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A PROSPECTIVE RANDOMIZED-CONTROLLED TRIAL STUDY TO STUDY THE CARDIAC AND HAEMODYNAMIC EFFECTS OF A COMBINATION OF LOW DOSE SPINAL ANAESTHESIA AND LUMBAR AND SACRAL PLEXUS BLOCKS IN LOWER LIMB SURGERY IN CARDIAC COMPROMISED VS NON CARDIAC PATIENTS

Anaesthesiology

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ABSTRACT

Introduction: Proximal Femur Fractures are a significant cause of morbidity. Patients suffering these fractures tend to be elderly and with multiple co-morbidities, especially compromised cardiac function. These patients poorly tolerate intra-operative hypotension and haemodynamic compromise. Peripheral nerve blocks cause minimal haemodynamic compromise, but have the disadvantage of unilateral effect leading to positioning discomfort. Low dose sub-arachnoid blocks combined with lumbar and sacral plexus blocks have the potential advantage of quick onset, bilateral effect and stable haemodynamics. The present study was undertaken to assess the haemodynamic effects of the procedure in patients with decreased cardiac reserve. **Material And Methods:** 30 patients were randomly selected out of patients reporting to our hospital with proximal femur fractures. They were assigned to Test and Control Groups based on an Ejection Fraction of 40% and below. They were all anaesthetized with low dose sub-arachnoid blocks in combination with lumbar and sacral plexus blocks. All patients were observed during surgery for haemodynamic changes. **Results:** All patients had similar changes in heart rate and blood pressure on induction and up to 30 minutes of the procedure, while the patients with cardiac compromise manifested lower Mean Arterial Pressures (MAP) after 30 minutes of surgery. **Conclusion:** Patients in both the groups had stable haemodynamic parameters and reacted similarly to the anaesthetic technique, while surgical factors led to decreased mean arterial pressures in patients with decreased cardiac reserve.

KEYWORDS

Decreased cardiac reserve, peripheral nerve blocks, proximal femur fractures

INTRODUCTION

Elderly individuals are more prone to risk of fractures due to age related osteoporosis.[1] A significant proportion of these fractures require surgical management. Somersalo et al. found the incidence of operative management in these fractures to be 80%. [2] Hip fragility fractures are associated with the maximum disability, mortality, and health care costs as compared to all the rest of the fractures put together.[1] Burge R et al. found that hip fractures account for 14% of all the fractures, but 72% of the healthcare costs. [3] Thus, elderly patients presenting with proximal femur fractures requiring operative management are a major portion of the orthopaedic workload in any hospital.

23% of the global burden of disease occurs in elderly people out of which cardiovascular disease accounts for 30.3% according to Prince MJ et al. [4] This similar percentage is reflected in the patients presenting for surgery, leading to this cohort being at increased risk of adverse events and operative morbidity. White SM et al found that intra-operative hypotension was associated with increased incidence of adverse outcomes.[5] Similarly, Salmasi V et al. found intra-operative MAP below 65 mm Hg, or 20% below baseline were associated with myocardial and renal morbidities. [6] Karim Kouz et al found intra-operative hypotension to be common under GA and to be a modifiable risk factor. [7]

Most anaesthetic agents are myocardial depressants. [8] The myocardial depressant effects in addition to vasodilatory effects can cause hypotension. These effects are exaggerated in patients with poor cardiac reserve. [8] However, lower extremity peripheral nerve blocks have minimal haemodynamic effects while intra- thecal anaesthesia can cause vasodilation below the level of block[9]. Mounet B and co-workers found multiple nerve blocks to provide better cardio-stability than General Anaesthesia. [10]

The nerve supply of the lower limb is derived from the lumbar and sacral plexuses with root values from L1 to S3. [11,12] Surgery can be carried out on the complete lower limb by blocking these nerve roots. This can be achieved by blocking the components of the lumbar and sacral plexuses,[13] or by a combination of lumbar plexus, and sacral plexus blocks. These blocks are safe and have certain advantages, such as postoperative pain relief and lack of complete sympathectomy, which make them ideal for selected patients.[9] Regional techniques have the potential to cause minimal intra-operative hypotension, while also sparing of opioids, and also causing prolonged post-operative analgesia. [9] Historically, these techniques were less popular due to the ease of performing Spinal/ Epidural Anaesthesia, the need for multiple needle injections and technical difficulties due to lack of availability of nerve stimulators and USG guidance. Another disadvantage was the restriction in performing an unilateral block as bilateral blocks can exceed the maximum safe dose of local anaesthetics. This often leads to patient discomfort on the unblocked side due to patient positioning on fracture tables.

A technique that could combine the quick onset and bilateral effect of Spinal anaesthesia, along with the lack of sympathectomy, opioid sparing, prolonged duration of action, and post operative analgesic effects of peripheral nerve blocks would be valuable, especially in elderly patients that poorly tolerate hypotension. A low dose subarachnoid block has the potential to have minimal sympatholytic effects while having fast onset and bilateral effects. Combining this block with lumbar and sacral plexus blocks has the potential to achieve prolonged duration of the block, adequate for longer duration surgeries. However, it is not clear if patients with cardiac diseases and disabilities and decreased cardiac reserve, will also be haemodynamically stable, and will respond similarly to patients with normal cardiac function. Hence this study aims to compare the effects of low dose sub-arachnoid blocks in combination with lumbar and sacral plexus blocks in patients with cardiac compromise as compared to those with normal cardiac function.

Hypothesis

Anaesthesia with a combination of low dose sub-arachnoid block and lumbar and sacral plexus blocks will have similar minimal haemodynamic effects in patients with decreased cardiac reserve, as compared to patients with normal cardiac reserve.

Aim

To compare the cardiac and haemodynamic effects of a low dose sub-arachnoid block with lumbar and sacral plexus blocks in patients with cardiac disabilities as compared to patients with normal cardiac function.

MATERIAL AND METHOD

Amongst all patients who presented to our institute with proximal femur fractures, a random sample of 27 patients were selected. These patients underwent Pre-anaesthetic assessment including a complete clinical examination, and echocardiography. The patients were divided into two groups: Group A were those patients with cardiac co-morbidities, and an Ejection Fraction of 40% or less. Group B were those patients who had an Ejection Fraction on echocardiography of above 40%, irrespective of the presence of other co-morbidities.

All patients were administered a sub-arachnoid block in the sitting position with 1 ml (5 mg) of 0.5% heavy bupivacaine. The patients were then placed in the supine position for a few minutes until the sub-arachnoid block was established. Subsequently, the patients were placed in the lateral position with the operative side uppermost.

A lumbar plexus block was administered as follows: A line was drawn from the iliac crest, intersecting a line joining the spinous processes at right angles. A point was marked at 4 cm from the midline along the first line. A 100 mm insulated needle, connected to a nerve stimulator was inserted perpendicular to the skin to a depth of 60-80 mm, until quadriceps contractions could be elicited at 1.5 m amps. The current was gradually reduced. Persistence of quadriceps twitches to a current of 0.3 mA was taken to be a positive sign. The patient was then injected 25 ml of 0.5% bupivacaine, with 1:200,000 adrenaline. [11]

Another line was drawn joining the posterior superior iliac spine to the ipsilateral ischial tuberosity. A point was marked 6 cm from the PSIS on this line. The same needle was connected to a nerve stimulator and inserted to a depth of 60-80 mm. Hamstring, calf muscle, ankle, or toe twitches were elicited at a current of 1.5 mA. The current was gradually decreased until the jerks disappeared at a current of 0.3-0.5 mA. 15 ml of 0.5% bupivacaine and 1:200,000 adrenaline was injected with repeated aspirations. [12] The patient was then positioned for surgery.

The following parameters were analysed:
1. Adequacy of block
2. Duration of effect: Time of Induction to VAS score of 3 on the Universal Visual Analogue Scale.
3. Heart rate
4. Blood Pressure
5. Blood oxygen saturation
6. Requirement of inotropes or any other drugs
7. Complications

The results were analysed by using Student's unpaired two tailed T Test.

RESULTS:

1. Patient Characteristics:

There were 15 patients in Group A i.e. the group with cardiac co-morbidities, and cardiac diseases. There were 15 patients in Group B, i.e. the group with no co-morbidities. The number of patients were equal in both the groups.

The average age of Group A was 75.6 years, while the average age of Group B was 61.8 years. Patients in Group A were significantly older, as compared to Group B.

The patients in Group A had two or more co-morbidities, and the modal ASA (American Society of Anesthesiologists) Grade was 3, with 3 patients in ASA 4, while the patients in Group B had a modal ASA Grade of 2 with ASA 1 being the second most common ASA Grade, and there were 3 patients in ASA grade 3. Group B had an average of 0.75 co-morbidity per patient, with some patients having no co-morbidities.

The male: female ratio was 8:7 in Group A, while it was 9:6 in Group B.

The mean duration of surgery was 115 minutes in Group A, and 133 minutes in Group B. The difference did not approach statistical significance.

The mean total effect duration was 15.51 hours in Group A, and 17.56 hours in Group B. The difference was not significant.

The time from end of surgery to administration of analgesic was 13.6 hours in Group A, and 15.33 hours in Group B. The difference was not significant.

Table 1: Patient Profile

	Group A	Group B	Significance
Mean Age	75.6	61.8	P<0.05
Sex (Male : Female)	8:7	9:6	Not Significant
Average number of Co-morbidities	2.2	0.75	P 0.05
ASA Grade (Modal Value)	3	2	Significant
Surgery time (minutes)	115	133	p>0.05
Total effect (Hours)	15.51	17.56	p>0.05
Analgesia time	13.6	15.33	p>0.05

2. Heart Rate: The heart rate was measured preoperatively, immediately after induction, and at 15 minute intervals thereafter. The results of the mean heart rates are as under:

Table 2: Mean Preoperative Heart Rate, And Mean Change From Preoperative Value Over Time

Time	Group A	Group B	Significance
Preoperative	90.67	87.93	p>0.05
After Induction (Mean change from initial value)	+0.27	-3.13	p>0.05
15 minutes	-5.0	-4.53	p>0.05
30 minutes	-3.07	-4.73	p>0.05
45 minutes	1.13	-9.6	P<0.01
60 minutes	-2.93	-8.0	p>0.05

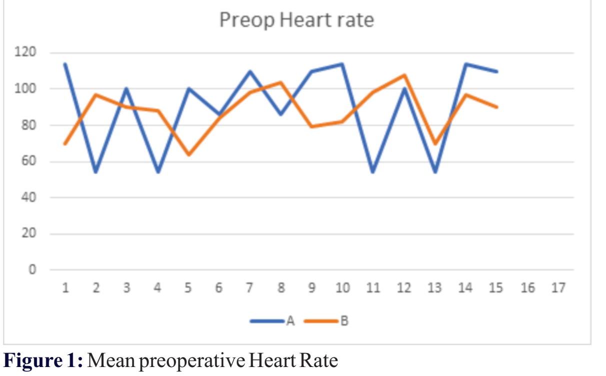

Figure 1: Mean preoperative Heart Rate

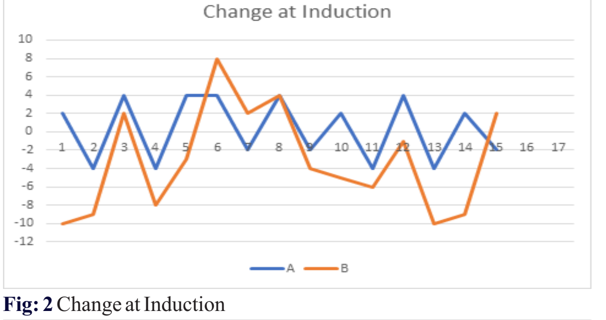

Fig: 2 Change at Induction

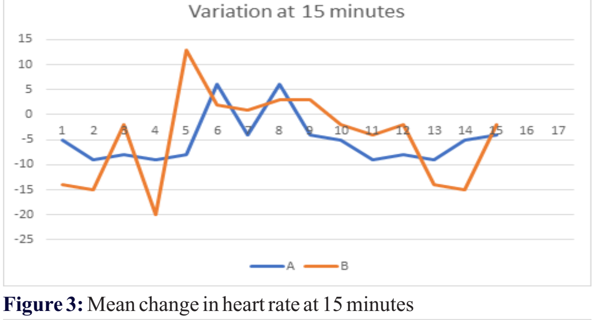

Figure 3: Mean change in heart rate at 15 minutes

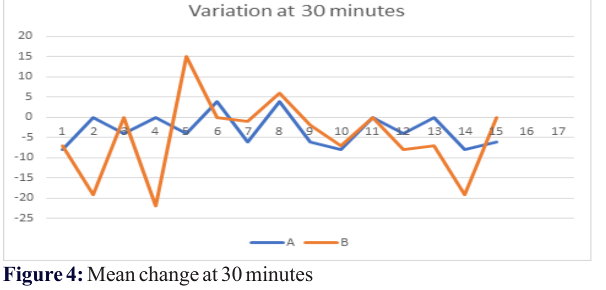

Figure 4: Mean change at 30 minutes

3. Mean Arterial Pressure: The MAP was measured preoperatively, immediately after induction, and at 15 minute intervals thereafter. The mean change from the preoperative value was noted and recorded for both the groups. The results are as under:

Table 3: Mean pre-operative MAP, And Mean Change Over Time

Time	Group A	Group B	Significance
Preoperative	101.2	107.4	p>0.05
After Induction (Mean change from initial value)	-5.27	-3.4	p>0.05
15 minutes	-3.20	-6.13	p>0.05
30 minutes	-16.0	-7.48	P<0.05
45 minutes	-19.47	-8.93	P<0.05
60 minutes	-16.73	-5.0	P<0.05

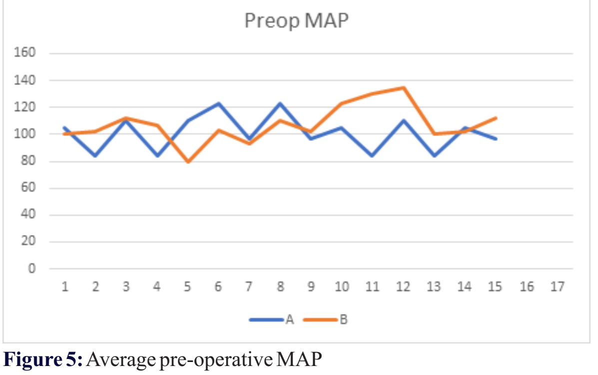

Figure 5: Average pre-operative MAP

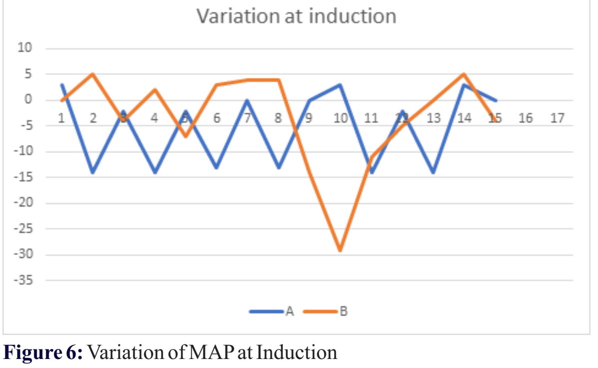

Figure 6: Variation of MAP at Induction

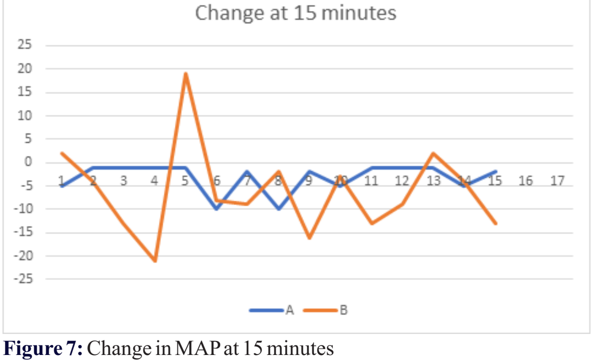

Figure 7: Change in MAP at 15 minutes

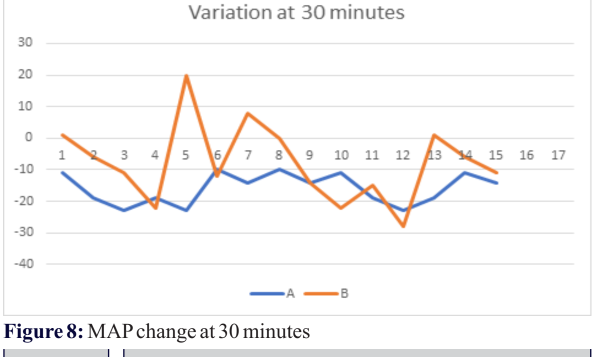

Figure 8: MAP change at 30 minutes

No patient had any hypertension or hypotension that required any pharmacological intervention.

4. Respiratory parameters: All patients were on supplemental O_2. There was no deterioration in either the blood oxygen saturation as measured by pulse oximetry, or in the respiratory rate, and minute ventilation.

5. Other parameters: There were no significant differences between either of the groups in other clinical parameters. There were no significant ECG changes, and no complications were seen. No patient required conversion to General Anaesthesia. Urine output was within physiological limits in all the patients. There was no excess blood loss in either group.

DISCUSSION

Our patients were randomly selected from a larger population of patients who presented to our institute with proximal femur fractures. After selecting the sample, the patients were divided into two groups based on the presence of cardiac compromise as seen from the ejection fraction, and presence of cardiac co-morbidities. Proximal femur fractures are more common in elderly patients as has also been found by other authors (Bäcker et al. 2021). [14] We too found the mean age of our patients to be 75.6, and 61.8 years in the two groups. However, the patients in Group A were significantly older, with a mean age difference of 14 years. This is not surprising, as the presence of cardiac disease tends to increase with age, and age is an independent risk factor. [1,14, 15] Similarly, we found that the patients with cardiac disease had additional co-morbidities with most having two or more chronic diseases, with Type 2 Diabetes and Hypertension being the most common. This is also as expected as the presence of Diabetes and Hypertension compound the risk of cardiac disease. [15] This is also reflected in the ASA Grades assigned to the patients where the patients in Group A were mainly in ASA 3, while some were in ASA 4. On the other hand, the patients in Group B were mainly in ASA1&2, with a few in ASA 3. We found that patients in Group A were on the whole older, sicker, and frailer than patients in Group B.

The types of surgery, and the duration of surgery were similar in both the groups, and the success rate, adequacy, and duration of effect of the anaesthetic procedure were similar in both the groups.

In spite of the marked difference in the age and physical condition of the patients in the two groups, we did not find any significant difference in the haemodynamic response to the anaesthetic procedure. The heart rates showed a slight fall on the whole after induction in both the groups, but the difference of the mean change in the heart rate did not reach statistical significance, except in the reading at 45 minutes, where the fall in heart rate was greater in Group B. This isolated difference in one reading after 45 minutes does not appear to be of any clinical significance, and is likely to disappear in a different sample, or with a larger sample size. No patient in either group required pharmacological intervention for tachycardia, or bradycardia.

The Mean arterial pressures also were similar in both the groups, both before and after induction. There was generally a slight fall in the MAP after induction, and this is not surprising as the pain is abolished after administration of the local anaesthetic. The magnitude of the fall from pre-operative values tended to be greater in Group A as compared to Group B, but this difference reached statistical significance at 30, 45, and at 60 minutes post induction time. There was no statistically significant difference in the fall in MAP on induction, or till 30 minutes of post induction time. Since the fall was seen only after the anaesthetic agent was fixed, it is unlikely to be caused by anaesthesia. Since surgical factors also play a role in intra-operative haemodynamics, those are the likely causes for the fall in MAP. [8] This reflects the fact that patients with decreased cardiac reserve are less tolerant to surgical stress, and intra-operative fluid losses. However, the fall in MAP was not clinically significant in any patient, and no patient required any vasopressors, or inotropes to support the blood pressure.

All other parameters remained similar in both the groups. There were no adverse effects seen, and no specific intervention was required for any complications. This showed that regional anaesthesia consisting of a low dose sub-arachnoid block in combination with peripheral nerve blocks has minimal physiological effects on the patient, in spite of the presence of cardiac compromise, and this procedure can be safely and successfully used in elderly frail patients.

Our study suffered from a drawback in that we could not measure cardiac output, and cardiac function due to lack of intra-operative echocardiography monitoring. Repeating this study with echocardiography monitoring can more specifically determine the effect of our procedure on patients with compromised cardiac function.

CONCLUSION

A combination of low dose sub arachnoid block with lumbar and sacral plexus blocks can be safely and effectively used for lower limb surgery in patients with cardiac compromise, and they cause minimal alteration of haemodynamic function as compared to patients with normal cardiac function. However, close monitoring of these patients and optimal management of blood loss, and other surgical stressors is necessary for a successful outcome.

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