

# Use of a Continuous Local Anesthetic Infusion for Pain Management after Median Sternotomy

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## Abstract

**Background-**The use of large doses of opioid analgesics to treat pain after cardiac surgery can prolong the time to tracheal extubation and interfere with the recovery of the bowel and bladder function in the postoperative period. Therefore, we sought to investigate the efficacy of a continuous infusion of Bupivacaine 0.5%, at the median sternotomy site, for 48 hours after cardiac surgery in reducing the opioid analgesic requirement and improving the recovery process.

**Methods-**In this prospective, randomized, placebo-controlled, double-blind clinical trial, 36 consenting patients undergoing open heart surgery with a standardized general anesthetic technique had two indwelling infusion catheters placed at the median sternotomy incision site at the end of surgery. The patients were randomly assigned to receive normal saline (control), Bupivacaine 0.5% via an elastomeric infusion pump at a constant rate of 4 ml/h for 48 hours. In addition, the postoperative opioid analgesic requirements and opioid-related adverse effects were recorded. The patients' satisfaction with their pain management was assessed at specific intervals during the postoperative period. Duration of mechanical ventilation and time of ventilation were assessed in the two groups.

**Results-**Compared with the control group, there was a statistically significant reduction in ambulatory time 13.7+/-2.5 vs. 16.5+/-4.6 hours (P=0.03). Hospital stay was also shorter in the case group (5+/-0.6 vs. 6.1+/-0.9 with P= 0.01). Extubation time and ICU stay were not statistically significant (P= 0.93 for extubation time and P=0.70 for duration of ICU stay), and also patient satisfaction in the two groups was not statistically significant. Opioid dose, used in the case group, was 1.1+/-0.8 and in the control group was 3.7+/-1.3, with the difference being statistically important (P = 0.02).

**Conclusion-**A continuous infusion of Bupivacaine 0.5% at 4 ml/h is effective for decreasing pain and the need for opioid analgesic medication as well as for improving patient satisfaction with pain management after cardiac surgery. Patients in the Bupivacaine-0.5% group were able to ambulate earlier, leading to a reduced length of hospital stay (*Iranian Heart Journal 2012; 13 (1):29 -33*).

**Keywords:** Pain ■ CABG ■ Local anesthesia ■ Bupivacaine

Postoperative pain is most often related to the median sternotomy<sup>1</sup>. Severity of sternotomy pain has been found to be significantly higher in the first two postoperative days. The effects of

postoperative pain not only influence the result of surgery but also can increase the morbidity and mortality rate and high blood pressure, tachycardia, and reduction of myocardial performance<sup>15,16</sup>

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Developing strategies for optimizing the analgesic management after cardiac surgery has assumed increased importance, especially with protocols requiring early tracheal extubation.<sup>2-4</sup>

In addition, postoperative pain is one of the main and primary concerns of patients admitted to the intensive care unit (ICU).<sup>5-7</sup> Prevention and treatment of postoperative pain and its complications is one of the most important issues in postoperative care and plays an important role in expediting the improvement in the patient's general condition.<sup>15</sup>

The most often used analgesic methods for alleviating pain after cardiac surgery are intravenous opioid analgesics *via* patient- or nurse-controlled delivery systems.<sup>2,4</sup> However, the use of parenteral opioid-based analgesic techniques can delay tracheal extubation as a result of their ability to produce drowsiness and respiratory depression. Opioid analgesics also produce adverse effects on the gastrointestinal tract (*e.g.*, nausea, vomiting, and ileus) and bladder function (*e.g.*, urinary retention). To reduce the adverse systemic effects of opioid analgesics, the use of central neuraxial techniques involving small doses of opioids has become increasingly popular.<sup>8-11</sup> Also due to the known side effects of these medications, several alternative ways have been attempted to reduce the need for opioid analgesics by finding new analgesics as well as new methods for reducing postoperative pain.<sup>15</sup> In recent years, new methods have been introduced to reduce postoperative pain and need for opioid analgesic in cardiac surgery. A part of success includes subcutaneous infusion methods, which are easily tolerated by patients, infiltration, and continuous infusion of Bupivacaine in the surgical wound. Although the use of this method was started in 90s, limited studies are available in regard to the efficacy of a local infusion of Bupivacaine in reducing pain after median sternotomy. Furthermore, there are some disagreements in the result.

Therefore, we designed this clinical study to examine the hypothesis that the infusion of a local anesthetic solution (Bupivacaine 0.5%) at the median sternotomy site would produce improved pain control and an opioid-sparing effect after cardiac surgery. A secondary objective of the study was to determine if the opioid-sparing effects of the local anesthetic infusion would facilitate the recovery process and improve patient outcome with respect to satisfaction with pain management.

## Methods

This study was designed as a prospective single blind randomized trial. The study population was comprised of patients who underwent elective Coronary Artery Bypass Surgery (CABG) with the off-pump technique in Imam Reza Hospital of Mashhad University of Medical Sciences. The exclusion criteria included patients with diabetes mellitus, known allergy to local anesthetic, redo CABG, neuropsychological disorders, and unreliable patients. Other exclusion criteria included poor LV function (EF < 25%) and COPD patients for whom the intubation time was expected to be higher than that of other patients.

The patients were randomized in two groups (group A = Cases Group B = Controls). Each group had 18 patients. All these patients received the same anesthesia with Midazolam, Atracurium, and Sufentanil for the induction and also maintenance of anesthesia. In group A, two indwelling infusion catheters were placed at the median sternotomy incision site at the end of surgery. These catheters had several side holes that were placed in the soft presternal tissue. Because most of the patients complained of pain with severe intensity in the lower part of the sternal incision close to the drain location, one of the infusion catheters was placed in this part.

The autoinfusion pump of ON-Q system was filled with 240 mg Bupivacaine 0.5% with

125 ml of normal saline in group A and with a continuous infusion rate of 4cc/h for 48 hours. Pain relief for the patients was also scored from 0-10: for scores 0-3, it means excellent satisfaction; for scores 4-7, it means good satisfaction; and for scores 8-10, it means poor satisfaction.

The data recorded consisted of age, sex, history of addiction, number of grafts used, ejection fraction, extubation time, duration of ICU stay, hospital stay, and need of opioid analgesics used in both groups.

These data were analyzed using the SPSS version 15 statistical software. The quantitative data are shown as mean $\pm$  SD, and the qualitative data are presented in terms of frequency. To compare the quantitative data and qualitative data, we used K2 for the qualitative data and *t*-test for the quantitative data. The level of significance was considered 0.05.

## Results

In our study, we had 36 patients: 18 cases in each group. The two groups were similar in terms of demographic data, including age, sex, smoking, and history of addiction (Table I) and also without significant differences in the operative data between the two groups.

**Table I. Demographic data in the two groups of patients**

		Group A(cases)	Group B(control)
Age	(mean $\pm$ -SD)	57 $\pm$ 14.1	61 $\pm$ 7.5
Sex	(Male/Female)	9/7	13/7
addiction	NO(%)	6(37.5 %)	5(25%)
Preop EF	(%)	46.6 $\pm$ -9.7	46.9 $\pm$ - 9.6

In Table II, we show the postoperative data, collected from the patients in the two groups. Extubation time was statistically similar in the

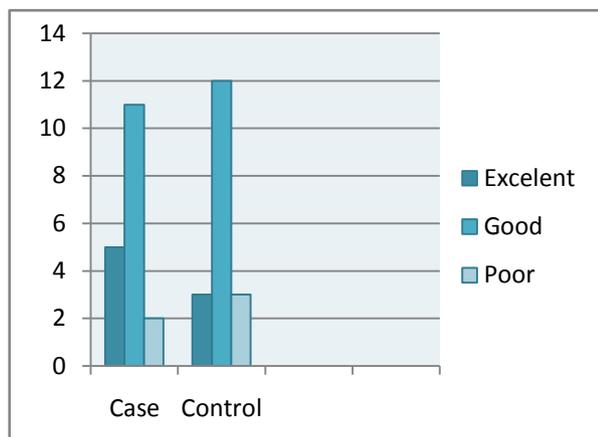
two groups. Although the mean of ICU stay between the two groups was different, it was not statistically important. In contrast, the mean of hospital stay was important ( $P=0.01$ ). The mean of time to ambulation was 13.7  $\pm$  2.5 hours in group A and 16.5  $\pm$  4.6 hours in group B; the difference was statistically significant ( $P$ - Value 0.03).

**Table II. Postoperative data in the two groups**

	GroupA (cases)	GroupB (control)	P-Value
Extubation Time (hour)	10.4 $\pm$ - 3.8	11 $\pm$ - 5.4	0.93
I.C.U Stay(hour)	1.6 $\pm$ -0.8	2 $\pm$ - 6	0.70
Hospital Stay(days)	5. $\pm$ -0.6	6.1 $\pm$ - 0.9	0.01
Ambulation Time(days)	13.7 $\pm$ - 2.5	16.5 $\pm$ - 4.6	0.03

The mean doses of the opioid agents for the control of the patients' pain during ICU stay and hospital stay were 1.1  $\pm$  0.8 in the Bupivacaine group (group A) and 3.7 $\pm$  1.3 in group B; these differences were significant ( $P=0.02$ ).

Patient satisfaction with pain control was excellent in 3 patients (16.5%) in the control group and 5 patients (27%) in the case group. Good satisfaction was reported in 12 patients (66%) in the control group and 11 patients (62%) in the case group. Poor satisfaction was reported in 3 patients (16.5%) in the control group and 2 (11%) in the case group. Patient satisfaction with pain control was not statistically important ( $P$ -value 0.58).



**Fig 1.** Patient Satisfaction level in the two groups

## Discussion

Mortality and morbidity after surgery seem to be related, in part, to the pathophysiological response to the surgical trauma and to postoperative complications.<sup>11</sup> Postoperative pain and the use of large doses of opioid under medications can increase adverse effects, which contributes to delays in postoperative recovery after major surgery.<sup>12,13</sup> Therefore, the use of opioid-sparing analgesic techniques that can improve postoperative pain control with less opioid medication might facilitate the recovery process and rehabilitation (*e.g.*, resumption of dietary intake and physical activity).<sup>14</sup> Analgesic techniques that improve pain control while minimizing the respiratory depressant effects of opioids in the early postoperative period are essential for fast-tracking patients through the recovery process after cardiac surgery.<sup>8-11</sup> Continuous local infusion of Bupivacaine is one of the methods suggested to reduce postoperative pain. The first successful report of this technique in cardiac surgery was published by Magnano et al. in 2005.<sup>18</sup>

White and his colleagues showed that the continuous infusion of Bupivacaine 0.5% with 4 ml/h could significantly reduce pain as well as need for opioids. Furthermore, this method increased the satisfaction of the

patients<sup>17</sup>. Controlling postoperative pain, therefore, reduces the length of hospital stay and also ICU stay.

We failed to demonstrate an improvement in all the key outcome variables. Moreover, the present study, involving a relatively small series of patients, was not adequately powered to examine the effect of local anesthesia on all of the secondary outcome variables. Other similar studies have used Bupivacaine in different concentrations, and we also need to conduct further investigation to find the best and optimal concentration of Bupivacaine for excellent pain relief. In our study, the level of pain score in Bupivacaine was less than that in the control group, which chimes in with the results of other studies. In addition, we had lower doses of opioid. Another concern was related to the low incidence of catheter-related problems (like inadvertent removal during dressing and breakage on removal). Also, the safety of the infusion of local anesthetics was limited to patient cardiac rhythm and plasma drug concentrations. Even in Bupivacaine 0.5%, plasma drug concentrations were below the toxic concentrations. In our study, no ventricular arrhythmia was noted.

In conclusion, the use of a continuous infusion of Bupivacaine 0.25% at the median sternotomy site reduced postoperative pain and the need for opioid analgesics after cardiac surgery. The use of the infusion of Bupivacaine 0.25% also improved some patient outcome variables (*e.g.*, time to ambulation) and patient satisfaction with pain management. This non-opioid pain management technique has the potential to facilitate the recovery process after open heart surgery.

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