Haemodynamic Changes in Continuous Spinal Anesthesia Versus Epidural Anesthesia in Preeclamptic Patients Undergoing Cesarean Section

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Abstract

Objective: To evaluate the hemodynamic changes 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 mean arterial pressure in mmHg, the heart rate in beats/min and the cardiac output in L/min were recorded during the operation with no significant difference between the 2 groups but the changes were delayed in the CEA group.

Conclusion: Continuous spinal anesthesia using catheter over needle technique in anesthetic management of mild to moderate preeclamptic patients undergoing cesarean section provides the same hemodynamic changes.

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 insertion, breakage, inadequate anesthesia, Postdural Puncture Headache (PDPH) and rarely, cauda equina syndrome. Spinocath provides accurate feedback, the pronounced dural click and the prompt visual check of CSF, confirming the intrathecal catheter position [8].

The study tried to evaluate the technical aspect, the advantages, disadvantages and complications
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of CSA using spinocath compared to epidural in mild to moderate preeclamptic patients undergoing cesarean section.

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 HELLP 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 1ml 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 hypotension (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.

Measurements:

The Mean Blood Pressure (MBP), the Heart rate (HR) and the cArdiac Output (CO) [measured noninvasively using the Impedance Cardiography (ICG) device (Bio.Z.Com , Cardio Dynamic International Corporation, USA)], before induction of anesthesia (baseline), every 3min during the first 20min, every 10min till the end of surgery and 12h and 24h postoperatively.

The incidence of postoperative complications in the form of Postdural Puncture Headache (PDPH), pruritus, urinary retention and persistent paresthesia 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 (\( \chi^2 \)) test was performed and followed by Fisher Exact as a posthoc. 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 and 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 as shown in (Table 1).

Table (1): Age, weight, ASA physical status and surgical time in the 2 studied groups.

<table>
<thead>
<tr>
<th></th>
<th>CSA group</th>
<th>CEA group</th>
<th>( p )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>24.75±3.29</td>
<td>24.55±3.03</td>
<td>0.84</td>
</tr>
<tr>
<td>Weight (in Kg)</td>
<td>88.7±12.7</td>
<td>81.74±14.2</td>
<td></td>
</tr>
<tr>
<td>Surgical time (in minutes)</td>
<td>73±26</td>
<td>78±28</td>
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</table>

Both techniques were hemodynamically stable, there were statistical significant changes in heart rate and blood pressure in the CSA group during the first 10 minutes, while in the CEA group, the changes were delayed after 20 minutes, with no significant changes in cardiac output in both groups along the intraoperative period. However, all changes were within the clinically accepted values as shown in Figs. (1-3).

![Fig. (1): Mean Arterial Pressure (MAP) changes in both groups during the intraoperative period.](image1)

![Fig. (2): Heart rate changes in both groups during the intraoperative period.](image2)
But there was significant difference in the ephedrine doses needed to treat intraoperative hypotension between the two groups. In the CSA group, no ephedrine used in 10 patients, 3mg needed for 5 patients and 6mg needed for the remaining 5 patients. While in the CEA group, no ephedrine used in 5 patients, 3mg needed for 6 patients, 6mg for 6 patients and 9mg for the remaining 3 patients as shown in (Table 2). No incidence of significant bradycardia was reported in both groups (so no atropine used).

Table (2): Doses of ephedrine used to treat intraoperative hypotension in both groups.

<table>
<thead>
<tr>
<th>Dose of Ephedrine (mg)</th>
<th>Number and percentage of patients</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>CSA group</td>
</tr>
<tr>
<td>No Ephedrine:</td>
<td>10 (50%)</td>
</tr>
<tr>
<td>3mg</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>6mg</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>9mg</td>
<td>3 (15%)</td>
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</table>

Most of patients suffered no or minor postoperative complications with no significant difference between the 2 groups as shown in (Table 3).

Table (3): Incidence of postoperative pruritus, PDPH, urinary retention and persistent paresthesia 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>Pruritus</td>
<td>2</td>
<td>1</td>
<td>0.548</td>
</tr>
<tr>
<td>Postdural puncture headache (PDPH)</td>
<td>2</td>
<td>0</td>
<td>0.147</td>
</tr>
<tr>
<td>Urinary retention</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Persistent paresthesia</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
</tbody>
</table>

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 [6]. 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 [7]. 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.

For the hemodynamics, both techniques were hemodynamically stable. There was statistically significant changes in the heart rate and blood pressure in the CSA group during the first 5 to 10min. While in the CEA group, it was after 20min. However the changes in the mean arterial pressure were in the normal range and the total ephedrine doses were very low in both groups.

In the CSA group, 50% of cases did not need ephedrine, 25% needed 6mg ephedrine (total dose) and 25% needed 9mg. While in the CEA group, only 25% of patients did not need ephedrine, 30% needed 3mg, 30% needed 6mg and 15% needed 9mg (total dose).

Although the clinical results showed that both techniques were hemodynamically stable, but the number of patients required ephedrine was significantly less in the CSA group compared to CEA group. These finding prove that the use of the CSA is hemodynamically more stable than the CEA in parturient patients.

Several studies have documented a more gradual and controlled onset of sympathetic blockade during the CSA compared to SDSA [8-10]; However the results were inconsistent [11,12]. Factors influencing the results of these studies include the type, dose, baricity and the volume of the local anesthetic injected, technique used and methodology [11,13]. In comparison of central neuraxis blocks (SDSA,
Ahmed E.M. Khalil, et al. CSA and CEA) in healthy elderly patients, Klimscha et al., [8] demonstrated that the decrease in the Mean Arterial Pressure (MAP) was significantly larger in the SDSA and CEA groups and required vasopressors use more frequently compared to CSA group. The rapid decrease in MAP in SDSA group in his study was consistent with findings from other investigators [14,15] they also reported that the hemodynamic effects produced by CSA were delayed for 20-60min after local anesthetic injection [16]. Consistent with the findings of Klimscha et al., [8]. Overdyke FJ et al., [17] who demonstrated the maximum BP decline occurred 35min after the initial injection of local anesthetics, well after delivery of the infant.

Consistent with these results, Collard et al., [18] showed that CSA in healthy elderly patients resulted in lesser decrease in blood pressure and lower incidence of vasopressor use when compared to age matched controls receiving CEA. Also Inal et al., [10] in his study observed no decrease in blood pressure.

In a study of Forster et al., [19] only 25% needed vasopressors during operation. This might be explained by the fact that they monitored the CVP invasively and tried to maintain it above a preset level.

In our current study, most of the patients suffered no or minor intraoperative or postoperative complications. Pruritus affected 3 patients, 2 in the CSA group and one in the CEA group; higher incidence in the CSA group is almost attributed to intrathecal fentanyl.

The PDPH affected 2 patients in the CSA group and no patients in the CEA group. Fortunately both cases were treated conservatively and resolved within the first 48 hours postoperatively.

Urinary retention and persistent paresthesia were not reported in both groups.

A new system of a catheter-over-needle design (spinocath) was developed to decrease the postoperative PDPH, is now available in the European market, many studies tried to investigate the use of this system for the obstetric patients regarding the incidence of PDPH.

In a study of Gosch UW et al., [20] a strikingly high overall rate of PDPH was reported, with a total frequency of 78%. They used 22G spinocath. The limitation of this study is the small group size which may mask group difference.

Alonso et al., [21] used this system for 92 elective cesarean deliveries, 90% of which had a 24 G catheter placed. For reasons that are not clear, the group reported a 14% failure rate in providing surgical anesthesia in patients in whom the catheter was successfully placed. While in our current study, we had no failure rate in the CSA group; furthermore, Alonso et al., reported a 28% incidence of PDPH (though <1 of 5 of this patients required an epidural blood patch), suggesting that different criteria for the diagnosis of PDPH may be used in this study.

Dresner and Pinder [22] used the same 24G catheter-over-needle system for cesarean delivery anesthesia in 34 patients with a variety of significant cardiac lesions. In contrast to Alonso et al., [21] they had no failures and only 3 of the 34 patients required an epidural blood patch (two of whom had received multiple dural punctures during the procedure).

Consistent with Dresner et al., [22]; Imbelloni et al., [5] reported that the incidence of PDPH was less than 3.3% when using spinocath and also Eberhard Albert Lux [23] found that the PDPH rate was 1.5% in patients who received CSA using spinocath. These results are comparable with our results.

Currently in the United States, the only catheters available for CSA are epidural catheters and kits. Most commercially available kits include 17G or 18G Tuohy-type needle, which can be used for dural puncture and placement of the catheter. An advantage of using such catheters is the ease with which the CSF flows back, confirming its placement. The disadvantage is the frequent incidence of PDPH in the obstetric population after dural puncture with those needles [7].

With the development of the catheter-over-needle design for CSA, the incidence of PDPH was dramatically decreased, this confirm its routine use especially in obstetric population. As well as, CSA is considered an attractive anesthetic technique in a number of situations and co-morbidities like cardiovascular diseases, morbid obesity, difficult epidural catheter placement and difficult airway, with much hemodynamic stability, less postoperative complications and flexibility of extending the duration of anesthesia.

**Conclusion:**

Continuous spinal anesthesia using catheter-over-needle technique in anesthetic management of mild to moderate preeclamptic patients under-
going cesarean section provides more hemodynamic stability compared to continuous epidural anesthesia.

References


الملخص العربي

هذه الدراسة الكلينيكية تهدف إلى تقييم أسلوب التخدير التصفيي المستمر باستخدام قسطرة (سيبيتوكا) من إنتاج شركة براون، بالمقارنة مع تخدير ما فوق الجافية لإجراء الولادة القيصرية في حالات تسمم الحمل البسيط والمعتدل.

ولقد تم تقسيم المرضى إلى مجموعتين بالتساوي حيث تحتوي كل مجموعة على 20 مريضة.

وقد أظهرت النتائج الكلينيكية أن التخدير التصفيي المستمر باستخدام قسطرة (سيبيتوكا) يتميز عن تخدير ما فوق الجافية بتأثيره المحدود على الجهاز الدورى حيث لم يكن هناك تغير يذكر في معدل النبض ومتوسط ضغط الدم.

إن التخدير التصفيي المستمر، إذا استخدم بشكل صحيح، هو تقنية فعالة وأمانة ليس فقط للتخدير أثناء الجراحة ولكن أيضا لتخفيض الألم بعد العملية.