postoperative drop in Hb concentration. Other parameters such as intraoperative mean arterial pressure and heart rate were also compared in these groups. Statistical Analysis: The results are presented in frequencies, percentages, and mean ± standard deviation. The Chi-square test was used to compare the categorical variables between the groups. Unpaired t-test was used to compare the continuous variables between the groups. Results: Hemodynamic parameters were similar in both the groups preoperatively. The Hb drop was significant in Group A (1.28 ± 0.35 g.dl⁻¹) as compared to Group B (1.10 ± 0.67 g.dl⁻¹). On calculating Hb in irrigated fluid-blood mixture, it was found to be significantly higher in Group A (1.87 ± 0.44 g.L⁻¹) as compared to Group B (1.25 ± 0.25 g.L⁻¹). Conclusions: Both GA and SAB are effective and safe in PCNL. However, SAB is associated with less blood loss as estimated by intraoperative blood loss and Hb drop.

Keywords: Blood loss, general anesthesia, hemodynamics, nephrolithiasis, percutaneous nephrolithotomy, subarachnoid block

Introduction

Percutaneous nephrolithotomy (PCNL) is the popular method for the removal of kidney stones and the treatment of choice for kidney calculi. PCNL can be performed under various anesthetic techniques such as general anesthesia (GA), subarachnoid block (SAB), epidural block, combined spinal epidural block, skin infiltration with renal capsule block, and interpleural block.¹² The advantages of GA in PCNL include feasibility to control tidal volume, secure patient’s airway, and flexibility of anesthesia duration²⁻⁴ but has the risk of pulmonary complications.¹³ On the other hand, the advantages of SAB over GA are lower postoperative pain, lower consumption of analgesic drugs, lower chances of hypertension, and avoidance of side effects from multiple medications used in GA. Blood loss had been one of the major complications during PCNL. The estimation of blood loss in PCNL is difficult because of dilution with the irrigating solution. The present study was planned to compare the blood loss by measuring the hemoglobin (Hb) of irrigated fluid and postoperative drop in Hb between PCNL conducted under GA and SAB.

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**Materials and Methods**

This prospective, randomized, comparative clinical trial was carried out in a tertiary care hospital after obtaining permission from the institutional ethical committee (vide no 57/15). Consenting patients aged between 18 and 60 years of the American Society of Anesthesiologists (ASA) physical status Grade 1 or 2 admitted for PCNL were included in the study, and those with renal anomalies (horseshoe kidney or ectopic kidney) or previously operated for renal stone were excluded from the study. The study was conducted over a period from June 1, 2016 to January 1, 2018 in a tertiary care hospital.

**Sample size**

Based on a pilot study conducted by us involving 12 patients (six from each group), we determined that a sample size of 27 in each group would be sufficient to detect the differences between the mean of blood loss, with an estimate a standard deviation (SD) of 19 ml, a power of 95%, and a significance level of 5%. We recruited thirty patients per group. The recruited patients were randomized to the two groups using computer-generated random number table.

**Study groups**

- **Group A**: PCNL was performed under GA
- **Group B**: PCNL was performed under SAB.

**Method**

In Group A, standard technique of GA with endotracheal intubation and controlled ventilation was adopted. In Group B, SAB was performed at L3–L4 interspace with hyperbaric bupivacaine 0.5% and fentanyl (0.5 µg.kg⁻¹).

Heart rate (HR) and blood pressure (BP) were recorded at baseline, 5, 10, 20, 30, 45, and 60 min after anesthesia, thereafter every 30 min till the completion of surgery. All cases were done in prone position. Hypotension was defined as fall in systolic blood pressure (SBP) <20% of baseline value or <90 mmHg. Bradycardia was defined as an HR <50 beats/min.

Blood loss was measured by the following:

(i) Difference in pre- and postoperative Hb concentration

(ii) Amount of blood in irrigated fluid by the formula:

\[
\text{Blood loss (in ml)} = (\text{Hb of irrigating fluid [g.ml}^{-1}\text{]/patient’s Hb [g.L}^{-1}\text{]} \times \text{amount of irrigating fluid}}
\]

**Statistical analysis**

The results are presented in frequencies, percentages, and mean ± SD. The Chi-square test was used to compare the categorical variables between the groups. Unpaired t-test was used to compare the continuous variables between the groups. Paired t-test was used to compare the change in Hb from pre- to postoperative. *P < 0.05* was considered statistically significant. All the analyses were carried out on SPSS Statistics for Windows, Version 22.0. IBM Corp., Armonk, NY.

**Results**

The demographic data such as different sexes, age, ASA grade, height, weight, and body surface area were comparable between the groups. Table 1 shows that there was no difference in the HR, SBP, diastolic blood pressure, and mean blood pressure (DBP and MAP) at baseline. However, thereafter, from 5 min to 120 min from baseline, these parameters were significantly higher in patients of Group A compared to those of Group B.

Table 2 shows that the mean change in Hb level and volume of irrigation fluid used was significantly higher in Group A than Group B. The calculated blood loss was significantly higher in Group A compared to Group B.

**Discussion**

This is the first-ever study to determine the volume of blood loss during PCNL by measuring the Hb level of the postprocedure irrigated fluid-blood mixture.

HR from 5 min (after induction or SAB) to 45 min and after the end of the surgery was significantly higher in Group A. This is because of the involvement of cardioacceleratory nerve fibers and decrease in systemic vascular resistance due to sympathectomy during neuraxial anesthesia causing decrease in the right atrial filling leading to decreases in the intrinsic
chronotropic stretch receptors. Similar findings were reported previously.\textsuperscript{[6,7]}

The SBP, DBP, and MAP were significantly higher in patients of Group A from 5 min till the end of the surgery. This may be due to blockade of sympathetic fibers arising from T\textsubscript{5}-L\textsubscript{1} in SAB, resulting in the loss of vasomotor tone leading to fall in BP, whereas in GA, there is sympathetic stimulation at the time of intubation and extubation which can cause a rise in BP and HR. One patient in Group A and three patients in Group B had hypotension which was managed by bolus of fluid (250 ml) and one patient in Group B needed 5 mg of intravenous mephentermine. Previous authors reported the use of ephedrine in 10\% of patients during PCNL procedure under SAB.\textsuperscript{[8]}

The mean change in Hb level and volume of irrigation fluid used was significantly higher in Group A than Group B. Further, the average amount of blood loss calculated in Group A was significantly higher compared to Group B. Thus, the blood loss during PCNL was greater in patients undergoing the procedure under GA compared to those under SAB. This can be due to the fact that SAB blocks preganglionic sympathetic nerves leading to redistribution of blood flow to the musculoskeletal system, skin, and subcutaneous tissues, as well as reducing SBP, DBP, MAP, and better hemostasis. Further, reduced intrathoracic pressure and epidural vein distension, due to spontaneous ventilation, result in reduced bleeding. The magnitude of the fall in Hb was similar to that reported previously.\textsuperscript{[9,10]}

**Limitations of the study**

This study had a small sample size, and so studies with larger sample sizes may be considered to further substantiate the findings of the present study.

**Conclusions**

Both GA and SAB are effective and safe in PCNL. However, SAB is associated with less blood loss as estimated by intraoperative blood loss and Hb drop.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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