

Prospective study of priming versus non-priming of Wik-Wire extension set during continuous spinal anaesthesia for repeat Caesarean section: A pilot study

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Abstract: Background: Continuous spinal anaesthesia during Caesarean delivery has been found to offer considerable advantages over "single-shot" spinal. Aim: This study aimed to find the difference between priming and non-priming of the Wik-Wire extension set with local anaesthetic on the induction-incision interval. Methods: Thirty ASA I and II parturients aged between 21 and 38 years scheduled for elective repeat Caesarean section were randomly allocated into one of two groups of 15 patients each. Patients in Group A had the Wik-Wire extension set primed with 1 ml of isobaric bupivacaine and threaded through flexible cannula. On connection with the hub of the cannula, back flow of cerebrospinal fluid (CSF) was confirmed by a drop hanging at the hub of the set. Group 2 patients had the un-primed Wik-Wire extension set connected to the flexible cannula. On connection with the hub of the cannula, back flow of CSF was evidenced by lowering the extension set to fill the tubing until the proximal cap of extension set was fully primed with passive flow of CSF. Isobaric 0.5% bupivacaine 10 mg was then administered intrathecally as the parturients returned supine while ensuring 15° left uterine displacement. Induction to delivery interval (I-D), defined as time from institution of induction of regional anaesthesia to delivery was studied. Results: All patients had satisfactory anaesthesia. The mean induction to incision (I-I) interval in group A 3.8 ± 1.5 mins while this was 7.2 ± 2.2 mins in group B, $p=0.001$. One patient in group B required a single dose of 5 mg ephedrine; while none required vasopressor support in group B. Conclusions: The study concludes that a primed Wik-Wire extension set can significantly reduce the induction of continuous spinal anaesthesia to delivery interval provides a fast and effective anaesthesia for caesarean section.

Keywords: Repeat Caesarean Section, Continuous Spinal Anaesthesia, Isobaric Bupivacaine

1. Introduction

Continuous spinal anaesthesia (CSA) is an underutilized technique in modern obstetric anaesthesia practice. Literatures showing the efficacy and safety of CSA during caesarean section are scarce but it is well known to have some advantages over single shot spinal anaesthesia in terms of rapidity in onset, high degree of success and provision for repeat dosing in aliquots.¹ Perhaps more accurately termed "fractional spinal anaesthesia", CSA involves intermittent dosing of local anaesthetic solution via an intrathecal catheter.

Where traditional spinal anaesthesia involves a single injection with a somewhat unpredictable spread and duration of effect, CSA allows titration of the block level to

the patient's needs, permits a spinal block of indefinite duration, and can provide greater haemodynamic stability than single-injection spinal anaesthesia.

Compared to previous reports^{2,3} the incidence of block failure and PDPH was found to be unacceptably high in one study⁴ with the conclusion that the risks of the technique appeared to outweigh the advantages of continuous spinal anaesthesia in obstetric practice. However, many other reports in the literature were merely case reports^{5,6} and in the non-obstetric population.⁷

The primary aim was to study the efficacy and safety of continuous spinal anaesthesia during repeat caesarean section and compare the induction to incision characteristics between priming and non-priming of the Wik-Wire extension *Wileyspinal*TM set.

2. Methods

Following approval from the Ethics Committee of the University of Port Harcourt Teaching Hospital, Port Harcourt and informed consent, thirty ASA I and II parturients aged between 21 and 38 yrs scheduled for elective repeat Caesarean section were recruited by convenient sampling method and randomly allocated into two groups of 15 parturients each. The technique used was catheter-over-needle and each of the *Wileyspinal™* EpiMed set used contained

- One *WileySpinal™*
- One Extension set with Wik-Wire™
- One 2Fr Peel-Away Introducer
- One 10ml Loss of Resistance Syringe
- One Insertion Site Support Pad

Inclusion criteria were, all uncomplicated, singleton term pregnancy scheduled for elective repeat Caesarean section. Excluded from the study were refusal to participate in the study, parturients younger than 18 years of age, pre-eclampsia, gestational age < 36 weeks and those with intercurrent medical diseases. Parturients with a history of allergy to the study drugs, anatomical deformity of the vertebrae, severe maternal hypovolaemia, coagulation disorders, localised infection over the injection site, neurological disorders, and severe congenital or acquired heart disease were excluded.

All the parturients were reviewed the day before surgery and had a premedication with ranitidine 50 mg intravenously in the morning of surgery. On arrival to the operation room, standard monitors for heart rate, peripheral oxygen saturation (SPO₂), non-invasive blood pressure, and electrocardiogram were applied, and variables measured and recorded. A preload using gelofusine 500 ml was administered over 10-20 mins. The parturients were positioned sitting with feet resting on a stool for the induction of anaesthesia. The procedures were performed by experienced anaesthetists with adequate knowledge of the procedure.

Following aseptic cleaning with povidone iodine and draping, a midline infiltration at L3/L4 with 3 ml 1% lidocaine was made to raise a skin weal. The epidural space was identified with the peel-away introducer with wings oriented laterally and advanced using the loss-of-resistance to air (LOR-A) technique. A pencil point needle and flexible cannula was then be advanced through the Peel-Away Introducer with the two handed technique. The pencil point needle with the flexible cannula was then advanced until a distinctive “give” was felt to indicate tip of needle piercing the dural sheath. A further 2 mm advancement of the cannula over needle was made. While the Wiley spinal flexible cannula was stabilized, the Peel-Away Introducer was separated from the parturient’s skin. The end point was evidenced by CSF back flow through the cannula after removal of the pencil point needle and stylet.

Parturients in Group 1 had the Wik-Wire extension set primed with 1 ml of isobaric bupivacaine and threaded through flexible cannula. On connection with the hub of the

cannula, back flow of CSF was evidenced by a drop hanging at the hub of the extension set. Group 2 parturients had the un-primed Wik-Wire extension set connected to the flexible cannula. On connection with the hub of the cannula, back flow of CSF was evidenced by lowering the extension set to fill the tubing until the proximal cap of extension set was fully filled with passive flow of CSF. Isobaric 0.5% bupivacaine 10 mg was then administered intrathecally as the parturients returned supine while ensuring 15° left uterine displacement.

The following variables were measured and recorded: (a) induction to incision interval; (b) duration of sensory blockade (defined by the reappearance of pain at the operative site requiring a reinjection of 1 ml of the same anaesthetic solution used); (c) incidence and amount of vasopressors and/or anti-cholinergics used; (d) total amounts of crystalloids and blood infused; (e) blood pressure and heart rate, measured before the anaesthetic injection and every 5 min thereafter until the end of surgery; and (f) urinary output, when possible every 30 min.

Motor blockade was assessed using the Bromage score every 10 mins after the spinal block; (1=able to raise legs above the bed, 2=able to flex knees, 3=able to move feet only, 4=no movement in legs or feet). Pain intensity was rated by the parturient using verbal pain score (VPS) ranging from 0 = pain free to 10 = worst pain imaginable. The VPS was recorded before the spinal analgesia and after 5, 15 and every 30 mins until delivery. Satisfactory analgesia was defined as decrease in pain scores < 3 within 5 mins of the institution of the spinal block.

Neonatal data recorded included the Apgar score and umbilical cord pH measured from the cord arterial blood collected shortly after delivery using the pH metre (IQ Scientific Instruments Mini-Lab Model IQ125). All parturients in both groups remained on admission for at least 5 days for close monitoring and with adequate fluid intakes and analgesics in the event of a post dural puncture headache.

The frequency of clinically important hypotension, defined as a decrease in systolic arterial pressure of 30% or more below preoperative baseline levels, as well as frequency of decreases in heart rate of more than 20%, was recorded. These haemodynamic changes were treated with 5 mg intravenous ephedrine and 0.5 mg intravenous atropine sulphate, respectively.

3. Statistical Analysis

Statistical analysis was performed using GB Stat (Dynamic Microsystems, Silver Spring, MD). Analysis of variance was used to analyze demographic data including baseline heart rate and pressures, lowest pressures, peak block level, and fluid requirements. The Mann-Whitney test was used to analyze induction to incision time, the number of measurements of hypotension for each parturient, and ephedrine dose.

The Fisher exact test was used for the number of

parturients treated for hypotension and the number requiring ephedrine. Results were considered significant at $P \leq 0.05$.

4. Results

Fifteen parturients were studied in each group. No parturient was excluded due to inadequate block or conversion to another form of anaesthesia. The bio-demographic data were similar in the two groups (Table 1). The haemodynamic variables are shown in Table 2. The mean baseline heart rate, systolic and diastolic blood pressures and; the mean maximal heart rate, systolic and diastolic blood pressure were essentially comparable between the two groups.

Table 3 shows the intraoperative intervals. While there was a statistically significant difference between the two groups in the mean induction to incision interval ($p=0.001$), the mean incision-delivery interval and mean duration of surgery were comparable between the two groups of parturients.

The neonatal outcome was comparable between the two groups (Table 4). However while one parturient each from the two groups complained about mild paraesthesia during the insertion of the flexible catheter, mild backache and mild hypotension were observed in one parturient each in Group A and B respectively (Table 5).

Table I. Bio-demographic data

	Group A	Group B	P-value
Age (yrs)	33.5±2.2	35.1±3.3	0.67
Height (m)	1.58±1.6	161.2±2.3	0.58
Weight	78.4±2.9	74.7±2.3	0.44

Table II. Haemodynamic variables

Variables	Group A	Group B	P-value
Mean baseline systolic BP (mmHg)	131.7±18.8	127.2±14.3	0.45
Mean maximal systolic BP decrease (mmHg)	28.1±7.5	30.8±5.5	0.21
Mean baseline diastolic BP (mmHg)	65.8±11.7	74.9±9.1	0.44
Mean maximal diastolic BP (mmHg)	14.3±10.4	17.5±8.6	0.18
Mean baseline HR (b/min)	68.4±13.5	68.4±13.5	0.11
Mean maximal HR decrease (b/min)	8.8±5.8	9.7±7.5	0.32

Table III. Intraoperative intervals

Intervals	Group A	Group B	P-value
Mean induction – incision interval (mins)	3.8 ± 1.5	7.2 ± 2.2	0.001*
Mean incision – delivery interval (mins)	2.7 ± 1.8	3.0 ± 1.3	0.51
Mean duration of surgery (mins)	111.7 ± 4.7	123.6 ± 3.5	0.06

*Statistically significant

Table IV. Neonatal outcomes

	Group A	Group B	P-value
Apgar score			
1 mins	10	10	
≥ 7			
5 mins	10	10	
≥ 9			
Umbilical artery pH	7.25±0.11	7.20±0.15	0.12

Table V. Complications

	Group A Number (%)	Group B Number (%)
Hypotension	-	1 (10%)
Paraesthesia	1 (10%)	1 (10%)
Backache	1 (10%)	-

5. Discussion

This prospective study described the use of continuous spinal anaesthesia with the *WileySpinal* flexible catheter as an effective and safe anaesthetic approach especially during repeat Caesarean section. Our study showed that priming the wik-wire extension set with local anaesthetic agent significantly reduced the induction to incision interval during continuous spinal anaesthesia. Although the use of regional techniques is being encouraged in obstetrics especially to prevent airway complications from the use of general anaesthesia, multiple or prolonged attempts at a technique can increase delivery time⁸ as well as have adverse neonatal outcome.⁹

The incidence of anaesthetic failure with CSA is likely to be variable. Although our study population was small we had 100% CSA success rate as compared to the work of Alonso et al.⁴ The group A parturients had a faster onset of analgesia than those in group B following an earlier priming of the extension set with the local anaesthetic agent. The group B extension set was lowered for it to be filled up passively by effect of gravity. The group B technique could be associated with some complications. Firstly, it could predispose the parturient to developing a PDPH following CSF displacement or loss. One study by Alonso et al.⁴ showed that the incidence of PDPH was as high as 29% (44% with the use of 22-gauge catheter versus 28% with the 24-gauge). The high incidence of PDPH in their study could be due to the aspiration of CSF during confirmation of correct intrathecal catheter placement. Although our study population was small, there was no case of PDPH recorded.

Spontaneous intracranial hypotension typically results from cerebrospinal fluid (CSF) leak or loss, often at spine level and only rarely from skull base. Once considered rare, it is now diagnosed far more commonly than before and is recognized as an important cause of headaches. CSF leak or drain leads to loss of CSF volume.¹⁰ The skull is a rigid non-collapsible container therefore loss of CSF volume

could be compensated by subdural fluid collections and by increase in intracranial venous blood which, in turn, causes pachy-meningeal thickening, enlarged pituitary, and engorgement of cerebral venous sinuses that could be visualised on magnetic resonance imaging.

Another consequence of CSF hypovolemia is sinking of the brain, with descent of the cerebellar tonsils and brainstem as well as crowding of the posterior fossa.¹⁰ The adult subarachnoid pressure of 5–15 cm H₂O is reduced to 4.0 cm H₂O or less.¹¹ The rate of CSF loss through the dural perforation¹² (0.084–4.5 ml s⁻¹) is generally greater than the rate of CSF production (0.35 ml min⁻¹), particularly with needle sizes larger than 25G.¹³

Secondly, meningitis could occur though uncommon complication of lumbar puncture. One review demonstrated that 50% of post-lumbar puncture meningitis occurs after spinal anaesthesia.¹⁴ Group B parturients in our study had the extension set lowered below the level of the skin puncture for the CSF to flow by gravity to fill the set. This technique could predispose the parturients to having the set contaminated by infective organisms.

The two groups of parturients were positioned sitting during the induction of continuous spinal anaesthesia. However, we advise using the most convenient position for the induction, based on obstetric factors as well as the anaesthetist's preference. However, the sitting position, commonly used for spinal insertion, may make the foetal condition worse. The left lateral position is usually better for uterine blood flow in the presence of foetal compromise.¹⁵ Once the spinal injection was performed, the parturients were immediately returned into the supine position with 15° lateral table or adequate pelvic tilt and maintained like this until delivery. It is a consistent finding that spinal block for Caesarean section develops more quickly in the supine position with lateral tilt compared to the lateral position.^{16, 17, 18} This finding was consistent with our study.

Fast and safe anaesthesia practice is always essential for any mode of anaesthesia for Caesarean section. While the conduction of continuous spinal anaesthesia may be simple in the hands of an experienced anaesthetist, it offers an advantage of providing adequate analgesia in aliquots of local anaesthetic agents. Previous Caesarean delivery is commonly related to abdominal adhesions, which might prolong the I–D interval.

Our study showed that the mean times from starting induction of CSA until achieving an adequate block were 3.8 ± 1.5 mins in group A and much slower in group B (7.2 ± 2.2 mins). We attach provisos to the use of CSA in our hospital. The possible risks attached to this technique have to be carefully weighed against those of the regular single shot spinal anaesthesia. We would not recommend it for use by novice practitioners of spinal anaesthesia, as it is preferable that they concentrate on providing one well administered anaesthetic technique, which by default is single shot spinal anaesthesia or general anaesthesia.

It should also not be used for cases where the vertebra is

predicted to be a difficult one, unless there are also specific factors imparting a high risk of general anaesthesia. If the trainee considered the risk of general or regional anaesthesia to be significantly high, for example in a woman with morbid obesity, the balance of risks might favour further attempts at spinal anaesthesia, particularly while waiting for the arrival of experienced assistance.

Continuous spinal anaesthesia is less frequently associated with wide fluctuations in the haemodynamic values. Minimal decreases in systolic, diastolic blood pressures and heart rates from preoperative baseline values were observed in our study. These changes were easily treated with atropine and rapid fluid administration. The relative haemodynamic stability of CSA observed in our study could probably be due to the slow development of sympathetic blockade. It has been shown that the maximum hemodynamic effects produced by local anaesthetic injection may not occur for up to 20 min after CSA, and this could give time for the compensating mechanisms to develop.¹⁹ The small sample size was a limitation of the study. Overall, our study demonstrated that a primed *Wileyspinal*TM extension set achieved a faster induction to incision interval during continuous spinal for repeat Caesarean section.

6. Conclusion

Our study showed that the induction to incision interval was reduced in the group with primed extension set during CSA for repeat Caesarean section. Nerve block that was adequate to start surgery was established in 3mins in the primed extension set group. It is important to note that reduction of decision-delivery interval requires effective teamwork. Although this study adds to the current knowledge on continuous spinal anaesthesia for Caesarean section, further studies with a larger study population may be needed.

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