A Comparison of the Effects of Epidural Anesthesia, Lumbar Paravertebral Block and General Anesthesia in Percutaneous Nephrolithotomy


The present study evaluated the effects of lumbar epidural anesthesia (E) vs lumbar paravertebral block (P) and general anesthesia (G) with respect to intraoperative mean arterial blood pressure, heart rate, postoperative pain intensity, analgesic requirements and postoperative complications in patients undergoing percutaneous nephrolithotomy. The study included 57 patients undergoing percutaneous nephrolithotomy patients were randomly allocated into three groups. Paravertebral group (P) (n = 18), Epidural group (E) (n = 19), General group (G) (n = 20), non invasive mean arterial blood pressure, intraoperative heart rate, the severity of postoperative pain for 24 h using (VAS), number of patients require analgesia, incidence of side effects: nausea, vomiting, urine retention were evaluated in all patients. Three patients were excluded from the study (2 in P group and 1 in E group) because of technical failure. Intraoperative mean arterial blood pressure was significantly lower in E group compared to P and G groups (p<0.05). Intraoperative heart rate shows no significant difference between P, E and G groups. The severity of postoperative pain were significantly less in P group compared to E and G groups (p<0.05), number of patients requiring postoperative analgesia was significantly lower in P group compared to E and G groups (p<0.05). Number of patients having postoperative nausea and vomiting was significantly higher in G group than in the P group and E group (p<0.05). Lumbar paravertebral block with bupivacain 0.5% was associated with more intraoperative hemodynamic stability, reduced postoperative pain and significantly decreased the postoperative analgesic requirements than epidural anesthesia and general anesthesia in patients undergoing percutaneous nephrolithotomy without increasing the incidence of PONV.

Key words: Paravertebral block, bupivacain, postoperative pain

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INTRODUCTION

Percutaneous nephrolithotomy, or PCNL, is used for the fragmentation and removal of stones from the renal pelvis and renal calyceal systems by means of nephroscope passed into the kidney through a track created in the patient’s back (Cic et al., 2005).

It has the advantages of lower morbidity, shorter operative time, shorter hospital stay and earlier return to work over open surgery (Al-Kohlany et al., 2005).

The choice of anesthetic technique depends on patient and surgeon preference, feasibility of the technique in a given patient, intra and postoperative pain control, skills of the anesthesiologist and perioperative costs, General Anesthesia (GA) with IPPV (Cic et al., 2005), spinal anesthesia (Atallah et al., 2006) and epidural anesthesia are used as anesthetic techniques for PCNL procedures.

Paravertebral block (PVB) is an alternative technique that may offer comparable analgesic effectiveness and a better side-effect profile, placement of local anesthetic within the paravertebral space produces unilateral somatic and sympathetic block. Paravertebral blockade is an appealing option in whom epidural analgesia may be contra-indicated (local sepsis, coagulopathy, preexisting neurological disease and difficult thoracic spine anatomy). PVB is associated with less urinary retention, less postoperative nausea and vomiting, less hypotension (Davies et al., 2006). Paravertebral nerve block has been used for a variety of surgical procedures to provide unilateral anesthesia and postoperative analgesia. Preoperatively, thoracic and lumbar paravertebral nerve blocks are used for patients with ureteral calculi (Jamieson and Mariano, 2007).

Klein et al. (2000) suggested that the use of paravertebral blocks provided longer lasting pain relief with few postoperative side effects.

The use of paravertebral blocks (PVB) as the sole anesthetic technique result in shorter time to achieve home readiness and improved same-day recovery over a fast-track general anesthesia (Hadjzic et al., 2006).

In a comparison of paravertebral block and general anesthesia for breast surgery, paravertebral block was a suitable alternative to general anesthesia (Pusch et al., 1999).

It is reported that paravertebral block produced equivalent analgesia with the local tissue infiltration technique (Klein et al., 2002).

It also provided 100% fast-track eligibility and an average time to discharge home of only 46 min using similar general anesthetic drugs with a LMA and local anesthetic infiltration (Tang et al., 2001).

In a study involving general endotracheal anesthesia for outpatient laparoscopic gynecologic surgery (Colorna et al., 2001) were able to fast-track 80% of these cases with an average time to home readiness of 120 min.

Preoperative PVB seems to reduce the prevalence of chronic pain 1 year after breast cancer surgery (Pekka et al., 2006).

PVB is used before or after the induction of general anesthesia to provide postoperative analgesia after breast surgery (Buggo and Kerin, 2004).

The present study was designed to compare the effect of epidural anesthesia and lumbar paravertebral block with general anesthesia as regards to in intraoperative mean arterial blood pressure, heart rate, postoperative pain intensity analgesic requirements and postoperative complications in patients undergoing percutaneous nephrolithotomy, as a randomized prospective clinical trial.

MATERIALS AND METHODS

Following approval of Local Ethical and Research Committee in Ksar El Aini Hospital (Egypt) Beni Suef University Hospital (Egypt) and Farwaniya hospital (Kuwait) from October 2006 to October 2007 and informed written consents were obtained from 60 male patients (30-50 year), ASA physical status I and II undergoing percutaneous nephrolithotomy.

Patients were excluded if they had history of cardiac, respiratory, neuromuscular, hepatic or major renal disease, systemic illness that contraindicates the occurrence of hypotension during anesthesia [hemodynamically significant aortic or mitral valve stenosis, advanced ischemic heart disease (EF<45%) or congestive heart failure]. They were also excluded if they were obese, diabetic, finally, any contraindication to regional anesthesia (e.g., local infection, coagulation abnormality, back deformity, or patient refusal) or allergy to local anesthetics.

The study protocol, the epidural and paravertebral block procedures and the Visual Analogue Scale (VAS) for pain, were explained to each patient during the preoperative visit.

All patients were premedicated with oral midazolam 5 mg, approximately 60-90 min prior to surgery. Upon arrival to the operating room, a wide bore intravenous cannula was inserted and 8 mL kg⁻¹ normal saline was infused intravenously. Monitoring included Electrocardiogram (lead II and V with ST segment analysis), pulse oximetry and non-invasive arterial blood pressure at 5 min intervals, were monitored.
Patients were randomly allocated into three equal sized groups using table of randomization \( n = 20 \), each.

Group P: with the patient in the sitting position, after cleaning the skin with an antiseptic solution, 3 mL of lidocaine 2% is infiltrated subcutaneously at L1-L2, 2.5 cm lateral to midline at the ipsilateral site of surgery, then a 18G Tuohy needle (PerifixTM, BBraunTM, Melsungen, Germany) was inserted and advanced perpendicular to the skin in all planes to contact the transverse process. After the transverse process is contacted, the needle was withdrawn to skin level and reinserted at a 10° superior or inferior needle angulation to walk off the transverse process allow the tip of the needle to pass 1 cm deeper to the transverse process to locate paravertebral space using the loss of resistance to air technique (www.nysora.com).

Thereafter, 4 cm of epidural catheter (Episoft™, BBraun™, Melsungen, Germany) were inserted cephale, after negative aspiration for blood and CSF. 0.5% bupivacaine (Marcaine, Astra Zeneca) 35 mL was injected over 10 min in increments of 5 mL, the patient then positioned in the prone position, at the end of surgery, the catheter was removed and the patient returned to the supine position.

Group E, Insertion of EPIDURAL catheter was performed, under strict aseptic condition and subcutaneous local anesthetic injection in the sitting position at L2-L3 or L3-L4 space using 18 gauge Tuohy needle and catheter (PERIFIX, B.BRAUN, Melsungen, Germany) using loss of air resistance technique. After catheter fixation, test dose of 3 mL lidocaine 2% with 1:200,000 adrenaline was injected and after exclusion of intrathecal or intravascular catheter placement, bupivacain 0.5% (Marcaine, Astra Zeneca), loading dose of local anesthetic 25 mL was injected over 10 min, in increments of 5 mL. The patient then positioned in the prone position, at the end of surgery, the epidural catheter was removed and the patient is returned to the supine position.

Group G, General anesthesia was induced in with propofol 2 mg kg⁻¹ IV, fentanyl 2 µg kg⁻¹ IV, atracurium 0.5 mg kg⁻¹ IV, the trachea was intubated with oral cuffed armored tube lubricated with lidocain jell 2% 2 min after atracurium administration guided by peripheral nerve stimulation, lidocain 1.5 mg kg⁻¹ IV was given 1.5 min before intubation.

Anesthesia was maintained with Isoflurane 0.8 to 1%, 100% \( O_2 \), incremental doses of atracurium guided by peripheral nerve stimulator.

The patient then positioned in the prone position, at the end of surgery the patient returned to the supine position, neuromuscular blockade was reversed with neostigmin 2.5 mg and atropine 1.2 mg IV and the trachea was extubated when the patient respond to commands.

All patient were transferred to PACU where they were monitored, the postoperative pain was assessed using Visual Analogue Scale (VAS), where zero score corresponds to no pain and 100 to the maximum or worst pain. Postoperative pain (VAS > 30) was initially managed with tramadol 100 mg IV.

The following parameters were evaluated in the studied groups:

- Patient characteristics and operative details
- Intraoperative mean arterial blood pressure
- Intraoperative Heart rate
- The severity of postoperative pain measured for 24 h using (VAS)
- Number of patients requiring postoperative analgesia
- Incidence of side effects: nausea, vomiting, urine retention

**Statistics:** Data were presented as mean (SD) or median (range), as appropriate. Complete failure and unsatisfactory block were grouped together as failure and excluded from the study. Satisfactory block was considered success. Comparison between the three groups was performed using One Way ANOVA followed by Post-Hoc comparison if it revealed significant effect. Comparison within the same group was analyzed by repeated measures analysis of variance (ANOVA) followed by Post-Hoc comparison if it revealed significant effect. Non parametric variables were compared using non-parametric version of ANOVA; Kruskal Wallis test. Error bars were omitted from the graph for the purpose of clarity. A p-value <0.05 was considered significant.

**RESULTS**

Three patients were excluded from the study (2 in P group and 1 in E group) because of technical failure.

Patient characteristics and duration of surgery showed no significant differences between the three studied groups (Table 1).

Intraoperative mean arterial blood pressure was significantly lower in the E group compared with P and G groups from 15 to 90 min (p<0.05). Intraoperative mean arterial blood pressure was significantly lower in the G group compared with P group at 5 and 15 min after induction of anesthesia (p<0.05). Intraoperative mean arterial blood pressure was significantly lower in the E group at 15, 30, 45, 60, 75 and 90 min compared to the base line reading (p<0.05). Intraoperative mean arterial blood pressure was significantly lower in the G group at 5 and 15 min compared to the base line reading (p<0.05).
Table 1: Patient’s characteristics and duration of surgery

<table>
<thead>
<tr>
<th>Groups</th>
<th>P group (n = 18)</th>
<th>E group (n = 19)</th>
<th>G group (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>43±12</td>
<td>41±13</td>
<td>39±15</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>74±1.8</td>
<td>73±2.8</td>
<td>75±1.5</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>165±10.5</td>
<td>161±11.2</td>
<td>163±10.8</td>
</tr>
<tr>
<td>ASA I/II (n)</td>
<td>14/6</td>
<td>15/5</td>
<td>15/5</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>87±3.5</td>
<td>89±2.3</td>
<td>90±1.3</td>
</tr>
</tbody>
</table>

Values are mean±SD or number. P = Paravertebral group, E = Epidural group, G = General group, n = number. No significant difference between the studied groups.

Table 2: MAP mmHg (Mean arterial blood pressure) in the study groups mean±SD

<table>
<thead>
<tr>
<th>Time</th>
<th>P group (n = 18)</th>
<th>E group (n = 19)</th>
<th>G group (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base line</td>
<td>94.94±8.20</td>
<td>96.84±7.65</td>
<td>95.82±11.60</td>
</tr>
<tr>
<td>5 min</td>
<td>93.85±8.18</td>
<td>96.81±7.63</td>
<td>78.45±8.49*</td>
</tr>
<tr>
<td>15 min</td>
<td>93.82±7.93</td>
<td>79.83±9.20*</td>
<td>86.83±9.32*</td>
</tr>
<tr>
<td>G (E)</td>
<td>94.75±8.33</td>
<td>74.95±9.30*</td>
<td>94.79±8.30</td>
</tr>
<tr>
<td>45 min</td>
<td>95.21±8.21</td>
<td>74.80±8.11*</td>
<td>94.98±8.45</td>
</tr>
<tr>
<td>60 min</td>
<td>95.20±9.10</td>
<td>75.35±6.71*</td>
<td>95.91±6.63</td>
</tr>
<tr>
<td>75 min</td>
<td>93.67±7.38</td>
<td>75.35±6.50*</td>
<td>95.30±5.33</td>
</tr>
<tr>
<td>90 min</td>
<td>93.45±6.99</td>
<td>75.48±7.21*</td>
<td>94.35±5.10</td>
</tr>
</tbody>
</table>

G1 = P group, G2 = E group, G3 = G group, P = Paravertebral group, E = Epidural group, G = General group, n = Number, *p<0.05 is significantly different from the same reading in the specified group/s, †p<0.05 is significantly different from the baseline in the same group.

Table 3: Heart rate (beats/min) in the study groups at different time intervals mean±SD

<table>
<thead>
<tr>
<th>Time</th>
<th>P group (n = 18)</th>
<th>E group (n = 19)</th>
<th>G group (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base line</td>
<td>80.39±8.30</td>
<td>81.79±6.10</td>
<td>80.65±6.00</td>
</tr>
<tr>
<td>5 min</td>
<td>80.35±0.01</td>
<td>81.61±6.95</td>
<td>82.72±6.12</td>
</tr>
<tr>
<td>15 min</td>
<td>80.65±7.64</td>
<td>80.90±7.46</td>
<td>81.83±6.35</td>
</tr>
<tr>
<td>30 min</td>
<td>80.79±8.84</td>
<td>80.92±7.30</td>
<td>80.91±6.42</td>
</tr>
<tr>
<td>45 min</td>
<td>80.73±7.94</td>
<td>80.75±7.10</td>
<td>80.64±6.71</td>
</tr>
<tr>
<td>60 min</td>
<td>80.46±6.21</td>
<td>80.56±8.01</td>
<td>80.56±6.37</td>
</tr>
<tr>
<td>75 min</td>
<td>80.82±4.32</td>
<td>79.95±8.43</td>
<td>80.60±5.95</td>
</tr>
<tr>
<td>90 min</td>
<td>80.55±4.45</td>
<td>79.83±8.50</td>
<td>80.34±7.10</td>
</tr>
</tbody>
</table>

P = Paravertebral group, E = Epidural group, G = General group, n = Number, No significant difference between the studied groups.

Intraoperative mean arterial blood pressure showed no significant difference in P group compared to the base line reading (Table 2).

Intraoperative heart rate shows no statistical significant difference among the three studied groups and no significant difference in comparison to the baseline reading in all groups (Table 3).

The severity of postoperative pain measured using Visual Analogue Scale (VAS) was significantly lower in the P group at 0, 2, 4, 6, 12 and 24 h compared to E and G groups (p<0.05) (Fig. 1).

Table 4: Number of patients consuming analgesics and PONV during the follow-up period

<table>
<thead>
<tr>
<th>Groups</th>
<th>P group (n = 18)</th>
<th>E group (n = 19)</th>
<th>G group (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients (n)</td>
<td>2*</td>
<td>13*</td>
<td>20</td>
</tr>
<tr>
<td>PONV</td>
<td>0*</td>
<td>0.3 (0.4)</td>
<td>0.5 (0.6)</td>
</tr>
</tbody>
</table>

P = Paravertebral group, E = Epidural group, G = General group, n = Number, *p<0.05 is significantly different from the same reading in the specified groups. Data represented as number or mean (SD).

Fig. 1: Mean postoperative Visual Analog Scale (VAS) pain scores in millimeters (0 = no pain to 100 = worst pain imaginable) reported by patients at 0, 2, 4, 6, 12 and 24 h after arrival at recovery, P = Paravertebral group, E = Epidural group, G = General group, *Statistically significant (p<0.05) compared with the other two groups.

Number of patients consuming analgesics in 24 h was significantly lower in the P group compared to group E and group G (p<0.05), it was 2, 13, 20 in P, E, G groups respectively. Number of patients having postoperative nausea and vomiting was significantly higher in G group than in the P group and E group G (p<0.05). It was 0, 0.3 (0.4), 0.65 (0.6) in P, E, G groups respectively (Table 4).

**DISCUSSION**

Epidural anesthesia although effective but associated with side-effects include hypotension, urinary retention, incomplete (or failed) blockade and in rare cases, paraplegia. Paravertebral block (PVB) is an alternative technique that may offer comparable analgesic effectiveness and a better side-effect profile (Davies et al., 2006). Placement of local anaesthetic within the paravertebral space produces unilateral somatic and sympathetic block, which is advantageous for unilateral surgical procedures of the chest and abdomen (Karmakar, 2001). These unique characteristics are attributed to ipsilateral blockade of the
spinal nerves and sympathetic chain, without blocking of the contralateral sympathetic chain (Richardson and Lönqvist, 1998).

The present study demonstrated that patients undergoing percutaneous nephrolithotomy using lumbar PVB with bupivacaine 0.5% was associated with more intraoperative hemodynamic stability, reduced postoperative pain and significantly lower postoperative analgesic requirements for 24 h than patients receiving epidural anesthesia or general anesthesia and it is not associated with PONV.

Postoperative urine retention could not be assessed as the patients were catheterized.

In this study, Intraoperative mean arterial pressure was significantly lower in the G group compared to the P and E groups 5 min after induction of anesthesia due to the use of propofol as an induction agent, it was also significantly lower in the G group compared to the P group 15 min after induction of anesthesia due to the use of IPPV and turning the patient to the prone position. Intraoperative mean arterial blood pressure was significantly lower in the E group compared with P and G groups from 15 to 90 min due to bilateral sympathetic block aggravated by turning the patient to the prone position.

The study done by Casati et al. (2006) showed that Continuous thoracic paravertebral analgesia is as effective as epidural blockade in controlling post-thoracotomy pain, but is associated with less haemodynamic effects. Also, the study done by Ben-David et al. (2007) showed that patients given preoperative bilateral PBVs using ropivacaine 0.5% and a single dose of a COX-2 inhibitor was associated with significantly lower pain scores and opioid consumption reduced Hospital LOS after radical retropubic prostatectomy than patients given 30 mL bupivacaine 0.25% infiltrated in the wound at skin closure and ketorolac 30 mg administered intravenously. Naja et al. (2005) showed that 80% of children undergoing herniorrhaphy given GA then, unilateral PBVs at the T12-L1, L1-L2 and L2-L3 0.1 mL kg⁻¹ of a local anesthetic mixture injected at each level, the pain scores (at rest, during movement and during activity) were found to be lower in the PVB group compared with the GA/SA (general anesthesia with systemic analgesia) group and less than one third of the patients requiring supplemental analgesics during the first 48 postoperative hours and also allowed for significantly earlier hospital discharge.

This prolonged analgesia could be due to the use of 6 mL lidocaine, 2%; 6 mL lidocaine, 2%, with 1/200,000 epinephrine; 6 mL bupivacaine, 0.5%; 1 mL fentanyl, 50 µg mL⁻¹ and 1 mL clonidine, 75 µg mL⁻¹ in this study we use only plain bupivacain 0.5% which offers analgesia for 24 h (the duration of the study) but prolonged analgesia (up to 23 h) has also been reported after the use of plain bupivacaine for breast surgery, indicating that paravertebral administration of plain local anesthetics seems to result in more long-lasting analgesia compared with most other anatomical locations (Greengrass et al., 1996).

The study done by Jamieson and Mariano (2007) showed that two patients with ureteral calculi given preoperatively, thoracic and lumbar paravertebral nerve blocks with 0.5% ropivacaine, one patient scheduled for cystoscopy and ureteroscopy with laser lithotripsy received general anesthesia intraoperatively. The second patient underwent extracorporeal shock wave lithotripsy with propofol intravenous sedation. Postoperatively, both patients reported pain scores of zero (Visual Analog Scale) for 24 h and required no opioid analgesia. Also, the study done by Naja et al. (2001) showed that patients undergoing inguinal hernia repair given either general anesthesia or spinal anesthesia or paravertebral the need for supplemental postoperative analgesics was found to be higher in both SA and GA when compared to PVB patients who were managed without any analgesics during the first 24 postoperative hours and the incidence of PONV was significantly reduced in patients treated with the PVB compared to patients receiving SA and GA.

Naja et al. (2002) showed that patients received bilateral paravertebral nerve blockade for ventral hernia repair had lower visual analogue scores and a significantly reduced need for supplemental opioid administration during the first 48 h postoperatively compared with general anaesthesia and the rate of postoperative nausea and vomiting in the paravertebral nerve blockade group was only 3.3% versus 26.7% in the general anesthesia group.

Najarian et al. (2003) compared paravertebral block (PVB) and general anesthesia in patients undergoing breast cancer surgery, PVB resulted in better postoperative pain control and earlier resumption of diet compared with GA. Also, Pekka et al. (2004) study showed that a PVB with bupivacaine 1.5 mg kg⁻¹, performed before general anesthesia in patients scheduled for breast surgery, resulted in less need for postoperative opioid analgesics in the first hours after surgery and in less overall intensity of pain on the first postoperative day, the PVB patients had fewer incidents of and received fewer doses of antiemetic medication than the control group.

Also Lönnqvist and Olsson (1994), showed that pediatric patients undergoing renal surgery, receiving either PVB or EDA The need for supplemental morphine administration was significantly lower and the number of patients with no need for supplemental morphine administration postoperatively was significantly higher in patients treated with PVB vs EDA in pediatric patients undergoing renal surgery.
Vogt et al. (2005) found that single-shot paravertebral block for postoperative pain treatment after thoracoscopic surgery produce prolonged postoperative analgesia and they confirmed the findings of previous studies showing that single-injection thoracic paravertebral block reduced the severity of postoperative pain after breast surgery (Pekka et al., 2004; Naja et al., 2003). This finding may be explained by a pre-emptive effect of the paravertebral block reducing the nociceptive input to the central nervous system in the first hour after surgery may have attenuated central sensitization, thereby leading to less postoperative pain (Woolf and Salter, 2000).

In summary, lumbar paravertebral block with bupivacaine 0.5% was associated with more intraoperative hemodynamic stability and associated with prolonged analgesia and significantly decreases the postoperative analgesic requirements than epidural anesthesia and general anesthesia in patients undergoing percutaneous nephrolithotomy with out increasing the incidence of nausea and vomiting.

REFERENCES


