

Pre-Sternal Local Anaesthetic Infiltration as Adjunct to Anaesthesia accelerates Extubation of Patients in Adult Cardiac Surgery.

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ABSTRACT

Objective: Compare the effect of Pre-Sternal local anaesthetic (LA) infiltration and systemic opioid analgesia on the early extubation in adult cardiac surgeries.

Introduction: Median sternotomy causes severe injury and alters the pulmonary functions and consequent recovery. Different methods have been used to allay the pain caused and local infiltration of anaesthetics has been documented with good results.

Material and Methods: Fifty (n=50) adult patients requiring open-heart surgeries were randomly allocated to two groups (I & II) of 25 each irrespective of gender and age. An infusion of fentanyl @ 1 mcg/kg/hr was given to Group I patients while as in Group II, 20 ml of 0.5% ropivacaine was infiltrated at the intended sternotomy site. Both groups further received 50 mcg bolus of fentanyl at the time of sternotomy retraction. Postoperatively patients were shifted to cardiac surgical intensive care unit (CSICU) and were observed for weaning and early extubation.

Results: The mean time of extubation was earlier in Group II patients at 4.24 hours after surgery with shorter time duration of postoperative ventilation as compared to 6.90 hours in Group I patients. We also observed a better postoperative pain relief as evident from their improved visual analogue scores (VAS) and better breathing pattern in Group II patients as compared to those in Group I after the patients were extubated. None of the patients of either group was re-intubated.

Conclusion: Pre-Sternal local anaesthetics infiltration of sternotomy site not only facilitates early extubation after open-heart surgery in CSICU but also improves pain scores hence also improves breathing and have less requirements for analgesics in postoperative periods.

Keywords: Local anesthesia infiltration, systemic opioid anesthesia, cardiac surgery, early extubation, pain scores, analgesia, sternotomy
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INTRODUCTION

Cardiac surgery is a major undertaking. Pain and impairment in pulmonary functions and increased morbidity and mortality are inherent. Over the last decade, cardiac anesthesia has been greatly standardized. Assessing the comparative benefits of different techniques of pain management, to guide clinical practice and to identify areas of further research needs evidence evaluation^[1] Median sternotomy causes severe surgical injury and alters the pulmonary functions and consequent recovery. Diverse analgesic approaches have been used to alleviate the pain

caused. LA infiltration has been documented with good results.^[2] Aparasternal intercostal block by single injection of bupivacaine in early postoperative period provides pain relief and facilitates early weaning and extubation after cardiac surgery and reduces pain scores and opioid

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requirements.^[3] Large doses of opioid analgesics for pain relief after cardiac surgery prolong duration to tracheal extubation and hampers recovery of bowel and bladder function in the postoperative period.^[4] Patient-controlled analgesia alone in reducing pain at 1, 3, and 90 days after cardiac surgeries is inferior to wound infusion and patient-controlled analgesia combined.^[5] We endeavoured to find out and compare the related outcomes of pre-sternal LA infiltration over systemic opioids based analgesia in adult patients undergoing cardiac surgeries on extubation times and pain scores in cardiac surgical intensive care unit.

MATERIAL AND METHODS

This prospective observational study was conducted in the Cardiovascular & Thoracic Anesthesiology Division of the Department of Anaesthesiology and Critical Care at a University Teaching and Tertiary Care Referral Hospital, Sher-I-Kashmir Institute of Medical Sciences (SKIMS), Srinagar, Jammu and Kashmir in the northern part of Indian sub-continent, after approval from Departmental Review Board (DRB) and obtaining written informed consent from patients. A total of fifty (n=50) patients aged above 18 years, were randomly divided into two groups (I and II) of 25 patients each after being discussed in cardio-surgical meet and planned for open-heart surgeries (mitral valve replacements, aortic valve replacements, or both, adult congenital surgeries like atrial septal defects, cardiac tumours) belonging to American Society of Anaesthesiology Physical Status (ASA) of 1 to 3 were included in the study. Patients who refused to give consent for surgery or participation in the study, or were allergic to LA or any drugs used during anaesthesia, or having opioid addiction, reduced mental capacity, previous cardiothoracic surgery and respiratory diseases were excluded from the study.

Patients were advised to remain fast for six hours before surgery. Patients were educated about the anesthesia plan and pain score assessment using a visual analog scale (VAS) on a linear scale of zero (no pain) to ten (worst possible pain) a day before surgery. After arrival in the operating room (OR), patients were reassured and shifted to an operating table. Intravenous (IV) access by 16 G cannula on dorsum of left hand was established after application of LA. Standard monitoring as per the institutional protocol comprising of electrocardiography (ECG) for rate and rhythm analysis^[6],

SpO₂ by digital pulse oximetry, temperature and blood pressure. Intra-arterial 20 gauge (G), 5 cm catheter was placed in the left radial artery after LA infiltration for hemodynamic invasive blood pressure (IBP) monitoring and arterial blood gas monitoring^[7], before induction of anesthesia.

Central venous catheter line (CVCL) 7.0 French 16 cm was placed in the left internal jugular vein (IJV) using ultrasonographic (USG) guidance after anesthesia induction. Both CVCL and IBP were zeroed and monitored continuously for central venous pressures (CVP) and IBP.

Antibiotics were given 30 minutes before the intended sternotomy time after the negative allergic test dose-response. The patients were induced by midazolam (0.15 mg/kg BW), fentanyl (10 mcg/kg BW) and vecuronium (0.1 mg/kg BW) to facilitate laryngoscopy and endotracheal tube (ETT) intubation. The ETT was fixed (at a mark at which there were bilateral equal chest rise on inspection and equal breath sounds on auscultation) and connected to anesthesia work station on the volume control mode of ventilation (VCV) with tidal volume (Vt) of 8ml/kg ideal BW, respiratory rate (RR) of 14 to 16 breaths per minute and PEEP of 5cmH₂O. The anaesthesia was maintained with 50% oxygen in air with 1.2 minimum alveolar concentration (MAC) of isoflurane to maintain optimal depth of anaesthesia and avoid awareness.

In Group I, infusion of fentanyl was started @1mcg/kg/hr after induction of anaesthesia and continued till extubation in CSICU, while as in Group II, 20ml of 0.5% ropivacaine was given subcutaneously up to sternal periosteum on intended sternotomy site prior to sternotomy incision. In addition, 50-mcg IV bolus of fentanyl was given at the time of sternotomy retraction and initiation of cardiopulmonary bypass (CPB) in both the groups using aorto-bicaval cannula. Magnesium sulfate 2 gms were given in the venous reservoir at the initiation of CPB. After surgical correction and planned weaning from CPB, inotropes and vasopressor were started to maintain the hemodynamic goals. Antibiotic doses were repeated after 4 hours of surgery in OR. Before the skin closure Infiltration of additional 20 ml of 0.5% ropivacaine into the surgical sternotomy site and drainage tube sites in Group II. After completion of surgery patients were shifted to CSICU and were observed for awakening and early extubation.

RESULTS

The preoperative patient characteristics were comparable between the two groups. [Table 1] Clinical hemodynamic characteristics at the time of extubation were also comparable between the two groups. [Table 2] The mean time of extubation in Group II was 4.24 ± 0.28 hours as compared to 6.90 ± 1.01 hours in Group I with a significant p-value of less than 0.05. The earlier time of extubation in patients receiving the pre-sternal LA infiltration has correspondingly low pain score as compared to the patients managed on standard opioid-based analgesia with a significant p-value. [Table 3]

DISCUSSION

Early weaning and extubation after cardiac surgery has gained precedence and is safe. Reduced costs and better outcome has been reported.^[8] The main sources of pain in cardiac surgical patients are median sternotomy incision and chest tube insertion sites.^[9] Pre-sternal LA infiltration before sternotomy incision helps improving analgesia and reducing opioid requirements after adult cardiac surgery besides providing effective sternal wound pain control.^[10] Therefore, infiltration of LA agents near the sternal incision sites is a possible way of diminishing early postoperative pain compared to systemic opioids based analgesia. This

Table 1. Pre-operative patient characteristics.

		Group I, n=25 (%)	Group II, n=25 (%)
Gender	Males	15 (60)	17 (68)
	Females	10 (40)	8 (32)
Age in years	Mean$\pm$SD	49.8 ± 14.56	48.4 ± 13.83
Weight in Kg	Mean$\pm$SD	65.2 ± 6.13	66.8 ± 4.89
ASA Status	1	10 (40)	11 (44)
	2	6 (24)	7 (28)
	3	9 (36)	7 (28)
Ejection Fraction	%	62	63
BSA in M²	Mean$\pm$SD	1.72 ± 0.6	1.74 ± 0.8
Cardiorespiratory parameters (Mean$\pm$SD)	Heart Rate (bpm)	71.45 ± 8.5	70.77 ± 7.5
	Mean Arterial Pressure (mmHg)	73.25 ± 8.80	72.8 ± 8.34
	SpO₂ (%)	98.7 ± 1.38	98.80 ± 1.12
	Temperature (°C)	36.50 ± 0.74	36.51 ± 0.69
Types of Open Heart Surgeries	AVR	6 (24)	7 (28)
	MVR	8 (32)	7 (28)
	Both AVR & DVR	5 (20)	4 (16)
	ASD's	4 (16)	5 (20)
	LAM	2 (8)	2 (8)

ASA= American society of Anaesthesiology physical status; BSA= Body Surface Area in M²; SD = Standard Deviation; n= Number of patients; SpO₂= arterial oxygen saturation by digital pulse oximetry; Kg = Kilograms; bpm = beats per minute; mmHg = millimetres of mercury; % = percentage; °C = temperature in degree Celsius; AVR = Aortic Valve Replacements; MVR = Mitral Valve Replacements; ASD's = Atrial Septal Defects; LAM = left atrial myxomas

Table 2: Clinical Parameters in Cardiac Surgical Intensive Care at Extubation

	Group I, (n=25) Mean±SD	Group II, (n=25) Mean±SD
Heart Rate (bpm)	72.60±3.95	69.53±2.88
Mean Arterial Pressure (mmHg)	72.60±3.96	70.68±2.73
SpO₂ (%)	99.7±1.81	98.99±1.02
Temperature (°C)	36.65±0.94	36.53±0.82
Tidal Volume (Vt) in ml/kg at PS of 6 cmH₂O	5.12 ±0.04	6.35±0.12

SD= Standard Deviation; n= Number of patients; SpO₂= arterial oxygen saturation by digital pulse oximetry; bpm = beats per minute; mmHg = millimetres of mercury; % = percentage; °C = temperature in degree Celsius; PS = pressure support in; cmH₂O = Centimetres of water; ml/kg = millilitres per kilogram of ideal body weight

Table 3: Time of extubation, Pain & Sedation Scores at Extubation, Rescue analgesic requirements

		Group I, (n=25)	Group II, (n=25)	p-value
Time of Extubation in hours (Mean±SD)		6.90±1.01	4.24±0.28	0.033*
Visual analogue Scale (Mean±SD)		3.64±0.35	2.50±0.05	0.045*
Sedation agitation score	3	18	21	0.048*
	4	7	4	0.034*
First rescue analgesic dose requirement in hours post-extubation		1.6±0.05	6.30±0.91	0.001*

SD= Standard Deviation; n= Number of patients; *= Significant p-value

further decreases the requirement and subsequent opioid-induced side effects such as sedation and respiratory depression.^[11,12] An important parameter for early weaning of cardiac surgery patients from ventilator is control and reduction of pain in early postoperative period that leads to quicker weaning, lesser intubation time, fewer postoperative analgesic dosage requirements and improved arterial blood gas parameters.^[9,11,12]

CONCLUSIONS

We observed that pre-sternal LA infiltration of the median sternotomy surgical wounds in adult cardiac surgery reduces opioid analgesic dosage requirement thus facilitating the weaning from ventilator and early extubation and post-extubation improvement in breathing and blood gas parameters by improving pain quality and scores.

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Conflicts of Interests: The authors declare that they have no conflicts of interest.

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Consent: Written informed consent was obtained from all patient who participated in the study.

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