ORIGINAL ARTICLE

Comparison Between Preloading with 10 ml/kg and 20 ml/kg of Ringer's Lactate in Preventing Hypotension During Spinal Anaesthesia for Caesarean Section

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SUMMARY

This prospective, randomized, study was designed to compare the effect of two different preloading volumes of Ringer's lactate for prevention of maternal hypotension induced by spinal anaesthesia for Caesarean section. Eighty ASA I or II obstetric patients were randomized to two groups. Group 1 (n=40) received 20 ml/kg of Ringer's lactate and Group 2 (n=40) 10 ml/kg of Ringer's lactate over 20 minutes before spinal anaesthesia. The lowest mean arterial pressure (MAP) for both groups were recorded at 15 minutes after giving spinal anaesthesia, This difference in the drop of MAP from base-line at 15 minutes (mean decrease of 12.5 mmHg from baseline), between preloading with 10 ml/kg and 20 ml/kg of Ringer's was statistically significant. Twelve patients from Group 1 required bolus doses of ephedrine and 15% of these needed additional crystalloid whereas two patients from Group 2 needed ephedrine boluses and 22% of these required additional crystalloid. The difference in frequency of requirement for treatment of hypotension was not statistically significant. There were five patients in Group 1 and six patients in Group 2 who experienced nausea and vomiting, the frequency of occurrence did not show any statistically significant difference between the two groups. In conclusion, for prevention of hypotension during spinal anaesthesia for Caesarean section, infusing 20 ml/kg or 10 ml/kg of Ringer's Lactate gave similar results and we do not recommend the use of a larger volume of crystalloid for preloading before spinal anaesthesia.

KEY WORDS:
Spinal anaesthesia, Hypotension, Caesarean section, Preloading

INTRODUCTION

Many anaesthetists are concerned over the hypotension induced by spinal anaesthesia during Caesarean section. Spinal anaesthesia causes some degree of sympathetic blockade resulting in peripheral vasodilatation and hypotension. Hypotension is often associated with nausea and vomiting, and may lead to more severe complications to mother and baby. Several strategies are currently used to prevent or minimize hypotension[1].

Many studies have been done to look into various methods of preventing or minimizing hypotension including types of fluid used for preloading[2,3] time of preloading,[4,5] use of vasopressors, positioning of patients, use of leg stockings and others[1]. Prophylactic intravenous preloading is the method currently most commonly used[6]. Many types of fluid have been used and studied for preloading before spinal anaesthesia[2,3], such as comparing crystalloid with colloid as fluid of choice for preloading[1,2,7]. However, the volume of fluid used for preloading differs for various studies giving rise to different results. Volumes which had been used for preloading before spinal anaesthesia, include 150 mls, 1L, 1.5L, 8 ml/kg, 10 ml/kg, 15 ml/kg, 20 ml/kg and others [3,4,7,8]. Although the majority of studies highlighted the benefit of preloading in preventing hypotension during spinal anaesthesia[2], there were some studies which concluded that preloading was not effective and the type of fluid used did not make a difference[6]. Ueyama *et al* suggested that the augmentation of blood volume with preloading, regardless of fluid used, must be large enough to result in significant increase of cardiac output in order to prevent hypotension[2].

Currently, the most often recommended fluid for preloading is Ringer's lactate at 10 ml/kg. In an attempt to determine whether there is any benefit of a larger volume preloading, we compared 20 ml/kg for preloading with this established regime.

MATERIALS AND METHODS

This study was done following institutional ethical committee approval and obtaining patients' written informed consent. Eighty ASA I or II obstetric patients scheduled for elective Caesarean section under spinal anaesthesia were enrolled into this prospective, randomized, single-blinded study. Patients who were selected had normal singleton pregnancy, more than 36 weeks gestation with body mass index of 20-38 kg/m^2 and height more than 145cm. The exclusion criteria were contraindications for spinal anaesthesia and failed spinal which necessitate conversion to general anaesthesia.

Patients were fasted for at least 6 hours prior to operation and premedicated with oral ranitidine 150mg the night before and in the morning of the operative day. Thirty ml of 0.3M sodium citrate was given to the patients on arrival at the operating theatre as prescribed according to written protocol. A 16G or 18G intravenous cannula was inserted into a vein on the dorsum of patient's hand under local anaesthesia.

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Patients were randomly allocated into two groups by toss of coin. Group 1 received 20 ml/kg of Ringer's lactate infusion over 20 minutes before spinal anaesthesia was performed while Group 2 patients received 10 ml /kg of Ringer's lactate infusion. The baseline blood pressure was checked prior to preloading and performing spinal anaesthesia. The preloading volume was given as allocated. During preloading the arterial oxygen saturation was monitored by means of pulse oximetry.

When preloading was completed spinal anaesthesia was performed at L3-L4 level under aseptic technique, using a 27G pencil point spinal needle with the patient in the sitting position. Intra-thecal injection of 1.5 ml of 0.5% heavy bupivacaine and 25 µg fentanyl was done over 20 seconds. The patient was then placed in the supine position with a left lateral tilt of 15º. Ringer's lactate solution was infused at 2 ml/kg/hr for fluid maintenance during the operation. The level of spinal block was assessed using cold sensation to ice every 5 minutes after spinal anaesthesia was performed. Once T6 block was established surgery was allowed to proceed. The patient received 5U of oxytocin intravenously when the baby was delivered.

Immediately after the completion of the subarachnoid blockade, the blood pressure was recorded every 3 minutes for half an hour. Hypotension was defined as a fall of > 20% of MAP from baseline. Bolus doses of ephedrine 6 mg were given intravenously as the rescue drug if blood pressure decreased below 20% of baseline. The blood pressure was rechecked 1 minute after each doses of ephedrine. If hypotension persisted after 30mg of ephedrine, an additional 2 ml/kg of Ringer's lactate was infused rapidly. The volume of additional fluid given was recorded. Oxygen saturation, respiratory rate and electrocardiogram (ECG) were monitored continuously during the operation.

Statistical analysis was performed using Student's t-test (two tailed) and chi-square test as appropriate. Blood pressure changes from base-line and between groups were analysed using repeated measure analysis of variance and a posteriori tests between groups. A P value of <0.05 was considered statistically significant.

RESULTS

A total of 80 patients were recruited for this study. There were no significant differences statistically with regards to age, gravida, weight, height and race between these two groups of patient. Table I shows the demographic data of these two groups.

The difference between the mean arterial pressure (MAP) at baseline between Group 1 (88.3 ± 9.3) and Group 2 (86.1 ± 9.7) was not statistically significant. The lowest mean MAP for both groups was recorded at 15 minutes, representing a reduction of 12.5 mmHg from baseline. This difference in the drop in mean MAP from base-line at 15 minute was statistically significant between the groups.

Both groups of patients experienced hypotensive episodes which required bolus doses of ephedrine and additional crystalloids as treatment. Figure 1 shows the changes of MAP for both groups.

Twelve patients from Group 1 required bolus doses of ephedrine and 15% of these needed additional crystalloid whereas 11 patients from Group 2 needed ephedrine boluses and 22% of these required additional crystalloid. The difference in frequency of requirement for treatment of hypotension was not statistically significant. There were five patients in Group 1 and six patients in Group 2 who experienced nausea and vomiting which did not show any statistically significant difference between the two groups.

There were no statistical significant differences in mean heart rates between groups at all intervals following spinal anaesthesia. Figure 2 shows the changes in mean heart rate for both groups.

DISCUSSION

Spinal anaesthesia is currently a very popular anaesthetic technique for Caesarean section for many reasons. The onset of spinal anaesthesia is fast and in many instances this advantage is made used of for emergency Caesarean section with few exceptions such as urgent cases with severe bleeding. General anaesthesia for caesarian section is associated with increased maternal risks as compared to regional anaesthesia, for example difficult or failed intubation and higher risk for aspiration. The risk ratio between general anaesthesia and regional anaesthesia for obstetric patients was 17/1 during the triennium 1988-1990[9].

Extremely important physiological responses to spinal anaesthesia occur in the cardiovascular system. It is determined by combined effects of sympathetic denervation, level of neural block and vagal reaction. After pharmacological sympathetic denervation the mean arterial pressure decreases for 15-18% in the presence of a normal cardiac output. In the pregnant patient, compression of the vena cava by the gravid uterus further impedes venous return to the heart. If untreated, this process may lead to maternal hypotension and uterine hypoperfusion.

Table I: Demographic data and maternal characteristics.
Values are expressed in mean ± SD or number as appropriate.

	Group 1 (n=40)	Group 2 (n=40)
Age (years)	30.2 ± 4.6	29.7 ± 4.6
Weight (kg)	76.4 ± 12.2	74.8 ± 11.0
Height (cm)	156.7 ± 6.7	155.1 ± 3.9
Race (Malay: Chinese: Indian: Others)	34: 3: 2: 1	33: 2: 4: 1

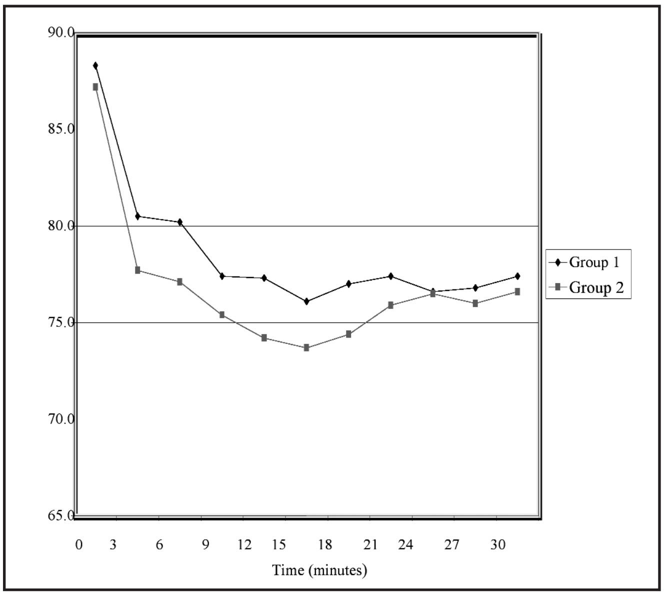

Fig. 1: Changes in mean MAP

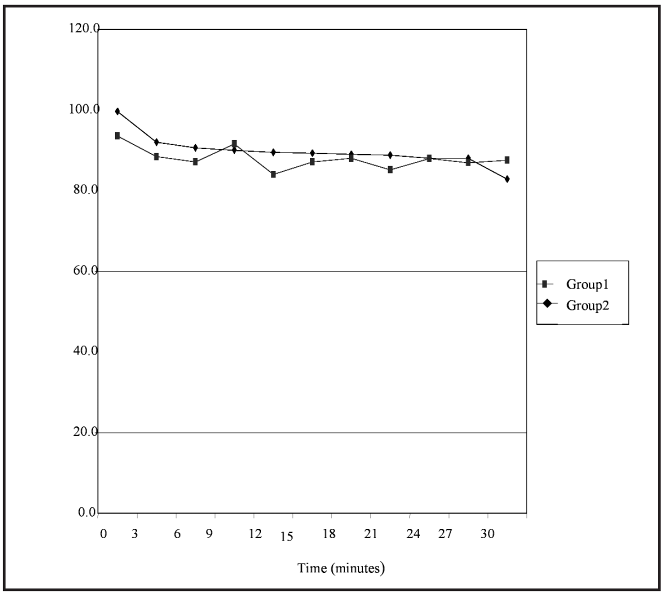

Fig. 2: Changes in mean heart rate

Fluid preloading is a traditional technique to prevent hypotension induced by neuraxial anaesthesia. Its function is to maintain intravascular volume in patients who are likely to lose 500-1000ml of blood and to reduce the incidence of hypotension associated with neuraxial anaesthesia[10]. Ueyama *et al* concluded that greater volume expansion results in less hypotension. Their study indicated that the augmentation of blood volume with preloading regardless of the fluid used must be large enough to result in a significant increase in cardiac output for effective prevention of hypotension[2]. However, currently no standard agreeable amount with regard to crystalloid volume required for preloading [3,4,7,8].

This study showed that there was a significant difference in the drop of MAP from base-line at 15 minutes (mean reduction of 12.5 mmHg from baseline), between preloading with 10 ml/kg and 20 ml/kg of Ringer's. Although the degree of hypotension may be clinically relevant, the number of patients who developed hypotension and received rescue measures were comparable in both groups. Giving a bigger volume of intravenous fluid did not reduce the frequency of hypotension.

Some studies have shown that hypotension associated with spinal anaesthesia for Caesarean section cannot be eliminated by volume preloading in the supine wedge patient[11,12]. One reason crystalloid solutions may not be effective is their short intravascular half-life. Despite this, intravenous crystalloids have been shown to significantly increase cardiac filling pressure before spinal anaesthesia but this increase is rapidly reversed after the onset of sympathetic blockade[13].

It has been shown that no technique totally eliminates the occurrence of hypotension. Combinations of techniques are more beneficial. The use of a colloid infusion for preloading, a co-loading technique, leg wrapping, and rapid fluid infusion have been studied, with some studies showing positive results.

In the newsletter published by the Society for Obstetric anaesthesia and Perinatology (spring 2003), Frolich, MA, presented a meta analysis that has cast doubt on the value of fluid preloading to prevent post spinal hypotension and also mentioned that, at the University of Florida, the practice of routine crystalloid fluid administration prior to neuraxial blockade has been stopped due to a lack of scientific evidence. It remains to be seen whether the long established routine practice of preloading will be discontinued in anaesthetic practice world wide. It should not be over emphasized that vigilant monitoring of maternal blood pressure after spinal anaesthesia with immediate treatment of hypotension by bolus doses of intravenous ephedrine must be advocated at all times.

CONCLUSION

For prevention of hypotension during spinal anaesthesia for Caesarean section, infusing 20 ml/kg or 10 ml/kg of Ringer's Lactate gave similar results.

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