

Clinical Evaluation Of Blood Loss With Or Without Deliberate Hypotensive Anaesthesia In Spinal Surgery

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Citation

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Abstract

Deliberate hypotension is the intentional reduction of systemic perfusion pressure. The study was conducted on 60 ASA grade I, II, of either sex undergoing spinal surgery under general anaesthesia. The study was aimed to compare the blood loss between hypotensive and normotensive group. There was no significant difference in age, weight and height in all groups. We observed that men in the age group 31-40 years were more prone for spinal problems than females. There was significant difference ($p < .001$) in mean blood loss in hypotensive group (170.43 ± 42.86 ml) as compared to normotensive group (399.7 ± 40.4 ml). There was significant reduction ($p < 0.001$) in operative time with deliberate hypotension. To conclude there is a significant reduction with deliberate hypotension as compared to normotensive group along with other advantages like cleaner surgical field and reduced operating time.

INTRODUCTION

In an assessment of the effect of hemorrhage on anaesthetic management, one of the most important requirements will be exact measurement of blood loss in the operating room. During this century many investigators have strived to develop methods to accurate measurement of blood loss in the operating room to supplant the educated visual estimate, which is subject to large errors of both underestimation and overestimation of blood loss. Displacement of blood from the limb by compression and application of a tourniquet is a well established technique to achieve a blood less field in orthopedic surgery. To lower blood pressure and shift blood volume away from surgical field with the aid of a pharmacological agent is a much more intricate manoeuvre however the vasodilatation and hypotension resulting is often inadequate to provide a bloodless operative field unless blood is drained into a dilated vascular bed away from the operative site .this accomplished by tilting the patient in such a manner that the area to be operated on is uppermost allowing blood to accumulate in dilated dependent vessels. The resultant reduction in blood loss from the operative field is indeed impressive. Eckenhoff et al 1 who have considerable experience in this technique reported a striking reduction in blood loss for a number of operations carried out under deliberate hypotension in comparison to normotensive. They stated that maintenance of BP at the preanaesthetic level is not always mandatory.

The various advantages are improving the visibility at the operative site (by decreasing the bleeding at the site of surgery) thereby facilitating the surgery and surgical outcome and decreasing the operative time (by decreasing the blood loss) and thereby reducing the transfusion and its related complications.^{2,3,4}

When balancing the risk of deliberate hypotension against probability of great blood loss during surgery one must take into account the physical status of the patient, magnitude and duration of contemplated procedure and the potential hazards of the multiple transfusions.

AIM

To estimate and compare blood loss in spinal surgery with normotensive and hypotensive anaesthesia. To study a comparison between the two groups in operative time and need for blood transfusion.

MATERIAL AND METHODS

This study was conducted in Department of Anaesthesiology and Intensive care, Himalayan Institute of Medical Sciences, Swami Rama Nagar, Dehradun. After obtaining approval from hospital Ethics Committee and written informed consent, 60 patients in the age group 21-70 years of either sex belonging to ASA grade I,II, undergoing elective spinal surgical procedures under general anaesthesia with or without deliberate hypotension were randomly allocated (by

opening a sealed envelope) two groups. Group I (n=30):- control Group II (N=30) hypotensive.

Exclusion criteria were history of difficult airway management, ASA grade III,IV, diabetes mellitus, pulmonary disease, uncontrolled hypertension, ischemic heart disease and gastro-esophageal reflux disease. After proper history and physical examination, basic routine investigations were advised special investigations were advised in specific patients where ever it was required to rule out systemic illness. Mallampatti score, thyromental and sternomental distances were noted. All the patients were kept fasting for at least eight hours prior to surgery. All the patients were given 10 mg tab diazepam H.S. and 5 mg with a sip of water two hours prior to surgery.

In all the groups patients received injection glycopyrrolate 0.2mg intramuscular at least 30 minutes prior to surgery to counteract the vagomimetic effect of propofol and fentanyl. Patients were placed in supine position with the head on a standard firm pillow 7 cm in height. Fluid replacement was done at 6ml/kg/hr. All the patients were catheterized with Foley's catheter for measuring urine output.

Oxygen was administered via a face mask for 5 minutes. Anaesthesia was induced with i.v inj fentanyl 2 µg/kg, inj propofol 2.5 mg/kg followed by i.v. injection rocuronium 0.6-0.9mg/kg body weight. Mask ventilation with Bain's circuit was done for 60 -90 seconds and the trachea was intubated using Macintosh laryngoscopy and endotracheal cuffed tube. The lungs were ventilated to maintain normocapnia. As surgery was to be performed in prone position firm supports under chest and pelvis were kept so that the abdominal movements and the venous return were not hampered. Compression of the abdomen by faulty positioning would result in the increase in central venous pressure (CVP) and engorged epidural veins. The eyes were closed and covered and arms were padded. The selected hypotensive agent was started after changing the patient to prone position.

Anaesthesia was maintained using 65% nitrous oxide in oxygen via Bains circuit with a fresh gas flow of 100ml/kg/min with a ventilatory frequency of 12-15 bpm and i.v. inj rocuronium 0.15 mg/kg, iv inj fentanyl 1µg/kg and sevoflurane was given in both the groups maintaining the Minimum alveolar concentration at 1-1.5 MAC.

In group II Nitroglycerine (NTG) infusion was started with 3µg/kg/min and titrated to achieve and maintain the desired

hypotension was started after placing the patient in prone position.

Monitoring of following parameters was done: NIBP, HR, SpO₂, ETCO₂, ECG, CVP, Temperature, urine output, was done using Lunar L & T Medical multichannel monitor.

At least three measurements of arterial blood pressure, heart rate, and peripheral oxygen saturation were obtained and the mean was taken to determine the baseline (B1). A second investigator that was not aware of the patient group recorded these measurements. Values were recorded at the time of induction (A1), at the start of hypotensive agent (A5) and then at 15,30,45,60 minutes after the start of hypotensive agent (H15, H30, H45, H60), at hypotensive agent discontinuation (Hd) and after extubation (Ae).

For blood loss measurement a single gravimetric technique was used which permits a continuous inexpensive and reasonably accurate measurement of external blood loss. The weight of 1 ml blood is taken as 1 gram. A scale accurate to 0.1 g was used for weighing the sponges and gauges considering dry sponge and gauge weight to be fairly uniform, so that there was no need to preweigh the standard sponges. The scale is an electronic weighing machine with a capacity of upto 400grams/per ounce and resolution upto 0.1g/0.01oz. Modelno.HL400 both battery and A.C. power operated. The weighing machine is of the A& D company LIMITED 3-23-14 Higashi -Ikebukuro, Toshima -ku , Tokyo 170 Japan. However some error may have been introduced when old sponges that have been laundered innumerable times are used, because they are lighter in weight than their newer fellows. Errors arise when sponges are not weighed as soon as collected, and the evaporative losses occur, so that the results are on low side.

Blood loss as determined by gain in sponges weight and gain in gauge weight represents the amount of blood loss .The blood measured in suction bottle is added to the increase in sponges and gauge weight to determine the total amount of blood loss during surgery.

At the end of surgery patients were reversed with IV neostigmine 0.05mg/kg and atropine 1.2 mg. Fluid inputs during surgery period was determined by the anesthetist based on preoperative fasting, blood loss and clinical criteria (arterial pressure, heart rate and observation of the patient).

Data analyzed with paired t test. p<0.05 was considered significant.

OBSERVATIONS & RESULTS

There was no significant difference in the demographic data of all the patients in either group.

Figure 1

Table 1. Demographic data of all patients

Patient characteristics	GROUP I (n=30)	GROUP II (n=30)
Patient Age (in years)	21-65	22-70
Mean ± SD	42.96± 10.68	42.66± 11.95
Male: Female	21(70%):9(30%)	18(60%):12(40%)
MP Grade I:II	18(60%):12(40%)	16 (53.3%):14(46.7%)
ASA Grade I:II	16(53.3%):14(46.7%)	13 (43.3%): 17(56.6%)
Height of the patient(cm)	152-176	150-169
Mean ± SD	161.26±6.82	159.33±5.59
Weight of the patient(kg)	38-78	40-76
Mean ± SD	60.58±12.12	57.3±11.03

Majority of the cases in Group I 12(40%) underwent dissection and laminectomy both while 7 (23.33%) and 11(40%) underwent laminectomy and dissection respectively. Majority of patients in group II 16(53.33%) underwent dissection. While 9 underwent laminectomy and the rest 5(16.67%) were operated for laminectomy and dissection both.

Figure 2

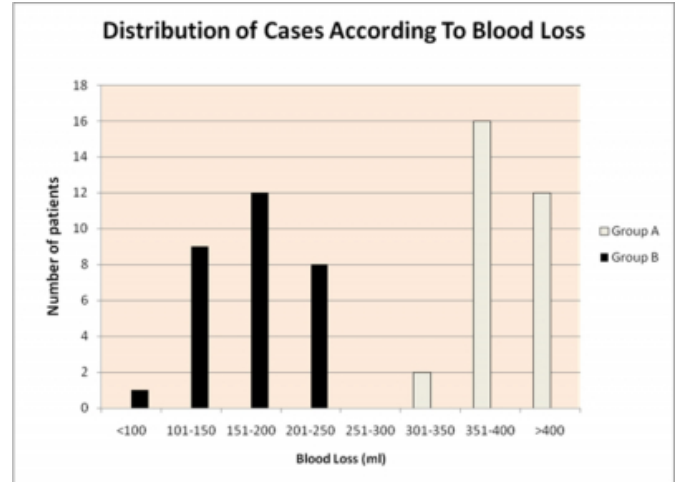
TABLE 2: OPERATIVE DETAILS

	GROUP I (n=30)	GROUP II (n=30)
Duration of surgery(min)	196.66±25.57	124±17.68
Mean ± SD		
Blood loss(ml)	399.7±40.4	170.43±42.86
Mean ± SD		

In our study time taken by NTG was (3.8±1.61min) to achieve desired systolic blood pressure of 90mm Hg with a average maximum dose of 5.72±1.62µg/kg/min for maintenance it was 2.38±1.13 µg/kg/min. There were neither significant changes in ECG nor arterial desaturation during hypotension or during any phase of anaesthesia and surgery. Urine output was maintained above 0.5ml/kg/hr in the hypotensive group.

Figure 3

Fig 1. Majority of the patients in group B 16(53.33%) have blood loss between 350-400ml and majority of patients in group A 12(40%) have blood loss between 150-200ml. Statistically there was significant difference in the blood loss in both the groups



DISCUSSION

Spinal surgery may be associated with bleeding that cannot be adequately controlled. Exposed cancellous bone structures, friable epidural veins and vessels in the subcutaneous tissues and the paraspinous muscles can all be the sources of continued blood loss. Despite meticulous surgical technique, such operation may require blood transfusion, with its danger of disease transmission and transfusion reaction. In addition, excessive oozing of blood, particularly from exposed cancellous surfaces, slows surgery and make dissection more difficult. Deliberate hypotension is used in spinal surgery as an effort to reduce blood loss, decrease the number of required blood transfusions facilitate surgery and shorten operative time.^{6,7}

In our study there was a male preponderance 39(65%) similar to that observed in the study by Sleath et al.⁸ This male preponderance can be attributed to the fact that larger population in our state is living mainly in hilly areas. Men of this region are devoted to the farming activities and are labourers lifting heavy weights, hence many workmen in this area engage in activity that involves strain or trauma of lumbar spine. For this reason there is always a plentiful supply of ruptured and extruded discs requiring surgical intervention in this area.

The age group in this study ranged from 21-70years mainly being in the age group 31-40 years 33(55%). Age group of 21-50 years is the working men age group that is why we can attribute more of spinal problems to this age group.

In the Uttaranchal state, men engage themselves at an earlier age in activities like farming, lifting heavy weights on their back and mountain trekking because of socioeconomic compulsions. Also the built and nutrition of the residents of this area is sub optimal. In this study, these reasons can be attributed for the involvement of average lower age limit of 31 years for spinal injuries and problems, who needed surgical intervention. The amount of blood loss depends on many factors:

- Arterial blood pressure
- Venous pressure
- Systemic vascular resistance

If the arterial and venous pressure is decreased, then it is reasoned that blood loss can be decreased or minimised. Even as early as 1929 Blain et al⁹ discussing his experience with 3000 transfusions emphasized the fact that the amount of blood loss during operations is often several times greater than estimated by surgeon. Wangesteen O.H. et al described for the first time the simple gravimetric method of determining blood loss with which he determined that the average loss in gastric resections was from 300-500cc. ¹⁰

Baronofsky I.D. et al ¹¹ compared calorimetric and gravimetric method in 21 patients found that there was a close relationship between the two methods and therefore advocated the simple gravimetric method. Similar results were given by Bonica J.J et al ¹² but Lyon R.P. et al ¹³ compared the results of standard calorimetric and gravimetric methods by red cell volume method. They found that the operative blood loss measured by the latter method was higher than obtained by either method.

Leeven et al ¹⁴ described an extraction dilution or washing method for measurement of blood loss that allowed continuous ongoing determination based on electrical conductivity of blood.

Matthias A.M et al¹⁵ measured blood loss through a new electronic washing machine but it was complex, the surgeon cannot use saline with it and it interferes with swab counting. They also used a simple with plastic pails to measure blood loss for every use swab placed in one pail they put an identical dry one in the other and the dial reading then gives the blood loss. The lids reduce the evaporation and all the swabs are left in the pail. The used swabs for counter balancing are coloured to prevent any confusion

with the count. When the blood loss reaches the maximum shown on scale (In their case 500 grams) this recorded and a 500g weight is added to the coloured swabs. The pointer then returns to zero and the process can now be repeated.

Brockner et al ¹⁶ compared the blood lost during operations as visually estimated by the anaesthesiologist and the anaesthetist nurse, with the amount determined electronically after washing out blood from drapes, swabs, sponges. The latter value was considered as the correct or very near correct, amount of blood lost by the patient. In 216 adult patients the estimated blood loss was equal to the measured value in 12. In 87 patient the visual estimation was higher than that measured by machine; it was lower in 117 patients.

Enderby ¹⁷ stressed the importance of posture on blood loss on and said the effect of posture on blood flow combined with a low systolic blood pressure, induced an ischemia of the raised end of the body. This postural ischemia enables many surgical operations to be done easily and skilfully with very little blood loss. The pressure at the operative site should be reduced to 35-45mm Hg to minimise blood loss.

In our study there was a significant decrease ($p < 0.01$) in the operative time in hypotensive groups (124 ± 17.68) in comparison with the normotensive group (199.66 min). This could be due to clear operating field, less suctioning required and the time saved in coagulation and ligating the bleeders to get a clear operating field. Our findings are similar to that observed Mc Neilletal, ¹⁸ Mandel et al¹⁹ and Patel et al²⁰.

In our study blood pressure was maintained at normotensive levels in the control group and Nitroglycerine (NTG) in the other group. In this study SBP was reduced to 25-30% of the preinduction values which was correlating with the observations of Sleath and Archer ⁸, who also decreased the SBP to 25%. More reduction in SBP than this level is not safe as it alters the cerebral and renal autoregulation. Another reason for not reducing the SBP further to more than 20-30mm Hg in this study is because Mandel et al ¹⁹ in their observation reported that reduction in SBP greater than 20mm Hg was not associated with greater reduction in blood loss. In our study nitroglycerine was found to be very potent in producing the desired levels of systolic blood pressure and has a rapid onset of action. NTG caused a significant increase in the heart rate ($P < 0.001$) in heart rate from the baseline i.e. 79 ± 5.11 beats/min to 92.9 ± 6.35 and 88.35 ± 4.71 at 15 and 30min respectively after the start of NTG infusion. At other time intervals during hypotension the heart rate

increased but nearer to the baseline values. This is in accordance with the study by Fahmy²¹ except a study by Tannieres et al²² which mentioned that there was no modification in the heart rate though there was a decrease in MAP by 34% but no explanation for the same is mentioned in his study.

In our study there was a significant difference ($p < .001$) in the reduction in blood loss in group B mean loss (170.43ml) as compared to group A mean loss (399.7ml). Our study confirms the findings of the previous studies.

CONCLUSION

In our study by using nitroglycerine to produce deliberate hypotension, there was significant reduction in blood loss and also in the operating time in patients who were given hypotension as compared to normotensive group and along with the advantages like smooth and uneventful postoperative course of patient, cleaner surgical field and reduction in amount of ligated or cauterised tissue which is the source of wound infection and reduction in the need for blood transfusion.

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