Evaluation of Motor and Sensory Blockade in Continuous Spinal Anesthesia Compared to Epidural Anesthesia in Preeclamptic Patients Undergoing Cesarean Section

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Abstract

Objectives: To evaluate the sensory and motor block of continuous spinal anesthesia compared to epidural anesthesia in mild to moderate preeclamptic patients undergoing cesarean section.

Methods: 40 mild to moderate preeclamptic patients undergoing cesarean section under regional anesthesia. Patients are randomly allocated into 2 groups, CSA group (n=20) received continuous spinal anesthesia using spinocath and were given 5mg of hyperbaric bupivacaine 0.5% + 25ug fentanyl as initial dose, and increments of 2.5mg of bupivacaine 0.5% at 5min intervals until the desired sensory level of T4. Patients of CEA group (n=20) received continuous epidural anesthesia and were given 60mg of lidocaine 2% as a test dose then the block is activated by giving 75mg of isobaric bupivacaine 0.5% + 100ug fentanyl and increments of 25mg of bupivacaine 0.5% at 15min interval until the desired level of T4. All patients were preloaded with 10ml/kg Ringer’s solution, and the block was performed at L3-L4 interspace with the patient in the sitting position through the midline approach.

Results: The performance time, onset, duration of the block were recorded in the CSA group (7.3±2.5, 6.2±2.1 and 115.4±16.3min respectively) which were significantly less performance time, faster onset and longer block duration than the CEA group (13.8±2.6, 19.6±7.2 and 100.3±14.7min, \(p < 0.001\)). The levels of sensory and motor block were assessed at 5, 10, 15, 20 and 30min after the block in both groups. There was significant difference (the \(p <0.001\)) with higher levels of sensory and motor block were observed in CSA group compared to CEA group.

Conclusion: Continuous spinal anesthesia using catheter over needle technique in anesthetic management of mild to moderate preeclamptic patients undergoing cesarean section provides less performance time, faster onset, effective sensory and motor block and longer duration than the continuous epidural anesthesia.

Key Words: Continuous spinal – Epidural – Spinocath – Preeclampsia.

Introduction

GENERAL anesthesia for cesarean section in preeclamptic parturient is complicated by increased upper airway edema, unpredictable duration of muscle relaxants with the use of magnesium and marked hypertensive response to tracheal intubation, surgical stimulation and emergence [1]. Also the obese patients’ predisposition toward difficult intubation further reinforces the desire to avoid general anesthesia [2]. When regional anesthesia is considered for management of preeclamptic patients, epidural rather than spinal anesthesia is often chosen due to more gradual onset of peripheral sympathetic blockade. Spinal anesthesia can rapidly decrease the systemic vascular resistance, resulting in maternal hypotension, uteroplacental hypoperfusion and poor fetal outcome [3].

Continuous Spinal Anesthesia (CSA) is an underutilized technique in modern anesthesia practice compared to epidural. CSA provides safer preoperative confirmation of catheter position, faster onset of action and more reliable block. Moreover, only 1/10 to 1/5 of anesthetics are required, resulting in lower risk of systemic toxicity. In contrast to Single-Dose Spinal Anesthesia (SDSA), with CSA repeated doses can be administered to prolong and control the duration and level of block during the operation, improving overall anesthetic control [4].

A new catheter-over-needle design (spinocath) has been developed to minimize problems and complications of CSA with microcatheters, which include difficult catheter insertion, failure of inser-
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Spinocath provides accurate feedback, the pronounced dural click and the prompt visual check of CSF, confirming the intrathecal catheter position [5].

Patients and Methods

The study was conducted in Kasr Al-Ainy Hospital in Obstetric Elective Unit from 2013-2014, after approval from the local ethical committee and obtaining written informed consent from all patients enrolled in the study.

The study included 40 patients with mild to moderate preeclampsia (Systolic Blood Pressure “SBP”=140-160mmHg and/or diastolic blood pressure “DBP”=90-110mmHg), pregnant in full term viable single baby, indicated for elective cesarean section under neuroaxial anesthesia. Patients with absolute or relative contraindications to neuroaxial blocks, with severe cardiovascular, pulmonary or renal insufficiency, patients in labor or in fetal distress or having severe preeclampsia and/or HELP syndrome were excluded from the study.

Patients were randomly allocated into 2 groups, CSA group (n=20) received continuous spinal anesthesia and CEA group (n=20) received continuous epidural anesthesia, after doing the standard institutional investigations, implementation of standard monitoring and preloading with 10ml/kg Ringer solution over 20-30min prior to the block. All blockades were performed at L3-L4 interspace with the patient in the sitting position through the midline approach under complete aseptic precautions.

For the CSA patients, a 22G catheter mounted over a 27 Quincke needle (Spinocath, B, Braun Melsungen AG, D-3429. Melsungen, Germany, product code number 4517725) was used. After identifying the epidural space with a modified Tuohy (Crawford) needle, the catheter with spinal needle inside was advanced through the epidural space until the dural puncture was felt and cerebrospinal fluid was seen in the catheter. The catheter was fed over the needle into the intrathecal space about 3cm. The spinal needle and the modified Tuohy needle were removed and a luer connector and a filter were attached to the catheter.

The block is initiated by giving 1 ml of hyperbaric bupivacaine 0.5% (5mg) + 25ug fentanyl, the incremental doses in the form of 0.5ml of bupivacaine (2.5mg) were given every 5min. until the desired level of T4 was achieved assessed by loss of cold sensation and pin-prick test. The motor block was monitored according to modified Bromage scale [6] ranging from 0 (the patient is able to move the hip, knee and ankle) to 3 (the patient is unable to move the hip, knee and ankle). The time and total volume of top-up doses were recorded.

At the end of surgery, 25ug fentanyl diluted in 1ml normal saline was injected intrathecally and the catheter was removed 24 hours afterwards.

For the CEA group, the block was performed using the epidural set (Perifix, B. Braun Melsungen AG, product number 4514017) with 18G Tuohy needle and 20G epidural catheter. The epidural space was identified by loss of resistance and the catheter is threaded through the Tuohy needle 3cm in the epidural space.

The epidural was tested by 3ml of lidocaine 2% after which the block was activated by 15ml of isobaric bupivacaine 0.5% (75mg) and increments of 5ml of bupivacaine every 15min. until the desired sensory level of T4 was reached. The time and total volume of top up doses were recorded.

At the end of surgery, 100ug fentanyl diluted in 10ml saline was injected in the epidural catheter and the catheter was removed 24 hours afterwards.

For both groups, if failure of the block has occurred as no block or inadequate block, it will be recorded and the patient was shifted to general anesthesia.

All patients received nasal oxygen at flow rate of 3L/min. and given intraoperative maintenance fluids at a rate of 10ml/kg/h. The incidental hypertension (SBP ≤20% of baseline level or mean arterial blood pressure <60mmHg) was treated by increment doses of 3mg of ephedrine and the incidental bradycardia (heart rate <50 beats/min) was treated by 0.5mg atropine increments. The incidence of hypotension and bradycardia and the total doses of ephedrine and atropine were recorded.

Statistical analysis: Data were statistically described in terms of mean ± standard deviation (mean ± SD), frequencies (number of cases) and relative frequencies (percentages) when appropriate. Comparison of quantitative variables between the study groups was done using the student t-test for normally distributed variables and Man Whitney U for non-normally distributed variables. For comparing categorical data, Chi square (χ²) test was performed and followed by Fisher Exact as a post-hoc. Multiple measures in the same group were compared using repeated measures analysis of variance (ANOVA) test. Probability value (p-value)
<0.05 was considered statistically significant. All statistical calculations were done using the SPSS program version 10 (SPSS In, Chicago, IL, USA).

Results

The study included 40 patients scheduled for cesarean section randomized in 2 groups; CSA group (n=20) received continuous spinal anesthesia. CEA group (n=20) received continuous epidural anesthesia. Both groups were comparable as regard the age, weight, the ASA physical status and the surgical time.

Comparison between the 2 groups regarding the performance time of the anesthetic technique, the onset time and the duration of anesthesia showed that the CSA group has significant shorter performance time and time to onset of anesthesia and longer duration of anesthesia than the CEA group as shown in (Table 1).

Significant higher levels of sensory blockade were observed in patients of CSA group compared to CEA group at 5, 10 and 15 minutes intraoperative (p-value <0.001). However, by the 20min, the majority of CEA group (85%) reached the sensory level of T6 to T4. After 30min intraoperative, more patients of CEA group reached the level of T4 as shown in Figs. (1,2).

Level of motor blockade was assessed using the modified Bromage scale [6] at 5, 10, 15, 20 and 30 minutes intraoperative. Rapid onset of motor block was evident in group CSA compared to CEA group as shown in (Table 2), with all patients of CSA group reached the maximum motor block (grade 3) after 20min while 20% of CEA group were still in grade 1 motor block (p<0.001). However, after 30min there was no significant difference between the 2 groups regarding the motor block (p=0.117). Almost all patients of the CEA group had complete motor block after 30 minutes except 2 patients.

The total volume of the local anesthetic needed to achieve the desired level in the CSA group was significantly lesser (<3,5ml in all patients of the group) compared to the CEA group (> 15 ml needed in all patients of the group).

Table (1): Performance time, onset time and duration of anesthesia in both groups.

<table>
<thead>
<tr>
<th></th>
<th>CSA group</th>
<th>CEA group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance time (min.)</td>
<td>7.3±2.5</td>
<td>13.8±2.6</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Onset time (min.)</td>
<td>6.2±2.1</td>
<td>19.6±7.2</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Duration of anesthesia (min.)</td>
<td>115.4±16.3</td>
<td>100.3±14.3</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

*: Statistically significant.

Fig. (1): Levels of sensory block of CSA group along the intraoperative period.

Fig. (2): Levels of sensory block of CEA group along the intraoperative period.
Discussion

Several studies indicate the increasing interest in CSA in obstetric patients because it offers the flexibility of extending the level and duration of the block when needed [7]. A completely different system, using catheter-over-needle design (spinocath), is currently available. This system is designed to minimize the postoperative complications of CSA with improved technique of its placement [8]. Our current study was designed to evaluate the safety, efficacy and the technical aspects of the CSA using the spinocath design compared to CEA in preeclamptic patients undergoing cesarean section.

The study showed that the CSA has less performance time, more rapid onset and longer duration of anesthesia compared to CEA with much less total dose of local anesthetics administered.

In the study of Klimscha et al., [9] they investigated the onset of anesthesia in SDSA, CSA and CEA and demonstrated that adequate surgical anesthesia was achieved significantly more rapidly in the SDSA group. But it was comparable in the CSA and CEA groups. In contrast to Schneider et al., [10] Collard et al., [11] and Inal et al., [12] who reported that the CSA has more rapid onset to attain the adequate surgical anesthesia compared to CEA this could be explained as Klimscha et al., waited 25min. before reinjection of local anesthetics while the other researchers waited 5-6min. the same as we did in our study.

Regarding the performance time of the CSA using the spinocath. Our results are comparable to what Imbelloni et al., [8] found in their study using spinocath 22G (needle 27G) confirming that it is easy technique to be performed taking short time comparable to epidural catheterization. But Andre et al., [13] reported that the CSA placement took longer time using the microcatheter 32G (needle 29G) compared to using Single Dose Spinal Anesthesia (SDSA) using a 24G Sproute spinal needle. This could be explained as using thinner microcatheter with spinal needle 29G may slow the flow of the spinal fluid through catheter confirming its intrathecal placement. It is well known that the time taken for spinal fluid to flow through a 29G needle is three times longer than through 27g needle. The use of different types of needles may explain different performance time.

The total doses of local anesthetics administered during CSA are much less compared to CEA which lower the risk of the systemic toxic reactions. Wilhelm and Sandle [14] also compared the total doses of local anesthetic administered during Combined Spinal Epidural (CSE) and the CSA among trauma patients. The doses were significantly smaller when using CSA.

Regarding the adequacy of sensory and motor blocks, there was a significant difference between the two groups. Higher levels of sensory block were reached more rapid in the CSA group compared to CEA group. After 5min, while all patients in CSA group reached the sensory level of T10-T12. 15 patients (75%) of the CEA group did not show any sensory block. CSA group kept superiority up to 20min intraoperative. However after 20min, the majority of CEA group (85%) reached the level of level of T4 or T6 of sensory block. Also rapid development of motor blockade was observed in the CSA group compared to CEA group. All patients of CSA group reached the maximum motor block after 20min, while 20% of CEA group still have grade I motor block.

In a study of Forster et al., [15] they found that the development of spinal anesthesia was quite slow in many instances especially the motor blockade when using CSA in patients undergoing peripheral bypass surgery of lower extremities, although the degree of skin anesthesia appeared sufficient before the start of surgery (loss of cold sensation up to at least T10), one third of patients experienced some pain at skin incision. The slow onset of motor blockade in Forster et al., study [15] might be attributed to as he used ropivacaine local anesthetic with weak motor blockade compared to bupivacaine.

Similar observations of slow onset of spinal anesthesia and occurrence of pain during incision
were also demonstrated by Pitkanen and his colleagues [16] who compared the CSA with SDSA but in their study they used small initial dose of bupivacaine of 5mg (1ml) and continued as slow infusion of plain bupivacaine of 2ml/hour which take longer time to attain the adequate surgical anesthesia.

Getting the adequate surgical anesthesia depends mostly on the protocol of giving the top-ups and the type of local anesthetic administered.

**Conclusion:**

Continuous spinal anesthesia using catheter-over-needle technique in anesthetic management of mild to moderate preeclamptic patients undergoing cesarean section provides more effective motor and sensory blockade compared to continuous epidural anesthesia.

**References**

الملخص العربي

هذة الدراسة الأكليتنيكية تهدف إلى تقييم أسلوب التخدير النصفي المستمر باستخدام قسطرة (سبينوكات) من انتاج شركة براون، بالمقارنة مع تخدير ما فوق الجافية إجراء الولادة القصصية في حالات تسمم الحمل البسيط والمتوسط.

وقد تم تقسيم المرضى إلى مجموعتين تشاركا حيث تحتوي كل مجموعة على 20 مريضة.

وقد أظهرت النتائج الأكليتنيكية أن التخدير النصفي المستمر باستخدام قسطرة (سبينوكات) يتميز عن تخدير ما فوق الجافية من حيث سهولة تركيب القسطرة، القدرة على توصيل مستوى تخدير مناسب للولادة القصصية، من ناحية منع الألم وارتخاء العضلات، في وقت أقل وكفاءة أعلى، باستخدام جرعات من المخدر الموضعى أقل بكثير جداً من الجرعات المستخدمة في تخدام ما فوق الجافية.

إن التخدير النصفي المستمر، إذا استخدم بشكل صحي يمكن القضاء على الشكوك السابقة حول سلامة ومضاعفات هذا التقنية عن طريق الدراسات الأكليتنيكية التي نشرت خلال السنوات الأخيرة، والتي تشجع على استخدام أكثر تواتراً لهذه التقنية في المستقبل.