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Research Article

EFFICACY AND SAFETY OF CONVENTIONAL EPIDURAL VERSUS COMBINED SPINAL EPIDURAL IN PERCUTANEOUS NEPHROLITHOTOMY: A PROSPECTIVE AND RANDOMIZED CLINICAL STUDY

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ABSTRACT

Objectives: The aim of the study was to compare the efficacy and safety of conventional epidural (ED) versus combined spinal epidural (CSE) in percutaneous nephrolithotomy (PCNL) with addition of opiods and dexmedetomidine.

Methods: This prospective, randomized, and double-blinded clinical study was conducted in the in patients undergoing PCNL. Group CSE had received CSE anesthesia and Group ED given conventional epidural anesthesia. Time to first rescue analgesic and total dose of rescue analgesic along with hemodynamic parameters were compared up to 24 h. Patient, surgeon satisfaction score, and post-operative complications were also compared.

Results: Time from onset of sensory block to first requirement of analgesia was prolonged in group CSE (218.4±18.30 min) as compared to Group ED (210±17.88 min). ($p<0.001$) Mean time for first rescue analgesia postoperatively was highly significant in group CSE (2.42±0.49) as compared to Group ED (2.08±0.28). ($p<0.0001$) Total dose of levobupivacaine required was high in Group ED (49.66±7.02) as compared to Group CSE (45.66±3.12). ($p<0.001$) In Group ED, surgeon score was good in 20 (44.44%) patients and which was highly significant. In Group CSE, surgeon score was excellent in 41 (91.1%) patients and which was highly significant. ($p<0.001$) Post-operative complications in both the group were comparable ($p>0.05$).

Conclusion: This study concluded that though both the anesthesia techniques are safe and efficient with each having its own benefits. CSE had proven superiority over the epidural technique.

Keywords: Percutaneous nephrolithotomy, Epidural, Spinal, Opiods.

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INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is a minimally invasive preferred endoscopic technique and treatment of choice for renal calculi larger than 20–30 mm, staghorn stones and stones that are multiple or resistant to extra corporeal shock wave Lithotripsy [1]. PCNL is mostly performed under general anesthesia (GA) in the prone position. Other alternative anesthetic techniques have been successfully used in PCNL; ranging from regional anesthesia (RA) to assisted local anesthesia. RA is associated with lower morbidity and mortality than GA. Besides side-effect of medications and cost of GA, the problems during change of position from supine to prone include displacement of the endotracheal tube, lung atelectasis, eye and brachial plexus injury, post-operative nausea, and vomiting as well as other urological complications [2].

Combined spinal epidural (CSE) has become increasingly popular in recent years. This technique is suitable whenever a rapid onset of analgesia is required but the period of analgesia required exceeds that of a single spinal injection. This technique also allows for post-operative pain relief through epidural patient controlled analgesia. The epidural catheter may be left in place for up to 72 h if required [3]. The CSE technique saves 15–20 min in establishing surgical anesthesia when compared to epidural anesthesia alone and it is an effective way to reduce the total drug dosage required for anesthesia or analgesia [4]. Similarly, epidural block with the catheter technique gives a better control of the level of analgesia, less hypotension, and can be used for providing post-operative pain relief but major drawbacks include slower onset of action, patchy block, comparatively poor motor blockade, and higher requirement of local anesthetics [5].

Dexmedetomidine (DMT) which is centrally acting alpha 2 agonist has become a frequently used drug in anesthetic armamentarium, along with routine anesthetic drugs, due to its haemodynamic, sedative, anxiolytic, analgesic, neuroprotective, and anesthetic sparing effects. Other claimed advantages include minimal respiratory depression with cardioprotection, neuroprotection, and renoprotection, thus making it useful in various situations including offsite procedures [6].

The present study aimed to compare the efficacy and safety of conventional epidural versus CSE in PCNL with addition of opiods and DMT.

METHODS

This prospective, randomized, and double-blinded clinical study was conducted in the Department of Anaesthesiology of a tertiary care teaching hospital from January 2018 to June 2019 after taking approval of the institutional ethical committee and informed consent of each patient. Ninety-six patients of aged 18–65 years, American society of Anaesthesiologists (ASA) physical status 1 and 2 scheduled for PCNL were included in the study. ASA 3, coagulopathy, neuropathy, vertebral deformity, metabolic acidosis, BMI >30, and non-consenting patients were excluded from the study.

Ninety-six patients were randomized into two groups using number generated randomization table and allocation concealment was done by envelope method. Primary investigator opened envelope and conducted the procedure according to the group allocated as follows;

1. Group CSE: received CSE anesthesia
2. Group ED: received conventional epidural anesthesia

Secondary investigator had recorded the data. Patient as well as the secondary investigator did not know about the technique used hence double blinding was achieved.

Procedure

All patients underwent thorough pre-anesthetic evaluation by primary investigator a day before surgery and were instructed to kept nil per oral after mid night. On the day of surgery, 18G intravenous cannula was secured and ringer's solution was started at the rate of 10 mL/kg/h. All patients were familiarized with the use of visual analogue score (VAS) for pain assessment before entering the operating room. In the operating room electrocardiogram, pulse oximetry, nasal capnograph, and automated non-invasive blood pressure (BP) were applied and base line values of BP, heart rate (HR), oxygen saturation (SPO_2), respiratory rate (RR), and $ETCO_2$ were recorded and patients were placed in sitting position.

In Group ED, epidural space was identified at L2-L3 or L3-L4 vertebral level and 18 gauge Tuohy needle was placed into epidural space using a loss of resistance to air or saline technique. Then 20 gauge and multi-orifice epidural catheter was inserted 4–5 cm. 3 mL of lignocaine 2% with adrenaline 5 mcg/mL was administered. Patients were made to lie in supine position and then 15 mL of 0.5% levobupivacaine with injection fentanyl 2 mcg/mL was injected through epidural catheter in epidural space.

In Group CSE, 27 gauge whitacre needle was placed into the subarachnoid space through the Tuohy needle after free flow of cerebrospinal fluid; bupivacaine heavy 0.5% 1.8 mL (8 mg) was given, and the spinal needle was withdrawn. The epidural catheter was inserted and advanced 4–5 cm into the epidural space. 3 mL of lignocaine 2% with adrenaline 5 mcg/mL was administered. Patients were made to lie in supine position and 15 mL of 0.5% levobupivacaine with injection fentanyl 2 mcg/mL was injected through the epidural catheter in epidural space.

Infusion of 0.5 mcg/kg injection DMT in 100 mL normal saline was infused immediately after epidural catheter insertion, over a period of 10 min in both groups.

Sensory level was assessed by pin prick method and motor block was assessed by modified Bromage scale at 1 min interval. GA was given if the desired level was still not achieved and was included in as drop outs. Catherization was done by the surgeon in lithotomy position and after that patients were made to lie in prone position for PCNL.

All patients were monitored intra operatively in terms of HR, MAP, SBP, DBP, SPO_2, and $ETCO_2$ at 2 min and then at 5, 10, 15, 30, 60, and 120 min of surgery. Hypotension was defined as a fall in MAP >20% below the pre-anesthetic baseline value and was treated with Inj. Mephentermin 6 mg incremental boluses. Any fall in the HR below 55 beats/min was considered as bradycardia and treated with incremental doses of injection intravenous (IV) atropine 0.3 mg.

Postoperatively, HR, MAP, SBP, DBP, SPO_2, and VAS score was recorded immediately after procedure and then every 3 h for 24 h. Patients were given recue analgesic dose of 9 mL 0.125% levobupivacaine on demand/VAS≥ 3 through epidural catheter. If not relieved then another rescue analgesic injection tramadol 50 mg i.v was given. VAS score was recorded immediately after procedure and then every 3 h for 24 h. Time to first rescue analgesic, total dose of rescue analgesic intra and postoperatively was recorded up to 24 h.

Ramsay sedation scale was assessed immediately and then at 1 h and 2 h postoperatively. Patient and surgeon satisfaction score (1=poor, 2=moderate, 3=good, and 4=excellent) was also recorded. Post-operative complications such as nausea, vomiting, chest pain, lower back pain, and headache were recorded for 24 h.

Statistical analysis

Statistical analysis was done using SPSS software (version 17, SPSS, Chicago, IL). Data were presented as mean, standard deviation, median (range), or percentage as appropriate. Chi-square test was used to find the significance of study parameter on categorical scale and unpaired t-test for intergroup comparison. $p<0.05$ were considered significant.

RESULTS

Finally, 45 patients were compared as three patients were dropped out in each group during the study period. There was no significant difference between the two groups regarding demographic data as mean values of age, weight, height, surgery time (min), ASA grade, and BMI were comparable between two groups ($p>0.05$) (Table 1).

Onset of sensory block (T10) was earlier in group CSE (4.11±0.64 min) as compared to Group ED (9.55±1.79 min) and difference was highly significant, $p<0.001$. Time to reach maximum sensory block was achieved significantly earlier in Group CSE (14.11±4.43 min) as compared to Group ED (26±4.95 min) and difference was highly significant, $p<0.001$. Total duration of sensory analgesia, that is, time from onset of sensory block to first requirement of analgesia was prolonged in Group CSE (218.4±18.30 min) as compared to Group ED (210±17.88 min), $p<0.001$ (Table 2).

Group CSE achieved Bromage score 5 earlier (1.46±0.50 min) as compared to Group ED (3.29±0.66 min) and difference was highly significant, $p<0.001$. Group CSE achieved Bromage score 1 earlier (4.93±2.71 min) as compared to Group ED (25.75±5.01 min) and difference was highly significant, $p<0.001$ (Table 2).

Figs. 1 and 2 showed change in intra operative HR, SBP, DBP, and MAP with the different time interval in both the groups. Comparison of mean arterial pressure, saturation, ETCO2, and RR at different time interval between the two groups were found to be non-significant. In Group CSE, 16 (35.5%) patients required vasopressor as compared to group ED in which only 6(13.3%) patients required and it was significant ($p=0.01$). 11.1% patients in CSE group developed bradycardia (HR <55 beats/min) requiring atropine while none of the patients in ED group developed bradycardia ($p<0.05$) (Figs. 1 and 2).

Post-operative hemodynamic parameters were comparable at different time interval and found to be non-significant.

Table 1: Comparison of demographic data

Variables	Group ED (n=45)	Group CSE (n=45)	p-value
Age	37.48±11.35	40.31±17.80	>0.05
Weight (kg)	62.06±8.11	63.93±35.56	>0.05
Height (cm)	168.53±3.50	169.26±64.53	>0.05
BMI	21.76±2.08	21.95±1.63	>0.05
ASA1	29	22	>0.05
ASA2	16	23	>0.05
Duration of surgery (mins)	73.44±21.99	68.77±26.39	0.18

Table 2: Comparison of sensory block and motor block characteristics in both groups

Sensory block	Group ED	Group CSE	p-value
Onset of sensory block (T10) (min)	9.55±1.79	4.11±0.64	<0.001*
Time to reach maximum highest sensory block (T6) (min)	26±4.96	14.11±4.43	<0.001*
Total duration of sensory analgesia (min)	210±17.89	218.4±18.30	<0.001*
Motor block			
Time for modified Bromage score 5 (min)	3.29±0.66	1.46±0.50	<0.001*
Time for modified Bromage score 1 (min)	25.75±5.01	4.93±2.71	<0.001*

*Significant

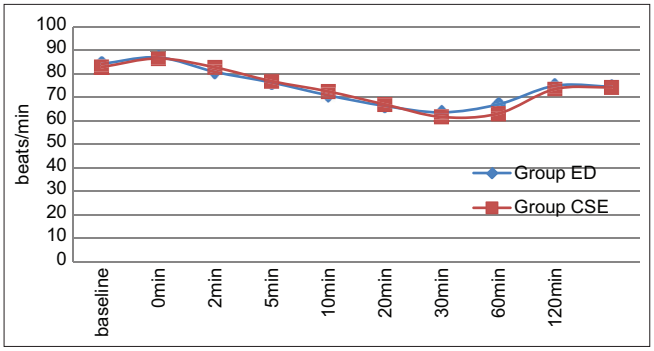

Fig. 1: Intra operative heart rate in both groups at different time intervals

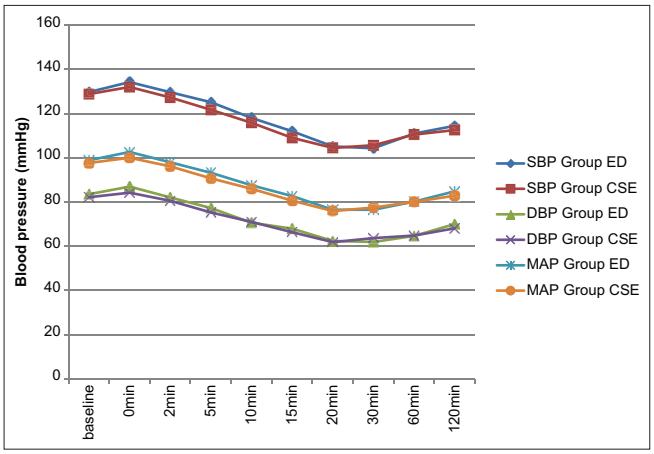

Fig. 2: Comparison of intra operative SBP, DBP, and MAP in two groups at different time intervals

Mean time for first rescue analgesia postoperatively was highly significant in group CSE (2.42±0.49) as compared to Group ED (2.08±0.28), p<0.0001. Total dose of levobupivacaine required was high in Group ED (49.66±7.02) as compared to Group CSE (45.66±3.12), p<0.001. Total number of mean top ups was more in Group ED (3.31±0.46) as compared to Group CSE (3.044±0.20), p<0.001. Total numbers of patients requiring additional analgesia in both groups were comparable (Table 3).

In Group ED, surgeon score was good in 20 (44.44%) patients and which was highly significant. In Group CSE, surgeon score was excellent in 41 (91.1%) patients and which was highly significant. (p<0.001) Patient satisfaction score after 24 h of surgery in both groups which was found to be comparable. Post-operative complications in both the group were also comparable (Table 4).

DISCUSSION

GA is the preferred technique for performing PCNL in many centers. However, due to challenges like staghorn calculi, chronic obstructive pulmonary disease, and cardiovascular disease, GA is not preferred choice of anesthesia. In such patients, regional or local anesthesia is good alternative.

In the present study, demographic variables were comparable in both the groups which were similar to other studies [7-10].

In the present study, time of onset of sensory block (T10 level) was significantly earlier, that is, 4.11±0.647 min in CSE group as compared to 9.55±1.79 min in ED group. Gupta *et al.* showed mean onset time to reach T10 dermatomes in Group LD (15 mL levobupivacaine+25 mcg DMT) was 7.25±2.3 min and 9.27±2.79 min in group LF (15 mL levobupivacaine+50 mcg fentanyl)

Table 3: Comparison of total dose and number of epidural top up required for post-operative analgesia in both the group

Analgesia	Group ED (n=45)	Group CSE (n=45)	p-value
Time to rescue analgesia at 2 h	41 (91%)	26 (57.77%)	<0.001*
Mean time for first analgesia postoperatively (h)	2.08±0.28	2.42±0.49	<0.0001*
Total dose of levobupivacaine (mg)	49.66±7.02	45.66±3.12	<0.001*
Total number of mean top ups	3.31±0.46	3.04±0.20	<0.001*
Total no of patients requiring additional analgesia	4	3	>0.05

*Significant

Table 4: Comparison of surgeon and patient satisfaction score and complications after completion of surgery

Parameters	Group ED (n=45) (%)	Group CSE (n=45) (%)	p-value
Surgeon satisfaction score			
Moderate	0	0	
Good	20 (44.44)	4 (8.88)	<0.001*
Excellent	25 (55.55)	41 (91.1)	<0.001*
Patient satisfaction score			
Moderate	0	0	
Good	10 (22.22)	9 (20)	>0.05
Excellent	35 (77.77)	36 (80)	>0.05
Post-operative complications			
Nausea/vomiting	3 (6.66)	3 (6.66)	>0.05
Chest pain	3 (6.66)	4 (8.88)	>0.05
Lower back pain	5 (11.11)	4 (8.88)	>0.05
Headache	4 (8.88)	5 (11.11)	>0.05

*Significant

which was not significant clinically [11]. Joel *et al.* reported in their study that mean onset time of analgesia was 3.87±0.83 min in Group 1 (0.125% bupivacaine+fentanyl 2 mcg/mL in epidural space) and 1.48±0.46 min in Group 2 (25 mcg fentanyl intrathecal and 0.125% bupivacaine+fentanyl 2 mcg/mL in epidural space), which was significantly faster in the latter can be because of additional intrathecal block [12]. Addition of adjuvant to levobupivacaine can cause synergistic interaction in terms of duration and block characteristics.

Time to reach maximum level of sensory block, that is, T6 level was significantly earlier, that is, 14.11±4.43 min in Group CSE as compared to 26±4.95 min in Group ED Lavanya and Ganesh also found that time to achieve T6 sensory block was significantly earlier, that is, 8.66±0.92 min in CSEA group as compared to 17±2.6 min in epidural group [13]. Parikh *et al.* [10] compared segmental epidural anesthesia with RA in PCNL and the mean time taken for complete block was 10.62±2.25 min which was less in comparison to the present study which can be due to level of epidural catheter insertion (T11-T12, T12-L1), concentration, and volume of ropivacaine used.

Duration of sensory analgesia, that is, the time from onset of sensory block to first requirement of analgesia was prolonged in CSE group 218.4±18.30 min as compared to group ED 210±17.6 min (p<0.001). Gupta *et al.* [11] found the mean duration of sensory analgesia in Group LF was 146±8.3 min and in Group LD was 167±6.9 min which was significant (p=0.001).

Mean time required to achieve complete motor blockade, that is, Bromage score 1 was significantly earlier in CSE group 4.93±2.70 min as compared to ED group 25.75±5.01 min (p<0.001). Similarly, Karaman *et al.* [14] found patients in CSEB group achieved complete motor blockade and it was reached earlier in comparison to EB group. Swarnkar *et al.* [15] also showed similar results. This difference in mean

time to reach complete motor blockade can be attributed to higher dose of fentanyl used by them.

In this study SBP, DBP, and MAP were comparable in both the groups at different time intervals. In Group CSE, 35.5% of patient developed hypotension in comparison to ED group, only 13.3% of patients developed hypotension (p=0.01); so requirement of vasopressor (mephentermine) was also high in Group CSE. Similar results were reported by other studies [10,12,16].

Mean HR was found to be significantly low in group CSE at 20 min and 30 min in comparison to ED group (p<0.001). This result can be due to additive effect of spinal and epidural component in CSE as well as because of intravenous loading dose of DMT. Although bradycardia was found to be in 11.11% of patients in CSE group, while no patients in ED group had fall in HR below 55 beats/min (p<0.05).

Parikh *et al*. [10] reported significant difference in mean HR between the two groups (SEA and GA group) from 0 min to 120th min (p=0.001) with mean HR higher in GA group. Gupta *et al*. [11] reported that intraoperative mean values of HR and systolic BP did not show statistically significant decline from the baseline. HR remained stable in range of 57–64 beats/min in both groups (LF and LD) and no patients required atropine. In this study, use of DMT intravenous could have been responsible for bradycardia in five patients in CSE group, while none of the patients in ED group developed HR below 55 beats/min. Other variables (RR, SPO_2, and $ETCO_2$) in present study were comparable in both the groups at different time intervals (p>0.05). Similar results were also reported by other studies [8-11,15]. Post-operative MAP, SBP, DBP and SPO_2 were comparable in both the groups (p>0.05) and intragroup comparison was also comparable regarding all hemodynamic parameters postoperatively.

About 91% of patients in ED group required first analgesic dose at 2 h in comparison to 57.77% of patients in CSE group which was statistically significant (p<0.0001). After 3 h post-operative period, 42.22% of patients in Group CSE demanded for first analgesic dose whereas in Group ED, 8.88% patients (p<0.001) suggesting that in group CSE duration of post-operative analgesia was prolonged in comparison to ED group. Mean time of first rescue analgesia requirement was significantly earlier, that is, 2.08±0.28 min in Group ED as compared to 2.42±0.49 min in Group CSE (p<0.001). Virkar *et al*. [8] reported that 30% of patients in Group GA required rescue analgesia within 1st h of post-operative period whereas no patient in CSE group required analgesia within 1st h. About 70% of patients in group CSE required rescue analgesia at 3 h whereas most of the patients in GA group required rescue analgesia within first 2 h (p<0.05). Mean of total dose of levobupivacaine (mg) required postoperatively in Group ED was significantly higher in comparison to Group CSE (p<0.001). Total number of mean top ups in Group ED was also significantly higher in Group ED (p<0.001). About 8.88% of patients in ED group and 6.68% in CSE group required additional analgesia (tramadol 50 mg intravenous) which was comparable statistically. Kumawat *et al*. [9] and Moawad and El Hefnawy [17] also reported that mean analgesic dose requirement was significantly low in Group EA as compared to Group GA (p<0.001). Similar results were also reported by other studies [7,18].

In the present study, surgeon satisfaction score was found that was excellent in 55.55% patients in Group ED and 91.1% of patients in Group CSE which was statistically highly significant (p<0.001) and was good in 44.44% in ED group and 8.88% in CSE which was statistically significant (p<0.001). Moawad and El Hefnawy [17] also reported that overall surgeons' satisfaction score was significantly higher in GA group as compared to SA group. This could have been because of surgeon to surgeon preference and comfort. In this study, patient satisfaction score was comparable in both Group ED and CSE. It was excellent in 77.77% in Group ED and 80% in Group CSE. Joel *et al.* [12] in their study reported that there was no significant difference in level of maternal satisfaction score between CSE and epidural groups in labor. Parikh *et al*. [10] reported significantly higher patient satisfaction score in Group SEA as compared to Group GA. Tangpaitoon *et al*. [19] reported a higher patient satisfaction score (level 4, 5) in regional epidural group as compared to GA group.

In the present study, post-operative complications were comparable in both groups. Kumawat *et al*. [9] reported that in Group EA, 8.9% of patients complained of nausea as compared to Group GA 37.5% and was statistically significant. Similarly high incidence of nausea and vomiting were also reported by other studies [8,17]. Mehrabi *et al*. [7] reported that post-operative headache and lower back pain was significantly high in group spinal as compared to Group GA. None of the patients in either group complained of shortness of breath intra and postoperatively.

CONCLUSION

Administration of CSE anesthesia demonstrated better sensory and motor block characteristics with early incision time in PCNL patients with reduced post-operative pain score and cumulative rescue analgesia requirement in first 24 h postoperatively; better patient and surgeon satisfaction score and reduced post-operative complications. Hemodynamics stability was better with conventional epidural technique with low post-operative headache.

AUTHORS' CONTRIBUTION

All the authors contributed to the preparation of the final manuscript.

CONFLICTS OF INTEREST

None.

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