UNILATERAL SPINAL ANESTHESIA FOR MAJOR LOWER LIMB SURGERY IN PATIENTS WITH CARDIAC FAILURE

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ABSTRACT

Objective: To determine the safety of unilateral spinal anesthesia in elderly patients with cardiac failure undergoing major lower limb surgery.

Study Design: Prospective, quasi- experimental study.

Place and Duration of Study: Department of Anesthesiology, Combined Military Hospital Rawalpindi, during the period of October 2012 to December 2013.

Material and Methods: In this study, 20, American Society of Anesthesiologists (ASA) III and IV patients with different severities of heart failure due to previous myocardial infarction (MI), aged between 60-110 years undergoing unilateral lower limb orthopaedic surgery were included by non probability consecutive sampling. All patients received unilateral spinal anesthesia using hyperbaric 0.75% Bupivacaine 7.5mg. They were given preload of 2ml/kg colloid. Patients were placed in the lateral position with fractured limb on lower side and kept in this position for 10 minutes. Haemodynamic variations were monitored and recorded for the whole duration of procedure. Dobutamine, Ephedrine and Atropine were used as vasopressor/inotropic agents.

Result: In this study 20 patients were included. Sixteen (80%) were male. Mean age of group was 80.8 ± 12.5 years. The mean duration of surgery in our patients was 63.55 ± 16.47 minutes. Ephedrine was needed in 12 patients, atropine in 4 patients. One patient required Dobutamin infusion and one patient required norepinephrine infusion for 15 minutes. Two patients did not require inotropic or vasopressor support. The average percent fall in mean arterial pressure from prespinal value was 20.59%. The block remained unilateral in all cases. Motor blockade was adequate in the limb to be operated.

Conclusion: Unilateral subarachnoid block with hyperbaric bupivacaine does not produce adverse hemodynamic changes. Under controlled setting and meticulous monitoring elderly patients with variable degree of heart failure can be safely given unilateral spinal anesthesia for major lower limb orthopaedic surgery.

Keywords: Bupivacaine, Heart failure, Unilateral spinal anesthesia.

INTRODUCTION

Unilateral spinal anesthesia is a promising alternative to traditional, widely used technique of central neuraxial blocks, as it markedly restricts the anesthetized area, thereby, decreasing the risk of adverse events and complications[1].

Spinal anesthesia is a less preferred technique or even contraindicated in patients with moderate to severe heart failure. Unilateral spinal anesthesia has been used successfully in patients undergoing lower limb surgery. It is particularly advantageous in high risk patients such as patients with ischemic heart disease (IHD), congenital cardiac diseases, pulmonary diseases and diabetes where it produces less hemodynamic changes[2]. It has many advantages over conventional spinal anaesthesia such as lower incidence of hypotension , faster recovery and increased patient satisfaction[3]. Cardiovascular system may be profoundly affected by spinal anesthesia due to unavoidable sympathetic blockade. Numerous studies have been conducted to see the cardiovascular effects of spinal blockade. Hypotension is the most frequent side effect of spinal anesthesia, occurring in more than 30% of patients[4]. In conventional spinal anesthesia it is not possible

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to limit the accompanied sympathetic block that normally exceeds the sensory block by 2-6 segments[5,6]. Ward et al reported a decrease in mean arterial blood pressure of 21.3% of the base line following spinal anesthesia. He also reported that a level of spinal anesthesia to T5 resulted in an increase in heart rate by 3.7%[7]. The cardio accelerator fibers originate from T1-T4 so the level of spinal anesthesia affecting these segments may cause bradycardia. Unilateral spinal anesthesia has been claimed by many as an alternative technique, to restrict the undesired sympathetic block[8]. The present study was conducted in elderly patients with cardiac failure of different degrees undergoing major lower limb orthopaedic surgery to assess whether a unilateral spinal anaesthesia using hyperbaric Bupivacaine will restrict the sympathetic block to avoid the undesired cardiovascular effects. Moreover in Pakistan this type of study has not been carried out before.

MATERIAL AND METHODS

This prospective, quasi -experimental study was conducted at Department of Anaesthesiology, Combined Military Hospital Rawalpindi, during the period of October 2012 to December 2013. Twenty adult ASA III and IV patients scheduled for unilateral lower limb surgery were included. Patients with any absolute contraindication for regional anesthesia were excluded from the study. After approval from hospital ethical committee, written informed consent of patients was taken regarding this modification of spinal anesthesia.

All patients were instructed "nil by mouth" (NPO) after mid night and no pre-medication was given. Standard monitoring, including electrocardiogram CM5 lead for ischemic changes and heart rate, non-invasive blood pressure and pulse oximetery was done in all patients. As a special monitoring effort, central venous pressure (CVP) and invasive arterial blood pressure were monitored in all

Table-1: Variation in MAP from prespinal value.

Patient no.	Prespinal MAP	Minimum MAP at any time during surgery	% fall from prespinal MAP
1	100	78	22
2	80	73	8.75
3	102	67	34.31
4	97	67	30.92
5	92	63	31.52
6	95	67	29.47
7	85	67	21.18
8	87	80	8.05
9	97	63	35.05
10	83	75	9.64
11	98	80	18.37
12	82	67	18.29
13	77	77	0
14	90	70	22.22
15	83	67	19.28
16	88	78	11.36
17	82	75	8.54
18	100	60	40
19	87	72	17.24
20	97	72	25.77
Average	90.1	70.9	20.59

patients. A 2ml/kg colloid was infused IV as preload. Patients were placed in lateral position with the limb to be operated on lower side. Lumbar area was prepared aseptically and draped. The inter-vertebral space L2-L3 or L3-L4 was identified and spinal anaesthesia was administered with 25 gauge Quinke needle. When the intrathecal placement was confirmed, 0.75% hyperbaric bupivacaine 7.5mg was injected over a period of 15-20 seconds. After removing spinal needle, sterile dressing was applied. The patients were kept in same position for ten minutes after intrathecal injection.

Hemodynamic variables including systolic, diastolic, mean arterial pressure and heart rate were recorded before spinal anesthesia, just after spinal anaesthesia and then every 5 minutes interval for the duration of surgery.

If systolic blood pressure decreased by more than 30% of baseline or systolic blood pressure less than 100 mmHg, ephedrine 5 - 20 milligrams in incremental doses with maximum of 50 milligram was given. In addition dobutamine (2-20 micro grams per kg per minute) and/or norepinephrine (2 – 5 micrograms per minute) continuous infusion was given in refractory cases[9]. If heart rate dropped less than 50 beats/minute, atropine 0.5 mg was given intravenously. Intraoperative sedation was provided to all patients with midazolam 1-2 mg intravenously. The duration of surgery, and any complications regarding anaesthesia were also recorded. All patients were shifted to recovery room after surgery. Patients were discharged from recovery room when they were able to move both legs and were haemodynamically stable.

The collected data was analyzed by using SPSS version 16.0. Results were expressed as numbers, percentages, means and standard deviation

RESULTS

In our study, out of 20 patients 16 (80%) were males and 4 (20%) were females. Mean age was 80.8 ± 12.5 yrs. The age range of patients was between 60 and 110 years. Average weight, 63.5 ± 8.95 kg. The mean duration of surgery in our patients was 63.55 ± 16.47 minutes. Twelve patients had ejection fraction of 30-35%, five patients had 26-30%, one patient had 21-25% and two patients had 15-20%.

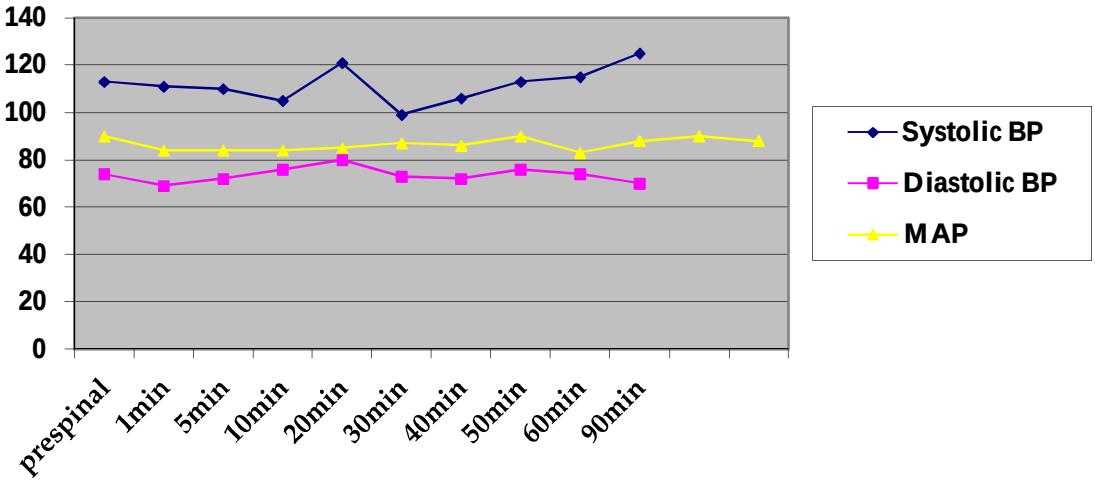

Figure-1: Blood pressure variation during surgery.

Ephedrine was needed in 12 patients. Four patients required atropine. Dobutamine infusion was started prophylactically in one patient and one patient required norepinephrine infusion 5mcg/min for 15 minutes. Two patients did not require inotropic or vasopressor support. Hypotension occurred

in 15 (75%) patients, bradycardia in 12(60%), tachycardia in 3(15%) and nausea occurred in 5(25%) patients. In table.1 prespinal mean arterial pressure is given. Post spinal mean arterial pressure was recorded at regular intervals and lowest value at any time during surgery is given in table. Difference of lowest mean arterial pressure from prespinal value was calculated as percentage. The average percent fall in mean arterial pressure from prespinal value was 20.59%. Variation in systolic, diastolic and mean pressure is shown in (fig-1). The maximum decrease in HR was seen at 20 minutes after giving spinal anesthesia (fig-2). The block remained unilateral in all the cases. Motor blockade was adequate in the limb to be operated.

All patients remained alert, and no ST segment changes were observed intra-operatively and till 6 hours after operation in all our subjects. In our study none of the patients complained of pain intraoperatively, although some of the surgical operation lasted as long as one and half hours. All patients were without complaints such as, respiratory complication and renal complication during and after operation.

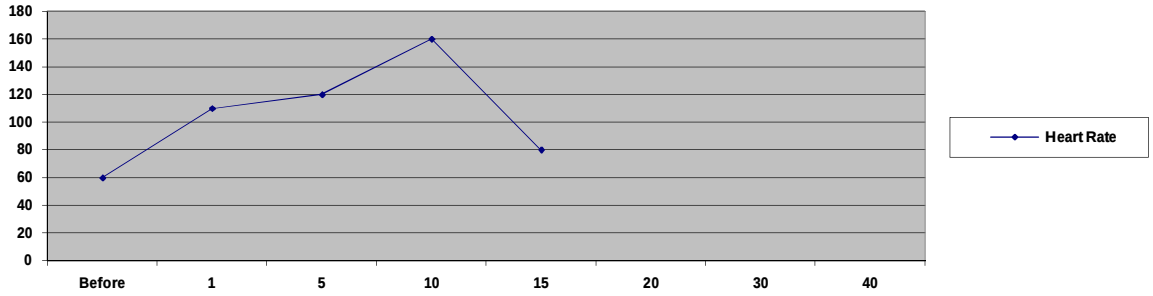

Figure-2: Heart rate variation during surgery.

DISCUSSION

Subarachnoid block (SAB) is often considered as a safe method of anesthesia because of low decrease in myocardial contractility and modest decrease in cardiac output[10].

Therefore, these situations are very attractive for patients with cardiac diseases and especially known congestive heart failure. In patients with congestive heart failure the activity of sympathetic nervous system increases[11,12], and with spinal anesthesia in these patients the systemic vascular resistance (SVR) and blood pressure may decrease more than patients with good left ventricular function[13]. Previous studies showed that hypotension after spinal block could be minimized by using of small dose of local anesthetics[14]. Elderly patients who underwent unilateral spinal anesthesia for orthopaedic surgery by hyperbaric bupivacaine showed low incidence of hypotension[14].

Two variables that identify cardiac output are ejection fraction and heart rate, and ejection fraction is dependent on myocardial contractility and end diastolic filling. The patients who have decreased myocardial contractility, for maintenance of cardiac output are very dependent on left ventricular end-diastolic volume (LVEDV) and in these patients increase of heart rate could not be efficacious[15,16]. In these patients sympathetic system activity and therefore SVR can increase and this modification could further decrease the cardiac output[17,18]. Spinal anesthesia with loss of sympathetic activity cause peripheral pooling of blood and could reduce end-diastolic volume.

Patients with low ejection fraction are preload-dependent and spinal block can further lower stroke volume and decrease cardiac output. Previous studies identified that spinal block may decrease LVEDV upto 19% and this modification was the primary cause of decrease in cardiac output especially in patients with low ejection fraction[19]. Patients with low cardiac

index who underwent spinal block with low dose of local anesthetic showed less decrease in mean arterial pressure because small dose of local anesthetic blocked sympathetic system less than traditional dose[14].

Limiting the spread of the spinal block offers many clinical advantages. First and foremost the haemodynamic impact of spinal anaesthesia is greatly reduced, as the increased venous capacity in affected side is compensated by a reflex vasoconstriction in the non-blocked areas. In case of successful unilateral spinal anaesthesia the difference in levels of sympathetic block between the two sides can be easily detected by measuring a higher temperature in the affected side, caused by a greater vasodilatation due to the sympathetic block.

Managing hypotension after spinal block may range from overloading intravenously fluids and using vasopressors[20]. Overloading in subjects with myocardial dysfunction may put them at risk of precipitating pulmonary edema[21]. Therefore, use of vasopressor in these patients may be preferred. Moreover, ephedrine treatment of hypotension increases heart rate and would be expected to be particularly deleterious in patients with low ejection fraction[22]. Epinephrine infusion during spinal anesthesia has been shown to restore systolic arterial pressure and increase cardiac output, but with no increase in diastolic or mean arterial pressure[23]. The incidence of deep vein thrombosis and pulmonary embolism increase in patients with left ventricular dysfunction therefore spinal block may be preferred to general anesthesia in these patients because thromboembolic events decrease with regional anesthesia[24,25].

Moreover, it has been demonstrated by clinical trials comparing unilateral spinal anaesthesia with conventional bilateral spinal block that cardiac index values are much more stable during the former than during the latter, with a small reduction in arterial blood pressure and heart rate[26] and a much lower incidence of clinically relevant hypotension (5% vs 20%)[27]. These characteristics justify unilateral spinal anesthesia in case of elderly patients with poor cardiovascular homeostasis.

Various studies were conducted to study the haemodynamic effects and adequacy of SAB with low dose of bupivacaine.

In a study, 1ml (5mg) of 0.5% hyperbaric bupivacaine was injected to produce unilateral spinal anaesthesia. The study concluded that, there were less haemodynamic changes and the block was predominantly unilateral with faster anaesthetic recovery and increased patient satisfaction[21].

In another study 1.1 to 1.8 ml of 0.5% hyperbaric bupivacaine was used to produce unilateral SAB and concluded that it was very effective and showed minimal haemodynamic changes[20].

Effects of 1.5ml (8mg) of 0.5% hyperbaric Bupivacaine was assessed in a study and concluded that there was predominantly unilateral block with minimal effects on the CV homeostasis[28].

Several studies have shown the usefulness of unilateral block in ASA I and II patients, however in our study only high risk patients were included. The expected small haemodynamic changes in unilateral block may be more relevant in elderly and chronically ill patients and further controlled studies should be performed to evaluate the usefulness of unilateral spinal anesthesia in high risks patients.

Our study showed that spinal block with small dose of bupivacaine in patients with low ejection fraction provides successful anesthesia and minimum decrease in arterial pressure. None of our cases complained of pain during operation. It may be due to delayed pharmacokinetics of drugs in subjects with cardiac dysfunction[29]. These characteristics are attractive for subjects with impaired myocardial contractility that predispose to hemodynamic instability. With agreement with previous studies we observed minimum heart rate changes after spinal block with small dose of local anesthetic, that this finding is very important in patients with low ejection fraction who had lower cardiac reserve.

CONCLUSION

Unilateral spinal anesthesia with a low dose, limited volume technique induces sufficient sensory and motor block with an appropriate level of analgesia. Therefore, we conclude that unilateral spinal block with low dose local anesthetic is a safe and effective method for lower limb surgery in patients with low ejection fraction.

However further studies are required in this regard with larger sample size, so that results of study can be generalized.

CONFLICT OF INTEREST

The authors of this study reported no conflict of interest.

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