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### Research Article

# Parasternal Block with Two Different Concentration of Ropivacaine for Post-Operative Analgesia in Patient Undergoing Coronary Artery Bypass Grafting: A Randomized Double Blind Controlled Trial

### Abstract

**Background:** Postoperative sternal pain is one of the most important factors affecting patients' quality of life during the early post-operative days. Optimal pain management after cardiac surgery improve comfort and wellbeing of the patients. Conventionally used techniques of postoperative analgesia mostly provided by intravenous route, have their own side effects, causing a delay in tracheal extubation. Parasternal intercostals block is one such technique which has several potential advantages and devoid of the above side effects.

**Objective:** To study the effect and efficacy of parasternal intercostals block analgesia with two different doses of ropivacaine for post-operative analgesia in patients undergoing coronary artery bypass grafting (CABG).

**Design:** Randomized, prospective, double blind study

**Setting:** Tertiary health care teaching hospital

**Participants:** One hundred and twenty adult cardiac surgical patients scheduled for elective coronary artery bypass grafting.

**Intervention:** 0.75% (group R1) and 0.5% (group R2) ropivacaine injection with 5 doses of 4 ml each on each side of Parasternal intercostals space with a total dose of ropivacaine 200 mg and 300 mg respectively or same volume of saline (group S) prior to surgical incision.

**Measurements and results:** The average time of extubation was significantly lower in R1 and R2 group compared to S group, being 5.15±1.13, 5.24±0.88 and 7.29±1.41 hours respectively (p < 0.001). The length of ICU stay was 1.67±0.57 days in group R1, 2.0±0.61 days in group R2 and 2.11±0.64 days in group S (p = 0.007). A similar finding was also present when the duration of hospital stay was concerned. The cumulative 24 hr fentanyl dose was significantly higher in group S compared to that of R1 and R2. (186.73±28.3, 217±36.8 and 344±68.2 µg respectively, p, 0.01). VAS score was highest in S group of patients with a mean of 5.08±0.82 for all the time periods, whereas that for group R1 and R2 was 3.64±0.84 and 3.77±0.71 respectively except that at post extubation. Statistical significance was observed for VAS score during inter group comparison (R1 vs S, p < 0.001, R2 vs S, p < 0.001). The mean heart rate and mean arterial pressure remained in higher side in group S patients when compared to the other two groups (p < 0.01 in each case). One patient in group R1, three in group R2 and seven in group S had arrhythmia during their ICU stay. Two patients from each R2 and S group had evidence of pneumonia and none of the patients in any group had evidence of sternal wound infection during the course of stay and one month follow up period.

**Conclusion:** Parasternal intercostals block for postoperative pain relief for adult cardiac surgical patients is a simple technique, which is easy to perform and appears to be a useful adjunct to post-operative pain relief during the postoperative period. 0.75% ropivacaine is more efficacious than that of 0.5% when used in the same route without any additional side effects. Unlike neuroaxial blocks, it can be used in patients who are anti-coagulated perioperatively and have deranged coagulation parameters.

### Introduction

Sternal incision is a major cause of postoperative pain in patients undergoing CABG. This pain may substantially get aggravated by coughing and movement. In first track anesthetic

protocol which is the norm in modern day practice of cardiac surgery, early extubation along with a stable hemodynamics is the goal; that is greatly facilitated by effective postoperative analgesia [1]. Regional anesthesia for postoperative pain relief has additional benefits like attenuation of altered circulatory,

metabolic, immunological and hemostatic systems [2,3]. Anesthetic techniques suitable for fast tracking include use of volatile anesthetics and low dose opioid based techniques with a limitation of suboptimal analgesia in immediate postoperative period. Intrathecal and epidural analgesia are often effective modalities of postoperative analgesia but entails the risk of potential epidural hematoma which may outweigh these benefits [4]. Use of intravenous opioids for pain relief during postoperative period may delay tracheal extubation and first tracking in addition to producing nausea, vomiting and ileus [1]. Excess dose of non-steroidal anti-inflammatory analgesics have their own potential side effects. The sternum and parasternal area is innervated by anterior and posterior branches of intercostals nerves. Blockade of these nerves by parasternal injection of local anaesthetics is safe even anticoagulated patients. There is paucity of literature pertinent to the use of parasternal intercostals block for postoperative pain relief in patients undergoing for elective CABG.

In this study we aim is to find out the effect of two different doses of ropivacaine used for parasternal intercostals block for postoperative relief in patients undergoing CABG under cardiopulmonary bypass.

## Materials and Methods

After approval from institute ethics committee and written informed consent, a total of 120 patients scheduled for elective CABG were enrolled in the study. The patients were selected in such a way that they were candidates for fast tracking and extubation within six hours postoperatively.

### Sample size calculation

Sample size was calculated to achieve 90% power to detect a 20% difference in mean VAS pain scores at the 5% level (2 sided) assuming the population mean VAS was 40 mm for the ropivacaine group and the saline group VAS mean was 50 mm; a common within-population standard deviation was 28, and the dropout rate was 5%. On this basis, a minimum of 40 patients per treatment group were allocated.

### Exclusion criteria's

Patients with severe ventricular dysfunction, low cardiac output syndrome, on preoperative inotropic support/mechanical ventilation, allergic to amide group of anesthetics and redo surgery were excluded from enrolment. Patients with recurrent ventricular fibrillation/recurrent arrhythmias, postoperative complications requiring return to operating room (OR), had a need of mechanical ventilation for more than 10 hours were excluded from the final analysis.

## Methods

All the preoperative cardiac medications were continued till the morning of surgery except angiotensin converting enzyme inhibitors for their propensity to cause hypotension during induction of anaesthesia and on bypass. All the patients were premeditated with tab diazepam 10 mg PO night before and 5 mg on the morning of surgery; intramuscular morphine 0.1 mg/

kg with promethazine 0.5 mg/kg was administered 30 minutes prior to anesthesia induction. Anesthesia was induced with thiopentone 5mg/kg along with 2-3 mg of midazolam and 5 µgm/kg of fentanyl. Rocuronium was used as a muscle relaxant to facilitate tracheal intubation. Maintenance of anesthesia was achieved with intermittent dose of midazolam, fentanyl and pancuronium bromide under the monitoring of bispectral index. The patients were randomized preoperatively into three groups by computer generated numbers.

**Group R1:** Patients who received parasternal block with ropivacaine 0.75%

**Group R2:** Patients who received parasternal block with ropivacaine 0.5%

**Group S:** Saline group (served as control)

Ropivacaine and saline preparations were prepared in the OR by cardiac anesthesia resident who was not a part of the study and both the preparations appeared identical. Medication administration and data collection was done in double blind manner such that neither patient nor the anesthesiologist/surgeon who were part of the study was aware of the medication assignment. Patients received parasternal intercostal block with 0.75 % ropivacaine or 0.5 % ropivacaine or 0.9 % normal saline, administered in 4 ml aliquots in to the anterior (2<sup>nd</sup> to 6<sup>th</sup>) intercostals spaces on each side about 2 cm lateral to sternal edge ensuring that there was no blood aspirated. The total dose of ropivacaine was 300 mg in R1 group and 200 mg in R2 group with total volume being 40 ml in all the three groups. The block was administered by the operating surgeon prior to the sternal closure. All patients had postoperative analgesia as per institutional protocol with iv fentanyl bolus as and when required as suggested by the features of sympathetic stimulation during the time when patients were ventilated hence were unable to communicate and after that as and when asked for by the patents. Injection paracetamol 1 gm was also administered 8 hourly to reduce the dose of fentanyl.

**The primary measures of the study were:** time to extubation, 24 hr cumulative fentanyl requirement, hemodynamic stability during intensive care unit(ICU) stay, occurrence of new arrhythmias and postoperative wound pain as judged by standard visual analogous score (VAS) [5]. VAS was used in our study because it is the most widely used pain score and is simple to use. Patients were familiarized with VAS score preoperatively.

**The secondary outcome measures were:** length of ICU stay, length of hospital stay, episodes of arterial desaturation (SpO<sub>2</sub>< 95%), occurrence of pneumonia as judged by appearance of pulmonary infiltrates on chest radiographs during the study period and occurrence of sternal wound infection till one month postoperatively. The hemodynamic parameters were measured every two hours till 8 hours than at 12,16,20 and 24 hours ( a total of 9 readings) and VAS scores were measured at the of extubation, at 08, 12,16,20 and 24 hours ( a total of 6 readings). Occurrence of arrhythmia was continuously noted

so also arterial oxygen saturation by pulse oxymeter. The postoperative data were collected by the aesthesiologist on duty in the ICU. Administration of fentanyl was done by the nurse on duty on the instructions of the attending doctor and all the doses were recorded on the chart.

### Statistical analysis

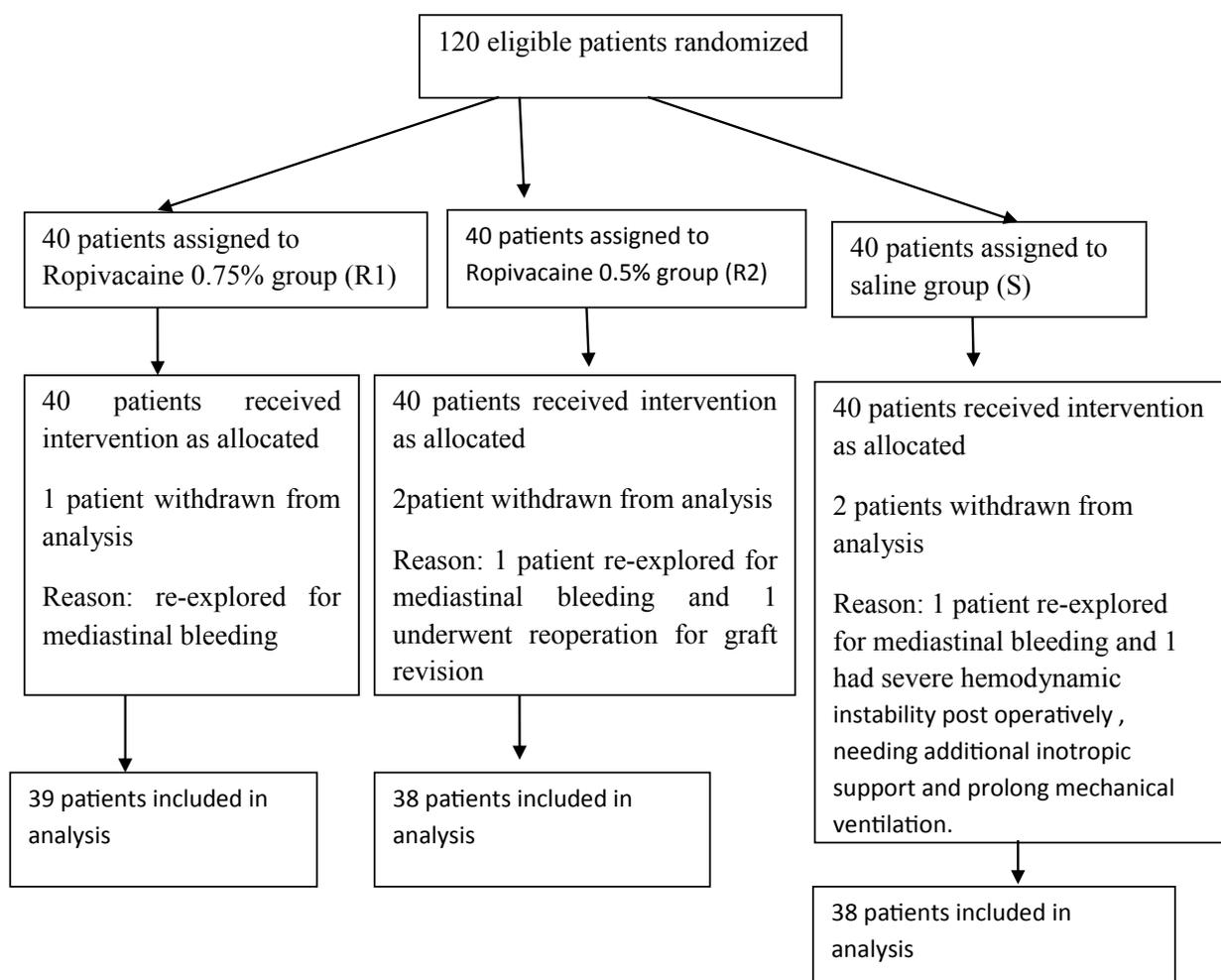
Data analysis was done by using SPSS software (version 1.5). Continuous data are presented as means with standard deviations, and groups were compared by using a 2-sided Student *t* test with equal variances. Pair wise analysis of hemodynamic data in each group was done by using two way ANOVA test followed by post- hoc analysis. For multiple comparison, Fisher's least significant method (LSD) was used. For intergroup comparison of the variables one way ANOVA followed by post hoc analysis by Bonferroni method was used. Changes in pain intensity over the study period were measured by using the 6-hour VAS scores as a predictor. For all the comparisons, a *p* value <0.05 was considered to be significant.

### Results

The following concert shows the detailing of the patient allocation and analysis. (**Concert Chart**)

A total of 120 eligible patients were enrolled in the study and randomly allocated to one of the three groups. Patients in all the three groups were comparable in their demographics, co-morbidities (Table 1). The cardiopulmonary bypass (CPB) time, aortic cross clamp (AoXcl) time, total dose of intraoperative fentanyl and midazolam used, as well as number of coronary grafts were comparable in all the three the groups (Table 1). Two patients each from group S (5.26%) and group R2 (5.26%), and one from group R1 (2.56%), (*p*=0.54) were excluded from the analysis due to development of postoperative complication. One patient in S group had hemodynamic instability during the postoperative period and the other underwent re-exploration for mediastinal bleeding. One patient from group R1 and one from R2 re-explored for pericardial tamponade. The other patient from group R2 had myocardial ischemia, early graft failure which required graft revision.

#### CONCERT CHART



**Table 1:** Demographics, clinical profile and intra-operative variables

Variables	Group R1 (n=39)	Group R2 (n=38)	Group S (n=38)	P value
Age (years)	61.92±6.84		60.13±6.20	0.092
Sex (M:F)	29/10	30/8	29/9	0.19
Weight (kg)	66.9±6.24	65.68±4.91	61.16±6.39	0.51
Diabetics (%)	38.5	42.1	36.8	0.89
Hypertension (%)	74.4	65.8	84.2	0.18
Ejection fraction	50.41±5.5	47.42±5.4	48.92±6.3	0.08
CPB time (mins)	64±9.1	62.45±7.02	69.38±7.5	0.001
AoXcl time (mins)	34.28±6.13	34.3±	36.74±5.97	0.16
Total dose of intraoperative fentanyl use (µ gm/kg)	14.7±3.2	14.2±4.2	15.4±2.6	0.18
Total dose of midazolam used (mg/kg)	0.13±0.06	0.12±0.03	0.12±0.03	0.82
Number of grafts	2.95±0.6	2.95±0.61	2.92±0.67	0.97

CPB: cardiopulmonary bypass; AoXcl: Aortic cross clamp

**Table 2:** Hemodynamic parameters and oxygen saturation (SpO<sub>2</sub>) at different time points

Variable	Group R1 (n=39)	Group R2 (n=38)	Group S (n=38)	p value	Group R1 vs R2, P value	Group R1 vs S P value	Group R2 vs S P value
HR-0	75.0±7.8	75.9±9.7	75.4±6.3	0.23	0.65	0.63	0.62
HR-1	75.8±7.4	76.4±9.6	84.6±7.4	0.001	0.75	0.001	0.001
HR-2	77.0±6.9	76.0±8.7	84.8±7.4	0.001	0.62	0.001	0.001
HR-3	77.69±8.4	76.0±9.8	85.8±7.1	0.001	0.65	0.001	0.001
HR-4	77.18±8.1	77.1±9.8	87.3±9.2	0.001	0.69	0.001	0.001
HR-5	76.46±7.8	77.9±7.7	89.3±9.6	0.001	0.66	0.001	0.001
HR-6	75.8±7.7	78.9±9.3	89.3±9.8	0.001	0.11	0.001	0.001
HR-7	76.8±7.4	78.1±7.8	88.7±8.7	0.001	0.76	0.001	0.001
HR-8	78.4±8.2	77.8±8.2	86.5±9.2	0.001	0.86	0.001	0.001
MAP-0	86.9±10.0	90.1±9.4	87.6±9.8	0.323	0.16	0.92	0.83
MAP-1	87.8±9.3	89.8±10.6	90.5±11.5	0.492	0.38	0.26	0.25
MAP-2	89.2±10.6	89.5±11.3	95.2±13.0	0.043	0.43	0.02	0.03
MAP-3	88.8±11.1	88.8±9.7	97.6±13.3	0.001	0.42	0.001	0.001
MAP-4	86.4±10.9	90.0±10.6	95.2±11.5	0.003	0.14	0.009	0.03
MAP-5	86.9±9.5	90.3±11.4	93.3±9.2	0.024	0.01	0.002	0.22
MAP-6	89.9±10.2	91.1±10.7	93.5±10.9	0.026	0.69	0.006	0.46
MAP-7	88.4±9.8	87.6±9.8	94.8±10.4	0.049	0.43	0.045	0.06
MAP-8	87.6±7.9	89.6±10.2	95.6±9.8	0.019	0.56	0.007	0.14
SpO <sub>2</sub> -0	98.6±1.2	98.9±1.2	98.5±2.2	0.44	0.45	0.52	0.63
SpO <sub>2</sub> -1	98.9±1.1	99.0±0.8	98.0±1.4	0.23	0.35	0.42	0.59
SpO <sub>2</sub> -2	97.9±1.9	98.0±1.9	97.8±2.0	0.007	0.007	0.82	0.75
SpO <sub>2</sub> -3	98.0±1.9	98.3±2.0	97.9±2.2	0.02	0.56	0.02	0.02
SpO <sub>2</sub> -4	98.3±2.0	98.5±1.0	98.2±1.9	0.65	0.54	0.64	0.62
SpO <sub>2</sub> -5	98.5±1.8	98.4±0.9	98.2±1.7	0.63	0.65	0.62	0.68
SpO <sub>2</sub> -6	98.8±1.5	99.2±1.1	98.1±1.4	0.35	0.45	0.56	0.57
SpO <sub>2</sub> -7	99.1±1.6	98.1±1.6	97.5±1.3	0.05	0.001	0.02	0.02
SpO <sub>2</sub> -8	98.9±1.1	99.0±1.3	98.6±1.2	0.83	0.72	0.56	0.63

HR: heart rate; MAP: mean arterial pressure; 0: at the end of surgery; 1: 2 hrs after surgery; 2: 4 hrs after surgery; 3: 6 hrs after surgery; 4: 8 hrs after surgery; 5: 12 hrs after surgery; 6: 16 hrs after surgery; 7: 20hrs after surgery; 8: 24 hrs after surgery

measured parameters. The mean time to extubation was significantly lower in group R1 and R2 compared to group S (5.15±1.13, 5.24±0.88 and 7.29±1.41 respectively, p<0.001). No

difference was noted between group R1 and R2 for this variable. The duration of ICU stay was shortest in R1 compared to that of R2 (1.67±57 days vs 2.0±0.61 days, p= 0.01 and S (1.67±57 days

Tables 2-4 described the comparison between all the measured parameters. The mean time to extubation was significantly lower in group R1 and R2 compared to group S (5.15±1.13, 5.24±0.88 and 7.29±1.41 respectively,  $p < 0.001$ ). No difference was noted between group R1 and R2 for this variable. The duration of ICU stay was shortest in R1 compared to that of R2 (1.67±0.57 days vs 2.0±0.61 days,  $p = 0.01$ ) and S (1.67±0.57 days vs 2.11±0.64 days,  $p = 0.002$ ). However, no statistical difference was found between group R2 and S ( $p = 0.44$ ). Inter group comparison did not reveal any difference when the duration of hospital stay was concerned (R1 vs R2,  $p = 0.43$ , R2 vs S,  $p = 0.08$  and R1 vs S,  $p = 0.02$ ). The cumulative fentanyl doses in first 24 hrs period was 126.73±28.3µgm, 217.36.8 µgm and 344±68.2µgm for group R1, R2 and S respectively. A statistical difference for the same was noted when compared between groups R1 vs R2 ( $p = 0.001$ ) R1 vs S ( $p = 0.001$ ) and group R2 vs S ( $p = 0.001$ ). A total of 12 patients (30.76%) in group R1 and 7 (18.42%) in group R2 did not require even a single bolus dose of fentanyl during post extubation till 24 hrs period. However, all the patients in group S required fentanyl boluses in addition to the routine paracetamol infusion.

The HR and MAP remained stable in all the time points throughout the study (Table 2). In group S, 9 patients had episodes of tachycardia (HR>100/min) and 07 patients had hypertension (MAP>105 mmHg); both of which responded to pain relief by intravenous fentanyl. A total of 06 patients in group S and 01 each from group R1 and R2 had episodes of low SpO<sub>2</sub>. However, this fall was not clinically significant.

VAS score was highest in S group at all-time points in comparison to that of R1 and R2 (Table 3). The mean VAS score at extubation was significantly lower in group R1 when

compared to that of R2 (4.0±0.65 vs 5.67±0.56,  $p = 0.001$ ) and S (4.0±0.65 vs 6.82±0.69,  $p = 0.001$ ). Intergroup comparison revealed statistical significant difference between R1 vs S and R2 vs S group ( $p < 0.001$  in each case). A significant difference for the same was noted just after extubation when group R1 and R2 was compared. There after the VAS score remained comparable among these two groups.

One patient from R1, 03 from R2 and 07 patients from S group had arrhythmia during study period and relieved with bolus fentanyl along with one of the antiarrhythmic agents. Two patients from each R2 and S group had evidence of pneumonia and none of the patients in any group had evidence of sternal wound infection during the course of stay and one month follow up period. None of the patients from the entire study groups developed post-operative renal insufficiency or deranged blood urea or serum creatinine.

## Discussion

In first track protocol in cardiac surgery, early tracheal extubation enables a better respiratory function and mechanics leading to decrease length of ICU stay and cost containment [6-8]. The essential requirements to achieve this are stable hemodynamics and good respiratory function which are facilitated by good postoperative analgesia. We, in this study investigated the utility of parasternal block as an adjunct to postoperative analgesia as well as opioid sparing method; thereby, enabling better hemodynamic control, better respiratory recruitment, early tracheal extubation, shorter length of ICU stay as well as hospital stay and thereby better patient outcome. We also studied the efficacy of two different doses of ropivacaine and any postoperative complications

**Table 3:** Pain scores (VAS) at different time intervals, values expressed as mean±SD

Visual Analogue Score (VAS)	Group R1 (n=39)	Group R2 (n=38)	Group S (n=38)	P value R1 vs R2	P value R1 vs S	P value R2 vs S
VAS-1	4.0±0.65	5.67±0.56	6.82±0.69	0.01	0.001	0.001
VAS-2	3.74±0.72	3.53±0.76	5.03±0.68	0.21	0.001	0.001
VAS-3	2.64±0.67	2.58±0.95	5.08±0.71	0.23	0.001	0.001
VAS-4	2.77±0.63	2.81±0.89	5.13±0.74	0.30	0.001	0.001
VAS-5	2.67±0.81	2.68±1.02	5.26±0.92	0.96	0.001	0.001
VAS-6	2.27±0.77	2.58±0.95	5.21±0.74	0.14	0.001	0.001

VAS-1: just after extubation, VAS-2: 8 hrs post operatively, VAS-3: 12 hrs post operatively, VAS-4: 16 hr post operatively, VAS-5: 20 hrs post operatively, VAS-6: 24 hr post operatively

**Table 4:** Clinical outcome variables, data expressed as mean±SD and numbers percentage

Parameter	Group R1 (n=38)	Group R2 (n=38)	Group S (n=38)	P value R1 vs R2	P value R1 vs S	P value R2 vs S
Cumulative dose of fentanyl (µgm/kg) in 24 hrs	126.76±28.3	217.65±36.8	344±68.2	0.0001	0.001	0.001
Time to extubation (hrs)	5.5±1.13	5.24±0.88	7.29±1.41	0.69	0.001	0.001
Duration of ICU stay (days)	1.67±0.57	2.0±0.61	2.11±0.64	0.01	0.002	0.44
Length of hospital stay(days)	6.21±1.1	6.39±0.88	6.74±0.86	0.43	0.02	0.08
Arrhythmias in 24 hr	1/39 (2.56)	3/39(7.8)	7/38(18.42)	0.3	0.2	0.08
Evidence of pneumonia	1/39(2.56)	2/39(5.26)	2/38(5.26)	0.54	0.54	0.54
Sternal infection within 4 weeks	0/39	0/39	0/38	-	-	-

related to the technique or the drug doses. All the patients in three groups received similar anesthetic agents, with a comparable intraoperative doses thus removing residual anesthetic effect as the confounding variable for postoperative analgesia. In this trial we found ropivacaine as a parasternal block significantly reduced postoperative pain and reduced fentanyl use compared with placebo. We also noted 0.75% ropivacaine as more efficacious than 0.5 % without any side effect. Our data add to that of other studies that also have shown that a parasternal intercostals block with bupivacaine and levobupivacaine.

Barr et al in their study on parasternal block with ropivacaine used 0.75% of the drug with a fixed dose of 300 mg for all the patients, and this dose for some patients exceeded the recommended dose limit of 3-4 mg/kg. Reducing the concentration of the drug to 0.5% without compromising on the duration of action and the quality of analgesia would enable nearly the same result with a dose of 200 mg which falls well within the recommended safe limits; hence we used two different concentrations of the drug 0.5 % and 0.75% to study their comparable efficacy and duration of analgesic effect.

This study showed that the duration of postoperative analgesia in the ropivacaine group, with lower pain scores and reduced consumption of supplementary analgesics, extended beyond the 8 hours cited in studies of single-shot peripheral nerve blocks [9]. These data suggest that the ropivacaine parasternal intercostal block may have a preemptive analgesic effect, preventing establishment of altered central processing of afferent input, which amplifies postoperative pain [10]. Pain during CABG not only due to sternotomy, but also due to harvesting of internal mammary artery (IMA) [11]. The parasternal block only affects the anterior cutaneous nerves involving the nociceptive pathway arising from sterna wound; not those nerves which get injured during IMA harvesting process. Thus, blocking the pain arising from sternotomy parasternal intercostals block may unmask post CABG pain originating from IMA bed; this is the pain which lasts longer and affect the quality of life in long term. The advantages of ropivacaine injection via parasternal route in our study helped us to identify the pain arising from chest wall that seemed to be masked by sternotomy pain.

The role of pain relief on maintenance of optimal hemodynamic stability in the postoperative cardiac surgery patients remained unquestioned. Optimal pain relief has been shown to decrease heart rate and blood pressure and hence reduce myocardial oxygen demand in the first 24 hours postoperatively [9]. This study showed the incidence of hypertension during the 24-hour study period was significantly higher in the saline group compared with the ropivacaine groups. Again both the R1 and R2 groups showed similar changes. This can be again explained by the fact that R2 group patients need a bit higher cumulative dose of fentanyl than R1 implying more effectiveness of 0.75% of the drug over 0.5%. More number of patients in S group had episodes of tachycardia and hypertension most of which responded to bolus injections of fentanyl.

In contrary to Mc Donald and associates result, who failed to observe any difference between time to tracheal extubation in levobupivacaine and placebo group, we noted a significantly lower duration of mechanical ventilation (time to tracheal extubation) in ropivacaine treated patients [12]. This could be due to the fact that, the previous authors used low doses of intravenous anesthetics along with desflurane which promoted a very early tracheal extubation. Barr AM et al., in a similar study using 0.75% ropivacaine in adult cardiac surgery patients could not show any difference in time to extubation when compared with placebo group. They attributed this to the rigid institutional protocols for tracheal extubation. This observed difference was possibly due to the ability of the patients to titrate patient controlled analgesia (PCA) morphine pump to bring down pain to lower levels. PCA morphine in the drug group was adequate analgesic adjunct whereas half of the patients in the saline group required rescue pain medication in addition to morphine.

Though the incidence of new onset of cardiac rhythm disturbances like AF, and premature ventricular contractions was lower in ropivacaine treated patients, was not statistically significant. In addition, the duration and frequency of postoperative ischemic episodes were not assessed. Parasternal intercostals block has been found to improve oxygenation in the postoperative period by previous authors [1,12]. In our study we too found a more number of episodes of fall in SpO<sub>2</sub> (<95%) in the saline group compared to the patients who received ropivacaine. These falls however were not correlated with PO<sub>2</sub> values in arterial blood gas analysis. This apparent benefit has been postulated to be due to reduction in splinting effect of diaphragm with parasternal intercostal block with ropivacaine thereby improvement of pulmonary function and reduction of atelectasis. May potentially reduce splinting and inhibition of diaphragmatic function and therefore improve pulmonary morbidity [13].

Even if the length of hospital stay did not differ between the groups, a shorter length of ICU stay in group R1 and R2 in comparison to that of S facilitated faster turnover time and better utilization of ICU resources for more number of patients and cost containment. Again the lesser duration of ICU hr in R1 group in comparison to R2 indicates more efficacy of 0.75% of ropivacaine than that of 0.5%. Our findings are similar to that of Koukis I et al., who also found a significantly shorter stay in ICU and hospital in the patients who received subcutaneous infusion of ropivacaine after median sternotomy [14].

Barr et al showed that the duration of postoperative analgesia in ropivacaine group was longer with less pain scores and reduced consumption of supplementary morphine analgesic, extended beyond 8 hrs and was similar to that cited in the study of single shot peripheral nerve blocks [1,9,15]. We too found the duration of parasternal block to be 18-24 hrs, as pain scores and opioid requirements were found to be remained beyond 18 -24 hrs. This data suggests that ropivacaine parasternal block may have pre emptive analgesic effect, preventing establishment of altered central processing of afferent output which amplifies postoperative pain [16]. The

two different concentrations of ropivacaine used in the present study appear to have similar effects on postoperative analgesia as evidenced by nearly similar pain scores and opioid sparing effect beyond extubation period and stable hemodynamics. The reduction in doses of ropivacaine was by 33% (300 mg vs 200 mg) in R2 group which was within the safe prescribed limit of the drug.

## Conclusion

Parasternal intercostals block for postoperative pain relief for adult cardiac surgical patients is a simple technique, which is easy to perform and appears to be a useful adjunct to postoperative pain relief during the postoperative period. Unlike neuroaxial blocks, it can be used in patients who are anticoagulated perioperatively and have deranged coagulation parameters. 0.75 % ropivacaine is more efficacious than that of 0.5% when used in the same route without any additional side effects.

## Limitation of the study

This study shows a shorter duration of ICU/hospital length of stay for most patients, its' impact on the cost containment has not been analyzed.

## Acknowledgment

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