Does Preloading with Colloids Prevent Hemodynamic Changes when Neurosurgical Patients are Subsequently Changed to the Seated Position?

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Objective: *This prospective, randomized, double-blind study was designed to determine and compare the usefulness of preloading colloids (Haemaccel) 10 ml/Kg before positioning whether it can prevent hemodynamic changes during seated positioning or not.*
Material and Method: *The authors studied 20 patients by randomly dividing them into 2 groups. The control group was given crystalloid as maintenance and deposit replacement but the study group was given extra colloids 10 ml/Kg 30 minutes before starting general anesthesia. Both groups were monitored and given anesthesia, balanced technique. Systolic and diastolic blood pressures, heart rate, central venous pressure (CVP) at different time intervals in the sitting position for 30 minutes were recorded. Statistical analysis was done by Student t-test, Chi-square test and ANOVA (p-value < 0.05 considered significant).*
Results: *The results showed that systolic blood pressure at 15, 20, 30 minutes and CVP at 15, 25, 30 minutes after positioning in the study group was maintained significantly compared to the control group and there were no significant changes in diastolic blood pressure and heart rate. There were no other complications during the sitting period.*
Conclusion: *It is concluded that preloading colloid fluid prior to repositioning could prevent the decrease of systolic blood pressure and central venous pressure during sitting positioning without other complications.*

Keywords: *Sitting position, Systolic blood pressure, Diastolic blood pressure, Heart rate, Central venous pressure*

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The sitting position for patients undergoing posterior fossa and the upper cervical spinal surgery is currently used. It facilitates not only good surgical access, better view of the facial area for monitoring evoked response from cranial nerve stimulation[1], reduction in the amount of venous bleeding[2], decrease in the incidence of intraoperative cerebral edema and certain advantages for respiration over the spontaneous breathing; but also represents a unique physiological challenge and is associated with several important complications; such as cardiovascular instability which may lead to a disproportionate reduction in cerebral blood flow[2]; other complications are venous air embolism[3,4], peripheral nerve compression, subdural hematoma[4], cervical spinal cord infarction[5] and pneumocephalus. The hemodynamic change is the most important complication especially hypotension during the positioning. The gravitational drainage of blood to the lower part of the body and also the fluid restriction in a neurosurgical patient promote this effect which is commonly found and troublesome during neuroanesthesia. Fluid resuscitation or vasopressors are necessary to compensate the pooling of the venous blood. Apart from crystalloid infusions, several colloids are available.

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The aim of the present study was to evaluate and compare the hemodynamic data between the routine fluid given without any colloid preloading which is termed the control group and gelatin-ingredient-colloid (Haemaccel) preloading 10 ml/kg 30 minutes before starting general anesthesia which is termed the experimental group. It is hypothesized that this latter procedure can maintain blood pressure, heart rate and central venous pressure during sitting positioning throughout a 30 minute period.

Material and Method

After obtaining Ethics Committee's approval by the Ministry of Public Health and patients' written informed consent, the authors studied the double-blind prospective of 20 consecutive adult patients of ASA physical status 1-2 scheduled to receive general anesthesia for an elective neurosurgical procedure in the sitting position (performed prior to the pilot study for the calculation of sample size) from October 1st, 1999 to March 31st, 2000. The exclusion criteria were the patients who had contraindication to colloid infusion as well as seated positioning.

Patients were allocated randomly to either group (control n = 10, experimental n = 10). Both were given intravascular isotonic crystalloid solution (Acetar) calculated by standard technique[6] at least 3 hours before anesthesia. NPO not less than 6 hours was ordered and blood pressure, heart rate, ECG, oxygen saturation and central venous pressure were monitored by the time they arrived at the theater. Anesthesia was induced with thiopental 5 mg/kg intravascularly. Vecuronium 0.08 mg/kg was administered as a muscle relaxation for intubation. Anesthesia was maintained with incremental doses of fentanyl 1-2 ug/kg, vecuronium 0.02 mg/kg as needed. Ventilation was controlled with 66% nitrous oxide in oxygen and inspired isoflurane not more than 1.5%. The patients were then wrapped with elastic bandages on both legs from toes to groin, placed in the pin headholder after being given 2% lidocaine as local anesthetics and slowly positioned to standard sitting position in 5 minutes. Further monitoring consisted of capnography, airway pressure, inspiratory oxygen fraction, tidal volume and respiratory rate. Also the precordial doppler ultrasound device was placed for air embolism detection.

The arterial cannulation was done at the radial artery for the measurement of invasive blood pressure which was set at zero level at the midaxillary line while in the supine position and at the left 4th intercostal space in the upright position. The heart rate was recorded by electrocardiography. The central venous cannulation was done at the left Basilic vein and confirmed by wave form figuration. All of those parameters were recorded and compared as time followed (there was no surgical stimulation during these measurements). T0 represented the time when the patients were admitted to the induction room, T1 before induction in the operating theater (after having finished colloid preloading in the experimental group), T2 after intubation, T3 before positioning 5 minutes after pin head holder placement, T4-T9 after positioning every 5 minutes for 30 minutes then the surgery started. If the subjects had cardiovascular problems such as cardiac arrhythmia, hypotension (less than 80/60 mmHg), hypertension (over 150/90 mmHg), alteration of heart rate over 30% from base line or central venous pressure changed over 10 cmH2O, they would receive treatment immediately.

Statistics

Data are reported as mean $\pm$ standard deviation. Demographic data were analyzed by Chi-square test and student t-test. The significance of parameter change within the group was analyzed by student paired t-test and between groups by two-way ANOVA (significance p level < 0.05)

Results

Twenty patients were operated on in the sitting position. Nine of them were diagnosed as cerebellar tumour, seven as cervical spinal cord compression and four as trigeminal neuralgia. Distribution of sex, mean age, weight, NPO time and classification of ASA physical status was not significant and shown in Table 1.

Table 1. Demographic data

	Control group n = 10	Experimental group n = 10	p-value
Ages (years)	46.50$\pm$12.22	40.50$\pm$12.30	p>0.05
Sex (male:female)	5:5	8:2	
Weight (Kg)	59.00$\pm$8.99	59.90$\pm$12.91	p>0.05
NPO time (hour)	13.50$\pm$3.54	11.30$\pm$4.30	p>0.05
ASA physical status (I:II)	7:3	6:4	p>0.05
Amounts of fentanyl (ug/Kg)	2.73$\pm$0.86	2.72$\pm$0.83	p>0.05
Inspired isoflurane concentration (%)	0.68$\pm$0.05	0.71$\pm$0.04	p>0.05

Values are means $\pm$ standard deviation except Sex and ASA physical status are shown in number ratio

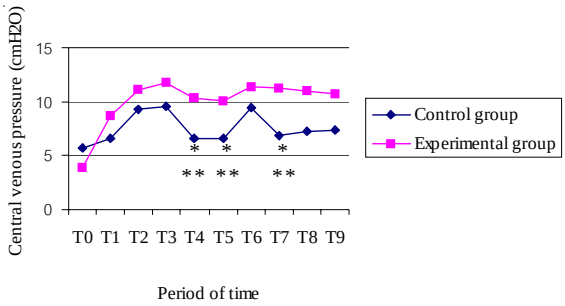

Fig. 1 Central venous pressure (cmH_2O) on 10 time-position moments

* Significant changes of central venous pressure in the control group when compared to the experimental group (p value < 0.05) at T4, T5 and T7

** Significant changes of the differences between both groups when compared to T0 (p value < 0.05) at T4, T5 and T7

In the control group the central venous pressure was less than that of the experimental group at 5, 10, 20 minutes after positioning (T4, T5 and T7 respectively). The differences between both groups were 3.75 ± 1.61, 3.50 ± 1.70 and 4.40 ± 1.77 cmH_2O which were statistically significant as well as the deceleration of central venous pressure within the control group at time interval as shown in Fig. 1.

Both systolic and diastolic blood pressures decreased significantly at 5, 10 and 25 minutes after positioning (T4, T5 and T8) in the control group. The differences of mean of systolic blood pressure between the control and experimental groups were 20.7 ± 9.25, 12.7 ± 7.25, 16.2 ± 4.63 and 12.9 ± 4.65 mmHg less at 5, 10, 25 and 30 minutes after positioning respectively (T4, T5, T8, T9) as shown in Fig. 2 while the diastolic blood pressure and the alteration in heart rate did not differ significantly between both groups (Fig. 3 and 4).

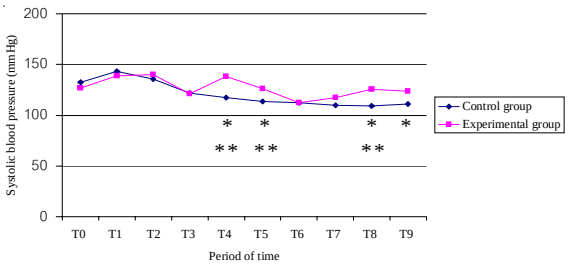

Fig. 2 Systolic blood pressure (mmHg) on 10 time-position moments

* Significant changes of systolic blood pressure in the control group when compared to the experimental group (p value < 0.05) at T4, T5, T8 and T9

** Significant changes of the differences between both groups when compared to T0 (p value < 0.05) at T4, T5 and T8

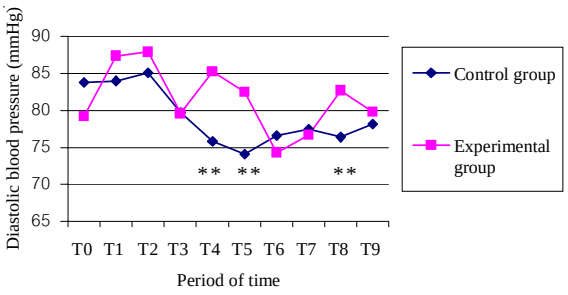

Fig. 3 Diastolic blood pressure (mmHg) on 10 time-position moments

** Significant changes of the differences between both groups when compared to T0 (P value < 0.05) at T4, T5 and T8

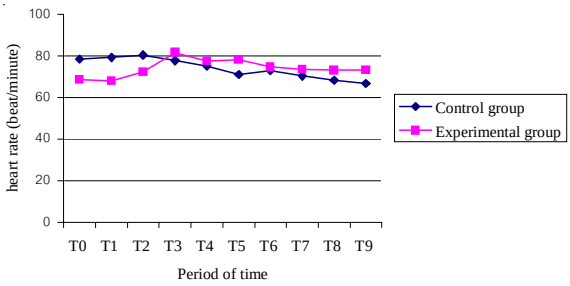

Fig. 4 Heart rate (beats/minute) on 10 time-position moments

Discussion

As mentioned above, the number of population in the present study was calculated from the pilot study because of the few number of cases (30-50 annually) and a significant reduction in the number of centers where sitting position for posterior fossa surgery used to be employed but it still needs to emphasize anesthetic personnel about the knowledge and skill for caring for those kinds of patients[2]. Normally a change from supine to sitting position in non-anesthetized healthy volunteers involves a complex hemodynamic adaptation. Thoracic blood volume and stroke volume decline while the sympathetic nervous system is stimulated promptly by the deactivation of baroreceptor and cardiopulmonary receptors. Heart rate and systemic vascular resistance increase and blood pressure is maintained at normal or near normal level[7]. But in the present study the authors found that the blood pressure was decreased. This may be caused by suppression of the sympathetic nervous system from anesthetic effect even although the patients were anesthetized with fentanyl-nitrous oxide, and avoided the exaggerated use of volatile anesthetics which was associated with the least cardiovascular depression after induction of

anesthesia[8] and associated with less orthostatic hypotension[9]. The peripheral venous compliance was decreased, resulting in low thoracic blood volume[10]. Giebler R, Kollenberg B, Pohlen G and Peters J have demonstrated in spontaneously breathing supine humans assuming the sitting position, that intrathoracic blood volume decreased by approximately 300-500 ml with a decrease in both pulmonary artery wedge pressure and central venous pressure[11]. In addition to the positioning, it influenced the decrease in venous blood return to the heart and diminished filling of the pulmonary circulation[12]. When a significant decline of blood pressure and central venous pressure occurred, the pressure gradient between the right and left atrium may reverse further especially in cases of controlled ventilation with positive end-expiratory pressure, bearing the risk of paradoxical air embolism[13] and possibly threatened by the deceleration of cerebral perfusion below the cerebral autoregulation range[4]. The authors preloaded with Haemaccel , which has a high molecular weight and similar colloid osmotic pressure to the plasma[14], in the experimental group and it caused an increase in the intravascular volume, thoracic blood volume indirectly and, thus preserving the blood pressure and central venous pressure significantly.

In the present study the authors found that the heart rate was maintained even when the blood pressure declined. Some have demonstrated that the response of the heart rate due to the sympathetic stimulation was inversely related to age[7,15]. This has been attributed to the impaired sensitivity of baroreceptor reflexes, decreased sensitivity of the beta-receptor or reduced density of the beta receptors[16]. Moreover, fentanyl is thought to produce a decrease in the heart rate by a central effect[17] which is the cause of maintaining the heart rate without tachycardia and no statistical difference among these groups.

The authors tried to reduce the variability in the hemodynamic response to orthostasis, venous pooling by the usage of an elastic bandage which increased flow velocity, venous emptying and reduced venous filling rate[18] but it was insufficient. Sjoberg J, Einansson E and Norgren L evaluated four different compression stockings that exerted pressure ranging from 18 to 35 mmHg at the ankle; it thus appeared that stockings with about 18 to 22 mmHg would be effective in achieving the benefits reported[19]. Finally, for the save of further studies, it should be noted that age accounted for part of the variance of the hemodynamic response to sitting. Other factors such as physical training, the effect of meals and nutritional status should be controlled or virtually excluded.

Conclusion

The moving of patients from the supine to sitting position can provoke hemodynamic effects; decreased systolic blood pressure and central venous pressure. Preloading fluid with colloid (Haemaccel) 10 ml/Kg 30 minutes prior to positioning efficiently preserves this effect and causes no harm to the patients.

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การให้สารน้ำประเภท colloid ก่อนการผ่าตัดในท่านั่ง สามารถป้องกันความเปลี่ยนแปลงทางระบบไหลเวียนโลหิตได้หรือไม่

ภูพิงค์ เอกะวิภาต, พวงผกา เมตตา

วัตถุประสงค์: *เพื่อประเมินและเปรียบเทียบประสิทธิภาพของการได้รับสารน้ำประเภท colloid 10 มล./กก. ก่อนการจัดท่า ในการป้องกันความเปลี่ยนแปลงของระบบไหลเวียนโลหิตที่อาจเกิดขึ้นในผู้ป่วยที่มารับการผ่าตัด ขณะที่กำลังจัดท่าให้อยู่ในท่านั่ง ระหว่างกลุ่มควบคุม และกลุ่มทดลอง*

วัสดุและวิธีการ: *สุ่มตัวอย่างประชากร ASA I – II จำนวน 20 ราย แบ่งเป็น 2 กลุ่ม คือกลุ่มควบคุม ซึ่งได้สารน้ำประเภท crystalloid ตามปกติ และกลุ่มทดลอง ซึ่งได้รับสารน้ำประเภท colloid 10 มล./กก. เพิ่มขึ้นจากปกติ ก่อนการจัดท่า 30 นาที ตรวจวัดความดันโลหิต อัตราการเต้นของหัวใจ ความดันในหลอดเลือดดำใหญ่ และภาวะแทรกซ้อนอื่นที่อาจเกิดขึ้น ตั้งแต่ก่อนให้ยาระงับความรู้สึก จนกระทั่งจัดท่านั่งแล้ว 30 นาที โดยใช้การวิเคราะห์ทางสถิติด้วยวิธี student t test, Chi - square test และ ANOVA โดยมีนัยสำคัญที่ $p < 0.05$*

ผลการศึกษา: *ความดันโลหิตในช่วง systole ที่เวลา 15, 20, 30 นาทีหลังการจัดท่า และความดันในหลอดเลือดดำใหญ่ที่เวลา 15, 25, 30 นาทีหลังการจัดท่าในกลุ่มทดลอง ไม่พบความเปลี่ยนแปลงอย่างมีนัยสำคัญ เมื่อเปรียบเทียบกับกลุ่มควบคุม และไม่มีความเปลี่ยนแปลงในอัตราการเต้นของหัวใจและความดันโลหิตในช่วง diastole เมื่อเปรียบเทียบระหว่างกลุ่ม โดยที่ไม่พบภาวะแทรกซ้อนอื่นระหว่างการจัดท่า*

สรุป: *การให้สารน้ำประเภท colloid 10 มล/กก. ก่อนการจัดท่าให้ผู้ป่วยอยู่ในท่านั่ง 30 นาที สามารถป้องกันการลดลงของความดันโลหิตช่วง systole และความดันในหลอดเลือดดำใหญ่ระหว่างการจัดท่าผู้ป่วยได้*