British Journal of Anaesthesia 1990; **65**: 819–822

PREVENTION OF HYPOTENSION FOLLOWING SPINAL ANAESTHESIA FOR ELECTIVE CAESAREAN SECTION BY WRAPPING OF THE LEGS

S. BHAGWANJEE, D. A. ROCKE, C. C. ROUT, R. V. KOOVARJEE AND R. BRIJBALL

SUMMARY

Twenty-four parturients undergoing elective Caesarean section were allocated randomly to have the legs wrapped with elasticated Esmarch bandages immediately following spinal anaesthesia or to serve as controls. Significant hypotension (systolic arterial pressure < 100 mm Hg and < 80% of baseline value) was treated with i.v. ephedrine in 5-mg boluses. Leg wrapped patients had a significantly (P = 0.0033) lower incidence (16.7%) of hypotension than controls (83.3%). Only two patients in the leg wrapped group required ephedrine compared with 10 in the control group. Systolic arterial pressure was significantly (P < 0.05) less in control subjects at 4, 5 and 6 min following spinal injection. No patient in the leg wrapped group became hypotensive following removal of the elasticated bandages.

KEY WORDS

Anaesthesia, obstetric. Anaesthetic techniques: spinal. Complications: hypotension.

The incidence and severity of spinal hypotension may be reduced by administration of a crystalloid preload and the use of left lateral tilt [1]. Whilst these measures should be considered mandatory, they do not prevent completely the occurrence of hypotension, and administration of a vasopressor is often required. We have investigated leg compression using elasticated Esmarch bandages as a method of reducing the incidence and severity of post-spinal hypotension at Caesarean section.

METHODS AND RESULTS

Twenty-four healthy term mothers undergoing elective Caesarean section under spinal anaesthesia gave informed consent to participate in the study, which was approved by the local Ethics Committee. Patients with placental dysfunction, intrauterine growth retardation, abnormal fetal presentation or who weighed more than 90 kg were excluded. Patients were allocated randomly to two groups; group I ($n = 12$) had their legs wrapped immediately following subarachnoid injection of the local anaesthetic solution. Group II patients ($n = 12$) did not have their legs wrapped and acted as a control group.

Upon entering the operating theatre, fluid preloading was commenced (Plasmalyte L, 20 ml kg^{-1}, pregnant weight) and baseline heart rate (HR), systolic (SAP) and diastolic (DAP) arterial pressure measured and recorded with patients in left lateral tilt position. The same dedicated non-invasive arterial pressure monitor (Critikon Dinamap) was used in all patients. The mean of three readings at 3-min intervals was taken as the baseline value provided that SAP did not vary by more than 10%.

Following completion of baseline readings, patients were positioned on the operating table in the sitting position and plain 0.5% bupivacaine 1.5 ml was injected over 10 s through a 25-gauge needle into the subarachnoid space at the L3–4 interspace. Immediately thereafter patients were

S. BHAGWANJEE, M.B., B.CH.(NATAL); D. A. ROCKE, M.R.C.P. (U.K.), F.F.A.(S.A.); C. C. ROUT, F.F.A.R.C.S.; R. V. KOOVARJEE; R. BRIJBALL; Department of Anaesthetics, University of Natal, P.O. Box 17039, Congella 4013, South Africa. Accepted for Publication: July 22, 1990.

Correspondence to D.A.R.

returned to the left lateral tilt position and HR, SAP and DAP recorded at 1-min intervals for 10 min and every 5 min thereafter until completion of surgery.

Immediately after repositioning, group I patients had their legs wrapped. Each leg was raised 45° from the horizontal and a 10-cm Esmarch elasticated bandage applied from the ankle to the mid thigh, where the end was tucked in to prevent unravelling. More than one bandage per leg was necessary sometimes. Each leg was wrapped in turn and the presence of adequate capillary pulsation in the toes used to ensure that arterial pressure had not been exceeded. Leg wrapping was completed within 3 min.

Hypotension was defined as a decrease in SAP > 20 % from baseline in association with an absolute value < 100 mm Hg. If hypotension occurred, ephedrine was administered i.v. in 5-mg boluses at 1-min intervals until SAP returned to within 20 % of control values or more than 100 mm Hg. Neonatal condition was assessed by Apgar minus colour (A − C) score at 2 and 5 min and by umbilical arterial (Ua) and venous (Uv) blood-gas measurements. At termination of the surgical procedure the legs were unwrapped and haemodynamic variables recorded at 1-min intervals for 10 min.

Data were analysed using paired and unpaired *t* tests and Fisher's exact probability test as appropriate.

Groups were comparable for maternal age, weight, preload volume, mean thoracic sensory levels, spinal injection to delivery time, uterine incision to delivery time and baseline arterial pressures and heart rate.

There was a high incidence of hypotension requiring vasopressor therapy in the control group (83 %) (95 % confidence limits 50.9–98.4) compared with the leg wrapped group (16 %) (95 % confidence limits 1.6–49.1)—a difference which was significant both clinically and statistically ($P = 0.0033$, Fisher exact). Only two patients in group I (leg wrapped) required ephedrine (15 and 25 mg), whilst 10 patients needed ephedrine in the control group (three needed 5 mg, two 10 mg, three 15 mg, one 25 mg and one 45 mg, corresponding to the duration of hypotension).

In the control patients there was a decrease in SAP following spinal injection (fig. 1) which was significantly lower ($P < 0.05$) than baseline values at 3, 4, 5 and 6 min. SAP returned to baseline by 10 min and was greater thereafter, being significantly greater than baseline at 25 min. Leg wrapped patients had a small decrease in SAP between 1 and 5 min, which was not significant. The difference in SAP between the groups was significant ($P < 0.05$) at 4, 5 and 6 min.

Heart rate initially increased in both groups and was greater ($P < 0.05$) than baseline values in the control group at 1, 3, 4 and 6 min, whereas leg wrapped subjects had no significant increase (fig.

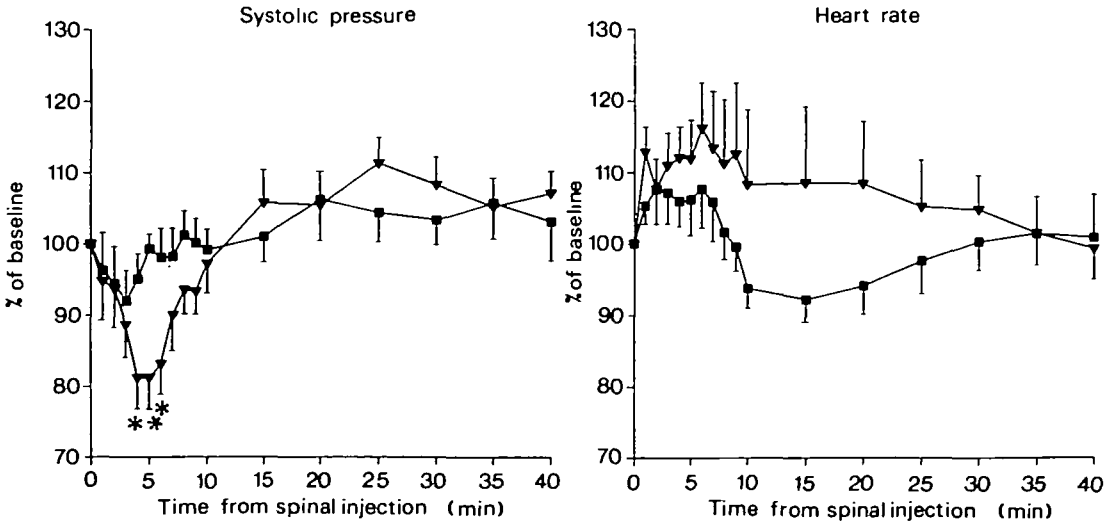

FIG. 1. Systolic arterial pressure and heart rate (mean, SEM) following spinal anaesthesia, expressed as a percentage of baseline values. *Significant differences ($P < 0.05$) between groups. See text for changes from baseline within groups. ■ = Legs wrapped; ▼ = control group.

1). HR in the leg wrapped group tended to decrease after 9 min and values at 10 and 15 min were lower ($P < 0.05$) than baseline. In the control group, HR remained increased from 10 to 30 min. The difference in HR between the groups was not statistically significant. No patient experienced hypotension following unwrapping of the legs. Papaveretum 10–15 mg i.v. was given to 22 of the patients following delivery, to provide postoperative analgesia.

All neonates were in good clinical condition at delivery. One neonate in the control group whose mother was hypotensive for 8 min had an A – C score of 7 at 2 min. There were no statistically significant differences in Ua and Uv blood-gas data between the groups; however, Ua oxygen tensions and saturations were significantly ($P < 0.05$) less in babies of mothers who developed clinically significant hypotension (hypotensive patients: Ua_{O_2} 1.9 (SD 0.49) kPa, saturation 13.9 (5.9)%; normotensive patients: Ua_{O_2} 2.5 (0.32) kPa, saturation 24.1 (6.94)%).

COMMENTARY

Hypotension following spinal anaesthesia results from a decrease in arteriolar and venous tone secondary to sympathetic block, with a consequent reduction in systemic vascular resistance and venous return [2]. As a significant contribution to the hypotension is made by venous pooling in the legs and abdomen, we investigated simple leg wrapping as a method of reducing the incidence and severity of hypotension.

Our study demonstrates that leg wrapping immediately following spinal injection resulted in a reduced incidence of hypotension and a subsequent reduction in the number of patients requiring vasopressor therapy. Two other studies have attempted to use compression of the legs to manage spinal hypotension. In 1973 James and Greiss reported their experience with inflatable boots but did not find them beneficial [3]. Their incidence of hypotension was 60% in patients managed with inflatable boots, which was the same as their control group. However, they used a much smaller preload (10 ml kg^{-1}) and did not institute left lateral tilt until after the onset of hypotension. However, they did comment that leg elevation during boot inflation may have explained the slightly later onset of hypotension in the patients wearing boots. In 1988 Goudie, Winter and Ferguson reported the use of inflatable splints in patients undergoing elective Caesarean section under spinal anaesthesia [4]. Whilst their preload was more in keeping with current practice (15 ml kg^{-1}) the incidence of hypotension remained unacceptably high (48%) in the study group compared with control (83%).

In addition to leg wrapping, simply raising the legs during the period of onset of spinal anaesthesia may have contributed to the decreased incidence of hypotension. We can find no studies on the effect of leg raising in the obstetric population, but studies of relative or absolute hypovolaemia suggest leg raising to be of little value with regard to improvement in arterial pressure or cardiac index [5]. Leg raising alone is unlikely to have played a major role as it results in autotransfusion of only 150 ml [6]. It is likely that the reduction in the incidence of hypotension by leg wrapping is caused by prevention of increased vascular capacitance by venodilatation in the legs following the development of autonomic block rather than autotransfusion of blood.

In conclusion, we have confirmed the high incidence of hypotension following spinal anaesthesia for Caesarean section despite routine preventative measures. However, unlike other authors, we have shown that the incidence of hypotension can be reduced by the use of simple leg wrapping with elasticated Esmarch bandages with a subsequent reduction in the use of potent vasopressor agents. Before widely recommending the technique, further study is required to evaluate its effect upon the severity and duration of hypotension.

ACKNOWLEDGEMENTS

The authors wish to thank the Ford Foundation programme for assistance for Mr Koovarjee and Mr Brijball. The non-invasive arterial pressure monitor was supplied by the Critikon division of Johnson & Johnson.

REFERENCES

1. Clark RB, Thompson DS, Thompson CM. Prevention of spinal hypotension associated with Cesarean section. *Anesthesiology* 1976; 45: 670–674.
2. Greene NM. *Physiology of Spinal Anaesthesia*. Baltimore: Williams and Wilkins, 1981; 117.
3. James FM, Greiss FC. The use of inflatable boots to prevent hypotension during spinal anesthesia for Cesarean section. *Anesthesia and Analgesia* 1973; 52: 246–251.
4. Goudie TA, Winter AW, Ferguson DJM. Lower limb compression using inflatable splints to prevent hypotension during spinal anaesthesia for Caesarean section. *Acta Anaesthesiologica Scandinavica* 1988; 32: 541–544.

5. Wong DH, Tremper KK, Zaccari J, Hajducek J, Konchigeri N, Hufstedler SM. Acute cardiovascular response to passive leg raising. *Critical Care Medicine* 1988; **16**: 123–125.

6. Rutlen DL, Wackers FJ, Zaret BL. Radionuclide assessment of peripheral intravascular capacity: A technique to measure intravascular volume changes in the capacitance circulation in man. *Circulation* 1981; **64**: 146–152.