

Subarachnoid block with low dose of bupivacaine and sufentanil in patients with coronary artery disease

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Original Article

Abstract

BACKGROUND: Subarachnoid block with local anesthetics and opioids enable efficacious spinal anesthesia because of their synergistic effect and permit the use of low-dose local anesthetics, which results in a stable hemodynamic state. The purpose of this study was to describe the cardiovascular effects of spinal anesthesia with low-dose bupivacaine and sufentanil on patients with coronary artery disease.

METHODS: This study was a double-blind randomized clinical trial. A total of 18 patients who had known coronary artery disease were enrolled. Our subjects underwent spinal block for lower limb surgery with 7.5 mg hyperbaric bupivacaine 0.5% and 5 µg sufentanil. Complications related to anesthesia such as hypotension, bradycardia, vasopressor need, and blood or volume use were recorded.

RESULTS: The average mean arterial pressure decreased 15% in the first 15 min of spinal block in our cases. No patients presented with hypotension and the subjects were without complaints during the spinal anesthesia. All patients remained alert, and no ST segment changes were observed intraoperatively and until 6 h after the operation. Baseline ejection fraction (EF) 40% or less was observed in 10 patients and these subjects were compared with other patients. Systolic and diastolic blood pressures, mean arterial pressure, and heart rate decreased during the first 15 min in response to spinal anesthesia in both groups of patients, but decreased more significantly in patients with EF > 40%.

CONCLUSION: We recommend spinal block with low-dose bupivacaine and sufentanil in patients with coronary artery disease and especially in patients with low EF.

Keywords: Bupivacaine, Coronary Artery Disease, Subarachnoid Block

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Introduction

Spinal anesthesia is used as a safe method in patients because of hemodynamic benefits compared with general anesthesia such as minimum decrease in myocardial contractility and only modest decreases in blood pressure and cardiac output.¹ These characteristics are attractive for elderly patients, especially with known coronary artery disease because of reduced cardiovascular reserve and predispose to hemodynamic instability. Sympathetic nervous system activity increases in patients with heart disease,^{2,3} therefore, these patients after spinal anesthesia could

be at risk of greater decreases in systemic vascular resistance (SVR) and blood pressure. In previous studies was shown that using small dose of local anesthetic could be minimized hypotension of spinal anesthesia.^{1,4} Low-dose of local anesthetic may not provide acceptable anesthesia, then opioids and local anesthetic administered together because of potent synergistic analgesic effect. Sufentanil has a higher affinity for the opioid receptor than fentanyl and it superior to fentanyl for hemodynamic stability and postoperative pain relief in patients.⁵ The problem of general anesthesia in patients with low cardiovascular

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reserve is hemodynamic instability and sometimes operation of these subjects is canceled. It seems that spinal anesthesia with a small dose of local anesthetics and opioid in these patients can safely be done. The purpose of this study was to describe the cardiovascular effects of spinal anesthesia with low dose of bupivacaine and sufentanil on patients with coronary artery disease.

Materials and Methods

Study design and samples

Eighty patients with American Society of Anesthesiologists (ASA) physical status I–III who underwent spinal anesthesia for lower limb surgery were identified in this randomized, double-blind clinical trial from June 2011 to February 2012. After approval of this study in local ethical committee, 18 patients with ASA physical status III, who had known coronary artery disease provided written informed consent and included in our study. Patients with recent deterioration in their medical status, such as unstable angina, severe congestive heart failure, and malignant arrhythmia were excluded. Standard monitoring including continuous electrocardiogram, heart rate, non-invasive arterial blood pressure, and continuous pulse oximetry and ST segment analyzer (Novin S1800, Iran) was used during surgery. The sensory and motor block was evaluated by pinprick test and modified Bromage scale (0 = no motor block; 1 = hip blocked; 2 = hip and knee blocked; 3 = hip, knee, and ankle blocked), respectively.⁶

Procedures

All patients preloading with 5 ml/kg ringer lactate and then underwent dural puncture with the midline approach at the L3-L4 interspace using a 25-Gauge Whitacre spinal needle. After free cerebrospinal fluid flow had been observed, 7.5 mg hyperbaric bupivacaine 0.5% (Marcaine Spinal Heavy, Astra, Sweden) and 5 µg sufentanil (Janssen-Cilag, Belgium) was injected through the needle. Specific gravity of the solutions at 37°C was 1.020. Then, patients were immediately turned to supine. The complication related anesthesia such as hypotension, bradycardia, vasopressor need, and blood or volume use were recorded. Hypotension was defined as a systolic blood pressure < 90 mmHg or a decrease of more than 25% from the baseline mean arterial pressure at the first 30 min after spinal anesthesia. The hypotension episodes were treated with a loading dose of intravenous fluids and intravenous bolus of ephedrine 5–10 mg.

Statistical analysis

The statistical significance of the effect of spinal anesthesia was assessed by using SPSS for Windows

(version 16, SPSS Inc., Chicago, IL, USA). Associations among variables were assessed by the Student's t-test and the ANOVA test. Associations among variables were assessed with the Pearson correlation coefficient. Values are reported as mean ± SD. Significance was defined as $P < 0.05$.

Results

The average mean arterial pressure decreased 15% (11.2 mmHg to 9.52 mmHg) in first 15 min of spinal block in our cases. The level of sensory block following anesthesia was observed in T6 (n = 2), T7 (n = 2), T8 (n = 10) and T10 (n = 4). The grade of motor block after spinal anesthesia was 0 (none), 1 (none), 2 (n = 4), and 3 (n = 14). No patients presented with hypotension and the subjects were without complaints during the spinal anesthesia. All patients remained alert, and no ST segment changes were observed intra-operative and till 6 h after operation. No patients presented with bradycardia or HR above 95 bpm during spinal anesthesia. In our study none of subjects complained of pain intraoperatively, although some of the surgical operation lasted as long as 120 min. Ten patients had baseline ejection fraction (EF) 40% or less and these subjects compared with other patients with EF more than 40%. Systolic, diastolic, mean arterial pressure, and heart rate were decreased during first 15 min in the response to spinal anesthesia in both groups of patients, but significantly more decreased in patients with EF > 40% (Table 1, Figures 1A–D).

Discussion

This study evaluated the effects of spinal anesthesia with low dose of bupivacaine and sufentanil in 18 patients with ASA class 3 who had coronary artery disease. The 15% average decrease in mean arterial pressure was not dramatic compared with other report with 21–32% decrease in mean arterial pressure in patients with regular dose of bupivacaine.^{4,6,7} Patients with cardiac disease may have played a different role in the response to spinal anesthesia compared with healthy patients. Resting sympathetic nervous system activity and norepinephrine release from nerve terminals have increased in patients with cardiac disease,^{8,9} therefore sympathetic activity block following spinal anesthesia would be expected to exaggerate the decrease in SVR and more episodes of hypotension. In our study, no patients presented with hypotension and did not need to vasopressor. The main mechanism for hypotension after spinal block

is a decreased in SVR and loading of crystalloid alone may not be able to compensate decrease in SVR. Decreases in cardiac output during spinal anesthesia due to shift in blood from the heart to peripheral arteries, but not due to decrease in cardiac contractility, therefore, use of vasopressor injection is associate with an increase in cardiac output.¹⁰ Although the most commonly used vasopressor for hypotension associated with spinal anesthesia (HAS) is ephedrine, but may not be the drug of choice in this situation. It is not a potent vasopressor; therefore, ephedrine may not reliably reverse decrease in SVR.^{11,12} Moreover, ephedrine treatment of hypotension increases heart rate and would be expected to be particularly deleterious in the patient with ischemic cardiac disease.^{13,14} 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.¹⁵ Our study showed that use of low dose of bupivacaine plus sufentanil for lower limb surgery in patients with coronary artery disease provides successful anesthesia and with minimum episodes of hypotension and minimum need for vasopressor support. Cardiac output remains constant when the

decrease in systolic arterial pressure is < 25% following spinal anesthesia.⁴ Furthermore, it was shown that the small dose of bupivacaine plus sufentanil caused dramatically less hypotension and nearly eliminated the need for vasopressor support of blood pressure.⁶ It was noted that the EF increased in patients with baseline EF 25% or less and unchanged in patients with baseline EF 50% or more.⁶ We think that the reason for increase in EF in patients with low EF was afterload reduction and lack of change in the pressure-volume ratio contractility index. Previous studies showed that left ventricular function in patients with coronary artery disease has been preserved during lumbar epidural anesthesia with reporting no regions of diminished wall motion,⁵ but one study reported new wall motion abnormalities in 4 of 10 subjects.¹⁶⁻¹⁹ It was shown that heart rate varies by 10% during subarachnoid block, usually decreasing with traditional dose of local anesthetic. However, several studies have suggested that there are opposing factors affecting heart rate.^{4,7} Heart rate in our subjects was unchanged with low dose of local anesthetic. In our study, none of the subjects complained of pain intraoperatively, although some of the surgical operation lasted as long as 120 min.

Table 1. The comparison of decreased of systolic, diastolic, mean arterial pressure, and heart rate during first 60 min in response to spinal anesthesia in patients with ejection fraction (EF) \leq 40% and EF > 40%

Variables	EF \leq 40% (%)	EF > 40% (%)	P
Systolic blood pressure			
5 min	2.8	10.8	< 0.001
10 min	7.0	16.5	
15 min	11.9	19.4	
30 min	11.9	20.0	
60 min	11.2	18.8	
Diastolic blood pressure			
5 min	2.2	8.7	< 0.001
10 min	3.3	14.5	
15 min	15.5	19.4	
30 min	16.6	18.4	
60 min	14.4	19.4	
Mean arterial pressure			
5 min	1.9	10.0	< 0.001
10 min	4.7	15.7	
15 min	14.0	19.6	
30 min	13.0	19.6	
60 min	12.1	18.8	
Heart rate			
5 min	3.1	6.2	< 0.001
10 min	6.2	7.4	
15 min	9.4	12.3	
30 min	9.3	13.5	
60 min	8.3	11.1	

EF: Ejection fraction

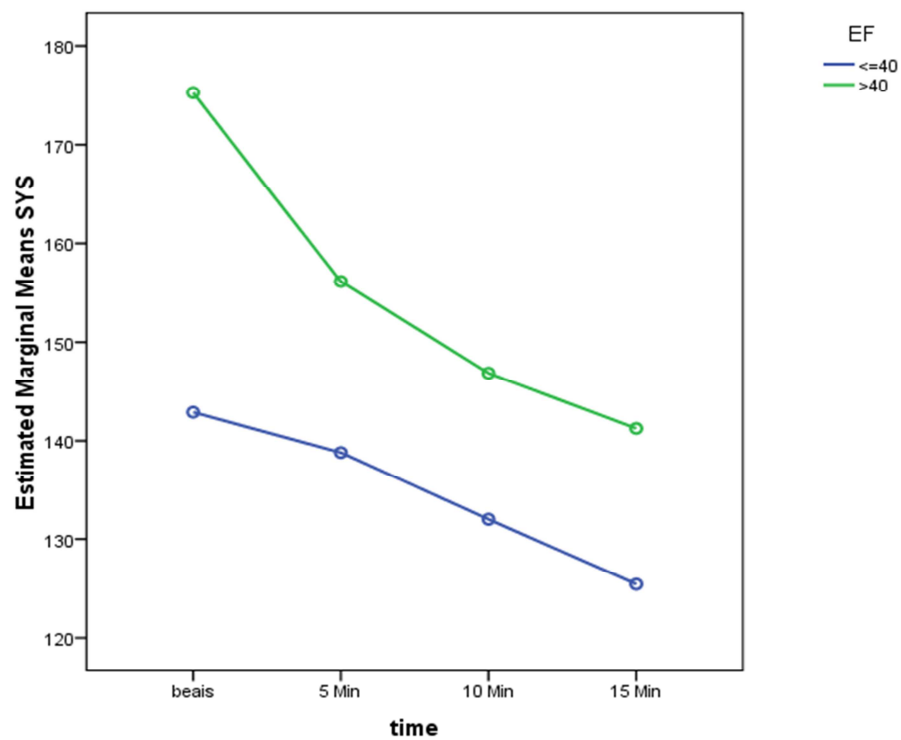


Figure 1A. The comparison of decreased of systolic blood pressure in the response to spinal anesthesia in patients with ejection fraction (EF) \leq 40% and EF > 40%
Sys: Systolic blood pressure

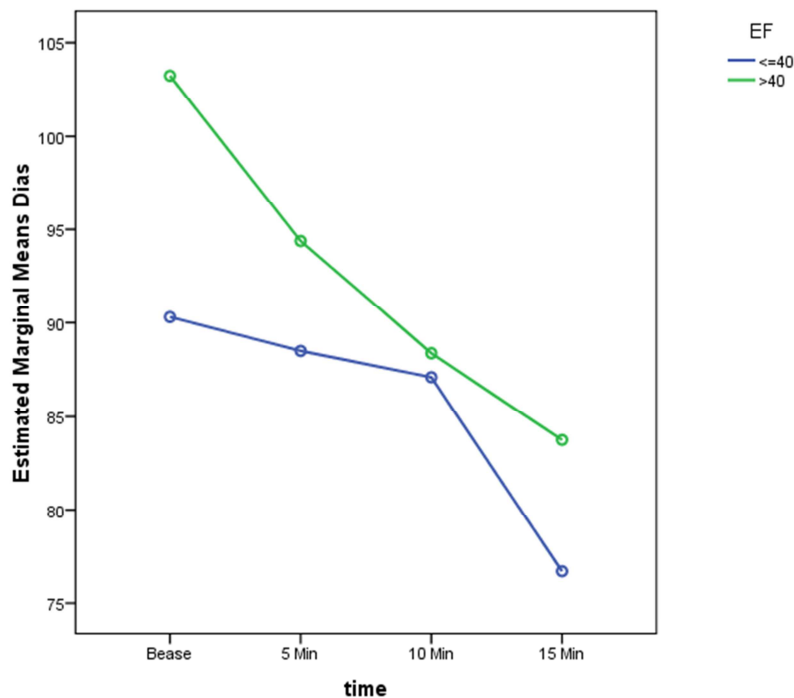


Figure 1B. The comparison of decreased of diastolic blood pressure in the response to spinal anesthesia in patients with ejection fraction (EF) \leq 40% and EF > 40%
Dias: Diastolic blood pressure

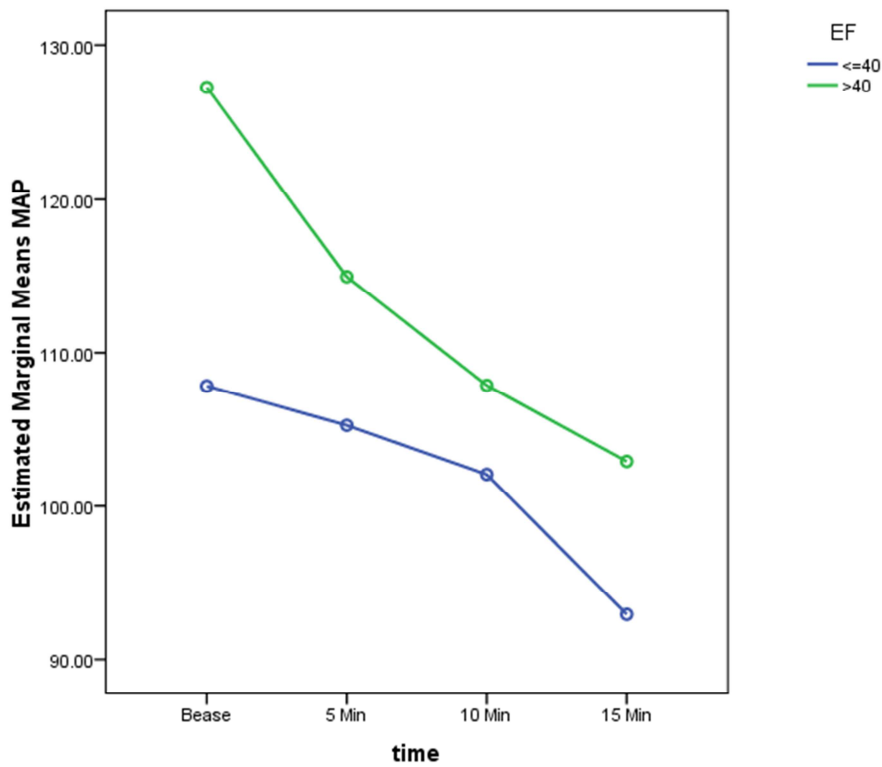


Figure 1C. The comparison of decreased of mean arterial pressure in the response to spinal anesthesia in patients with ejection fraction (EF) \leq 40% and EF > 40%
 MAP: Mean arterial pressure

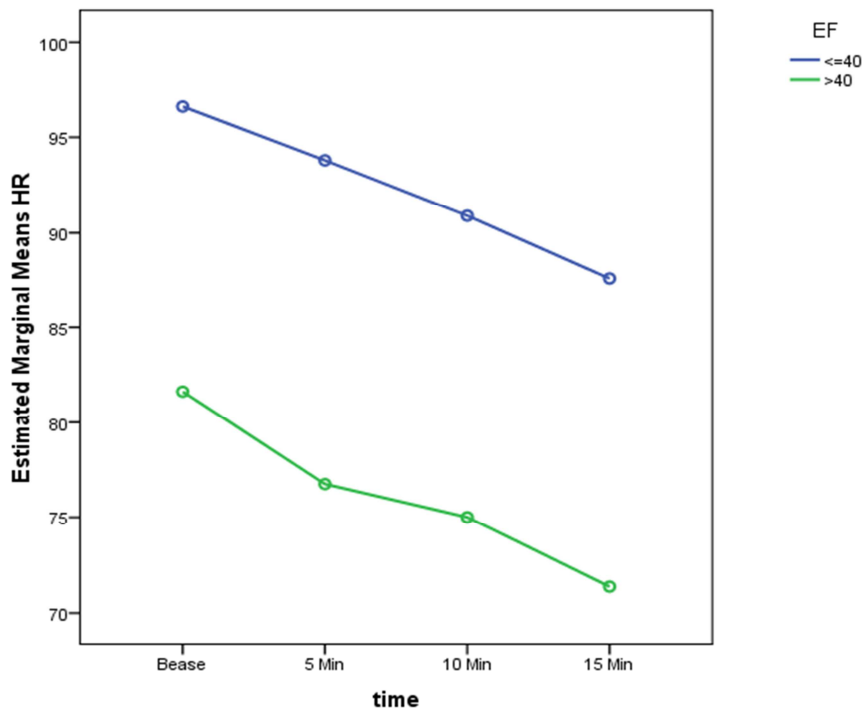


Figure 1D. The comparison of decreased of heart rate in the response to spinal anesthesia in patients with ejection fraction (EF) \leq 40% and EF > 40%
 HR: Heart rate

Conclusion

Our study showed that use of low dose of bupivacaine plus sufentanil for lower limb surgery in patients with coronary artery disease provides successful anesthesia and with minimum episodes of hypotension and nearly eliminate the need for vasopressor support of blood pressure and without tachycardia and ST segment changes. Therefore, we recommend that spinal block with low-dose local anesthetic and sufentanil for lower limb surgery in patients with coronary artery disease and especially for patients with low EF.

Conflict of Interests

Authors have no conflict of interests.

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