PREVENTION OF HYPOTENSION IN CAESAREAN DELIVERY UNDER SPINAL ANAESTHESIA; THE COMBINATION OF MODIFIED SUPINE WEDGED POSITION, CRYSTALLOID CO–HYDRATION AND PROPHYLACTIC ATROPINE

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ABSTRACT

Objectives: To evaluate the efficacy of a modified supine wedged position with table tilt, crystalloid co hydration and prophylactic intravenous atropine in the prevention of hypotension in caesarean delivery under spinal anaesthesia.

Study Design: Phase 2 clinical trial.

Place and Duration of Study: PAF Hospital Masroor Karachi and PAF Hospital Rafiqi Shorkot Oct 2005 – April 2006.

Subjects and Methods: 40 parturients undergoing elective caesarean section under spinal anaesthesia were studied. Lactated Ringer's solution 10 ml/kg was administered over 10min.After Spinal in the sitting position with a 25-gauge Quincke needle using0.75% hyperbaric bupivacaine (12.75-15mg), the parturient was placed in the modified supine position with table tilt .Atropine 10µg/kg was given i/v. The baseline blood pressure and heart rate in each parturient before intervention (crystalloid co hydration, spinal, modified supine wedged position and i/v atropine) were taken as control and evaluated against the values after the intervention at different time intervals.

Results: Thirty nine out of forty patients completed the study. Mean upper sensory level was T4 at 6min post spinal. The mean spinal to delivery time was less than 12 min.5% of the parturients developed hypotension at 2 min post spinal. The mean heart rate was 96/min. The mean, systolic and diastolic blood pressures remained close to the base line values at 4, 6, 10, 12, 16 and 20 min post spinal.

Conclusion: Modified supine wedged position with table tilt, crystalloid co-hydration and prophylactic i/v atropine is an effective combination technique which prevents spinal induced hypotension in caesarean delivery.

Keywords: Spinal anaesthesia, hypotension, aesarean delivery, modified supine wedged position

INTRODUCTION

Spinal anaesthesia is often selected for elective or emergency Caesarean section [1,2]. The advantages are simplicity, rapid onset, reliability, dense motor block, and avoidance of the potential airway complications associated with general anaesthesia. However, hypotension occurs frequently following spinal block. The incidence of hypotension during spinal anaesthesia for Caesarean section is reported to be as high as 80%, despite fluid preload, lateral uterine displacement and use of vasopressors [3,4]. Although fluid preloading is still widely used, its place in the management of hypotension induced by spinal anaesthesia has been questioned [5]. The management of choice of this common problem is the use of intravenous (i.v.) vasopressors as required. Accumulating evidence that doses of

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ephedrine large enough to maintain maternal blood pressure after the induction of spinal anaesthesia may be detrimental to the fetus are causing a major change in approach to this problem [6].

There is good evidence that the strategy of recruiting blood from the lower extremities under spinal anaesthesia for Caesarean section is clinically beneficial [7-10]. A significant reduction in the incidence of hypotension by wrapping the patient's legs with an Esmarch bandage has been reported [8].

Different maternal positioning techniques have been described like Oxford [11] sitting to supine wedged or right or left lateral positions but none can effectively prevent hypotension and require rescue ephedrine boluses [12].

In this study a new modified supine wedged position with table tilt has been described in combination with other hypotension prevention strategies like rapid crystalloid cohydration (10-15 ml/kg) and use of atropine (10µg /kg).The objective was to test the effectiveness of this combination technique. Prevention of hypotension and intrathecal drug spread upto thoracic dermatome T4-T5 for adequate surgical conditions were the primary outcomes and prevention of maternal nausea and vomiting with good apgar scores secondary outcomes.

SUBJECTS AND METHODS

A phase two clinical trail was carried out at PAF Hospital Masroor Karachi and PAF Hospital Rafiqi Sharkot from Oct 2005 to April 2006. After approval of the hospital ethics committee, 40 parturients with American Society of Anaesthesiologists physical status I and II, having term pregnancies and undergoing elective cesarean section under spinal anaesthesia were included in the study. All patients gave written informed consent. Patients with strong active labour, preexisting or moderate to severe pregnancy-induced hypertension, cardiovascular or cerebrovascular disease, known fetal abnormalities, diabetes, morbid obesity or contraindications to spinal anaesthesia were excluded. The baseline blood pressure and heart rate in each parturient before intervention (crystalloid cohydration, spinal block, i/v atropine and modified supine wedged position) was evaluated against the values after the intervention .A reduction in 50% of incidence of hypotension through our intervention at various time intervals was considered significant. So this prospective phase II cliwas conducted.

Patients were premedicated with 0.3 m sodium citrate 30 ml on arrival to the operating room. Monitoring included noninvasive oscillotonometric mean arterial blood pressure measurement and computation of systolic and diastolic blood pressures, 3 lead electrocardiograms, and pulse oximetry (Siemens Germany, multiparametric monitor). Baseline mean, systolic arterial pressure (SAP), diastolic arterial pressure and heart rate (HR) were calculated as the mean of three successive measurements taken one minute apart after an initial 5 minute period of stabilization. The mean, systolic, diastolic blood pressures and heart rate were measured every two minutes after the induction of spinal till the time of delivery and continued upto the completion of surgery. The readings at 2 min, 4, 6,10,12,16, and 20 minute post spinal were used for comparison base line blood pressure and the statical analyses were based against these comparisons for the percentage of hypotension. Hypotension was defined as fall to 80% of mean blood pressure from baseline or below 100 mm Hg systolic.

Lactated Ringer's solution 10 ml kg-1 administered fast over 10 minutes and simultaneously with spinal another 2-5 ml kg-1 was given to a maximum of 15 ml kg-1 (cohydration). After this, the infusion was slowed down till the completion of surgery. Any additional fluid requirement according to surgical blood loss was recorded separately. Spinal anaesthesia was administered in the sitting position using 25-gauge Quincke needle inserted at the L2-L3 or

L3-L4 vertebral interspace, 0.75% Hyperbaric Bupivacaine was injected intrathecally. The dose depending upon patients' height and weight varied from 1.70 ml-2.0 ml (12.75 mg-15 mg). After the intra thecal injection the parturient was placed in the supine position with a wedge under the right buttock to give a 150 tilt. The head and cervical spine were raised utilising a specially designed wedge under the shoulders supporting the upper thoracic and cervical spine giving a 200-250 rise from the table surface. The table was tilted 100 down and the leg end raised 100 up thus giving enough gradient to the pooled blood in the lower extermities and pelvis to enter the central blood volume (fig. 1). Intrathecal drug spread and the block height was assessed every minute after waiting for five minutes after the intrathecal injection and the time noted from the injection time to the time when the block rose to T5. Injection Atropine 10µg.kg-1was given soon after the intrathecal bupivacaine.. Inj ephedrine was kept ready in 5mg bolus to treat hypotension. The times of spinal, skin incision, and delivery were recorded by a stopwatch. Neonatal Apgar score was assessed at 1 minute and five minutes by the attending paediatrician.

Data had been analyzed using SPSS version 10.0. Paired samples t-test was used to compare the base line mean blood pressure with mean blood pressure at different times post spina. P-value <0.05 was considered as significant.

RESULTS

A total of 40 parturients with full term pregnancy were included out of which 39 completed the study. In one parturient the spinal was not effective and was converted to general anaesthesia. Maternal demographic data and clinical variables (table-1). Spinal to skin incision time and other clinical variables (table-2).

The mean height and weight adjusted dose of Hyperbaric Bupivacaine was 14.38 mg and resulted in fast and dense block in 6.15 minutes in 95% of the parturient.

Ringers lactate used for cohydration varied between 550-750 ml with a mean value of 617.9 ml. The mean total crystalloid infusion till the end of surgery was 1075.6 ml with a maximum of 1500 ml in 5% of the patients.The mean dose of i/v Atropine was 0.68 mg. None of the patients had bradycardia (heart rate < 50/min), rather it was well maintained near a mean value of 96/min. Five percent of the patients had vomiting after the induction of spinal but without the episode of hypotension..

Mean upper sensory level was T4 at 6min post spinal and there was no block above T2. The mean spinal to skin incision time was 6.15 min but in 5% of the patients it took 12 min to allow skin incision the mean spinal to delivery time was less than 12 min. The mean 5 min Apgar score was 9.84 (+ 0.36).

Despite hypotension occurring at 2 minute post spinal, the minimum pulse at 2 minute was 70/min and the mean pulse was 96.5 + 15/min (table-3).

Five percent of the patients had systolic blood pressure less than 100 mmHg at 2 min post spinal with a minimum recorded at 63 mmHg. The systolic blood pressure was well maintained at 4 min post spinal (table-4).

The minimum diastolic blood pressure was 48 mmHg occurring in 2.5 % of the patients at 2 minute post spinal. The mean diastolic blood pressure at 2 minute was however maintained at 74.82 + 11.40 (SD). The minimum diastolic blood pressure at 4 min post spinal was 58 mmHg.

The mean systolic and diastolic blood pressures remained close to the base line values at 6 min, 10 min, 12 min, 16 min and 20 min post spinal (table-5).

There was insignificant difference between the base line mean blood pressure and the mean blood pressure at different time intervals post spinal, the value of p being 0.136, 0.186, and 0.243. 0.953, 0.704, 0.904,

0.572 respectively for each pair (table-6 & fig. 2).

Table-1: Patient characteristics and clinical variables (n=39).

	Minimum	Maximum	Mean	Std Deviation
Patient Age (years)	19.00	35.00	25.3590	3.8898
Weight (kg)	55.00	92.00	68.4103	7.6390
Height (cm)	145.00	178.00	160.2308	7.4744
Abocaine dose (mg)	13.50	15.00	14.3846	0.6855
Cry co- hyd (ml)	550.00	750.00	617.9487	38.8776
Total Crystalloides (ml)	1000.00	1500.00	1075.6410	113.4807
Atropine (ml)	0.60	0.90	0.6821	7.905E-02

crys = crystalloids, co - hyd = co – hydration

Table-2: Clinical variables.

	N	Minimum	Maximum	Mean	Std. Deviation
Spinal to skin inc time (Min)	39	4.00	12.00	6.1500	1.6878
Inc to del time (min)	39	4.00	12.00	5.3000	1.14711
Uterine inc to del time (s)	39	30.00	60.00	43.0500	7.2002
APGAR at 1 min	39	6.00	9.00	7.7436	0.5946
APGAR at 5min	39	9.00	10.00	9.8462	0.3655
Valid N (list wise)	39				

inc = incision, min= minutes, del = delivery, s = second

Table-3: Pulse changes baseline and at time intervals post spinal.

	Minimum	Maximum	Mean	Std. Deviation
Pulse /min Base Line	69.00	120.00	95.0256	12.0928
Pulse at 2 min	70.00	128.00	96.5128	15.0243
Pulse at 6 min	65.00	120.00	97.3333	16.0285
Pulse at 10 min	69.00	130.00	96.2821	15.4493
Pulse at 12 min	60.00	120.00	94.0000	14.2957
Pulse at 16 min	62.00	120.00	92.5641	12.5526
Pulse at 20 min	65.00	120.00	93.7692	14.5737

Table-4: Systolic blood pressure changes baseline and at time intervals post spinal.

	Minimum	Maximum	Mean	Std. Deviation
Sys Base Line	109.00	171.00	129.6667	12.6227
Sys B.P 2 min	63.00	172.00	125.1282	18.2903
Sys B.P 4 min	112.00	162.00	128.2308	11.6855
Sys B.P 6 min	101.00	159.00	126.4103	13.3726
Sys B.P 10 min	108.00	156.00	129.2564	12.2232
Sys B.P 12 min	103.00	162.00	128.8205	13.3059
Sys B.P 16 min	105.00	180.00	129.6923	14.5352
Sys B.P 20 min	105.00	182.00	128.1795	13.9168

Sys B.P =Systolic blood pressure mmHg,min= minutes

DISCUSSION

Despite measures utilised for prevention of hypotension, the incidence of hypotension following spinal anaesthesia for elective cesarean delivery remains high. Hypotension is defined arbitrarily in most studies, with values ranging from a 20–30% reduction from baseline systolic arterial pressures (SAP) to absolute values less than 90–100 mm Hg [13-15]. Techniques currently in use for prevention of hypotension include i/v fluid pre or co hydration [16] sympathomimatic drugs like ephedrine or phenylephrine [17], and physical methods such as table tilt, leg binders, compression devices [9].

However a cochrane review concluded that none of these theniques alone was effective in eliminating hypotension and

suggested that the future research be directed already fluid

Table-5: Diastolic blood pressure changes baseline and at time intervals

	Minimum	Maximum
Dia B.P Baseline	61.00	97.00
Dia B.P 2 min	48.00	95.00
Dia B.P 4min	58.00	95.00
Dia B.P 6min	56.00	92.00
Dia B.P 10 min	50.00	92.00
Dia B.P 12 min	51.00	95.00
Dia B.P 16 min	55.00	96.00
Dia B.P 20 min	58.00	98.00

dia = diastolic, B.P = blood pressure mmHg

Fig1. Position of operating table with the wedge under the shoulders.

Table-6: Mean blood pressure changes baseline and at time intervals post s pinal.

	Minimum	Maximum	Mean	Std. Deviation
Mean B.P control	66.00	115.00	94.5897	9.7811
Mean B.P 2 min	56.00	121.00	92.2051	13.9283
Mean B.P 4min	75.00	117.00	92.5128	10.7651
Mean B.P 6min	71.00	115.00	92.3590	11.4420
Mean B.P 10 min	72.00	128.00	94.7179	12.6552
Mean B.P 12 min	78.00	111.00	93.8974	9.4918
Mean B.P 16 min	78.00	121.00	94.4103	10.3815
Mean B.P 20 min	78.00	116.00	93.7949	10.5835

towards a combination of interventions [18].

Rapid crystalloid administration at the time of spinal (co hydration) in combination of high dose phenylephrine infusion is effective in preventionof hypotension [19]. How ever without prehydration 25% of patients develop one or more episodes of hypotension despite agressive phenylephrine infusion regimen [20]. The technique of rapid intravenous crystalloid infusion after spinal injection (cohydration or coload) is more physiologically appropriate than the practice of giving large volumes before spinal injection (prehydration or preload) for decreasing hypotension during spinal anaesthesia for cesarean delivery. This is explained by the rapid distribution into the interstitial space that occurs after infusion of crystalloids, which limits the effective augmentation of intravascular volume that is achieved [21]. Crystalloid cohydration decreases ephedrine requirements [22]. In our study inj Ringers lactate was administered fast and 10 ml/kg was given over 10 minutes. No parturient received more than 1500 ml whereas Ngan Kee et al [19] infused 2000 ml of crystalloid as cohydration.This can be detrimental in the retained parturients or those with PIH or limited cardiac reserve.

Intravenous atropine increases dose related heart rate and reduces the incidence of spinal induced hypotension and ephedrine requirements [23]. IV atropine may be a useful supplement to the existing methods in preventing hypotension induced by spinal anaesthesia.

Aortocaval compression is exacerbated by lying supine and has adverse effects on mother and fetus [24,25]. Lateral tilt reduces aortocaval compression and its associated effects. The common recommendation is a 15° lateral tilt which was first described by Crawford and colleagues in 1972 [26] and was achieved using a wedge. We used a uniformed wedge giving a 15° - 20° tilt in all the cases.

Every authority on spinal anaesthesia from the time of Labat has recommended a small degree of head down tilt to ensure venous return, thereby maintaining cardiac output and blood pressure. Clinicians are often concerned that this manoeuvre will increase the cephalad spread of a hyperbaric

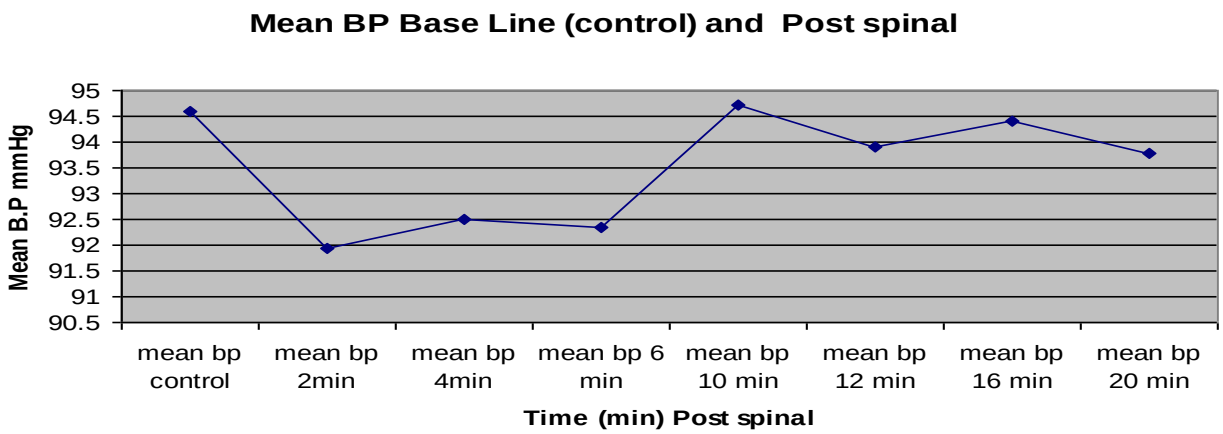

Fig. 2: Mean blood pressure changes over time (meanbp).

solution and make hypotension more likely, but even a 30° tilt has minimal effect on mean spread, although it does increase variability [26-28]. In our study we maintained about 25° - 30° head elevation with a specifically designed wedge to give a uniform elevation to lower cervical and upper thoracic spine. Due to good recruitment of central blood volume secondary to table tilt and leg elevation there was greater hemodynamic control.Transient hypotension occurred in 5% of the parturients only which required no vasopressor (fig. 2).

Maternal position during induction of spinal anaesthesia for cesarean section influences block height and hemodynamic stability [13]. Russel et al [14] compared three positions, oxford position [13] ,the right lateral to supine wedged and sitting to supine wedged for block height and hypotension using 12.5 mg hyperbaric bupivacaine. In our positioning technique as compared to the oxford technique, the parturient does not have to be placed in the left lateral position and after the block turned right lateral along with all the monitoring equipment which is inconvenient to the patient and offers no great advantage[14]. The quick onset of block and the time of about 6 minutes to reach T4 with good hemodynamic stability are the main advantages of this technique. Despite transient hypotension in 5% of the cases there was not a single episode of bradycardia which further validates the prophylactic use of intravenous atropine. The lack of need to use vasopressors and the moderate amount of crystalloid infusion as co hydration (mean 650 ml and a mean total fluid infusion of 1070 ml) without causing excessive fluid overload are the important findings of this study.

CONCLUSION

Modified supine wedged position with table tilt, crystalloid co-hydration and prophylactic intravenous atropine is an effective combination technique which prevents spinal induced hypotension in caesarean delivery. More randomised, case controlled studies are required to further validate our findings.

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