



## Original Research Article

## A prospective randomized study of the post-operative outcomes of thoracic epidural analgesia in patients undergoing coronary artery bypass graft surgery

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## ABSTRACT

**Context and Aims:** To assess the efficacy of thoracic epidural analgesia (TEA) for postoperative pain and effect on haemodynamics, pulmonary functions postoperatively in patients undergoing coronary artery bypass graft (CABG).

**Materials and Methods:** Ninety patients posted for elective CABG were randomly allocated using sealed envelope method into two groups, Group A received injection fentanyl for intraoperative analgesia and injection tramadol for postoperative analgesia intravenously and Group B received 10 ml of 0.5% ropivacaine with 50 µg fentanyl as bolus dose epidurally and thereafter, continuous epidural infusion of 0.2% ropivacaine with 2 µg/ml fentanyl at the rate of 8ml/h till the end of surgery for intraoperative analgesia and then 6-10ml/h till 48h for postoperative analgesia. All patients were given general anaesthesia. Haemodynamics, arterial blood gases, visual analog scale (VAS) score and peak expiratory flow rate (PEFR) were reported in ICU till 48h postoperatively.

Statistical analysis used: unpaired *t* - test and Chi-square test.

**Results:** Group B showed significantly lesser VAS score, higher PEFR, higher PaO<sub>2</sub> and normal values of PaCO<sub>2</sub>.

**Conclusions:** TEA reduces postoperative pain and improves postoperative pulmonary function in patients undergoing CABG. Also, it is associated with earlier extubation and a waking, stable haemodynamics and lesser ICU stay after CABG surgery.

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### 1. Introduction

The prospect of moderate or severe pain is a common concern of patients when contemplating cardiac surgeries. Pain after thoracotomy often leads to difficulty in breathing and coughing, results in accumulation of airway secretions and further impairing lung functions.<sup>1</sup>

Two thirds of patients undergoing coronary artery bypass surgery (CABG) report moderate to severe pain,<sup>2</sup> particularly with ambulatory or respiratory effort.<sup>3</sup> Adequate postoperative analgesia prevents unnecessary patient discomfort, may decrease morbidity, especially pulmonary complications and decrease ICU/hospital length of stay.

High thoracic epidural anaesthesia (TEA) in patients undergoing CABG surgery has beneficial effects on the perioperative stress response, analgesia, and postoperative pulmonary function.<sup>4</sup>

This study was conducted to assess the efficacy of thoracic epidural analgesia for post thoracotomy pain, their effect on pulmonary function, hemodynamic parameters, extubation time and length of ICU stay in postoperative period in patients undergoing coronary artery bypass graft (CABG).

### 2. Materials and Methods

With due permission from institutional ethical committee and written informed consent, a randomized, prospective study was conducted in the period between June 2016 to

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September 2016. Ninety patients of age between 40-60 years with left ventricular ejection fraction > 35% posted for elective CABG surgery were included in study. If patients were on oral antiplatelets like aspirin or clopidogrel then included in the study after discontinuing drugs as per institutional protocol and once coagulation profile is in normal limits. Patients with coagulopathy or bleeding disorders, infection at the site of epidural puncture, septicaemia, redo open heart surgery, those with neurologic disorders, hepatic diseases, pulmonary diseases, severe spinal deformities were excluded from study.

Based on reference studies,<sup>5,6</sup> a sample size of forty-five in each group was calculated to achieve a power of 80% within 95% confidence limit. Patients were randomly allocated using sealed envelope method into two groups, Group A (control group) received General Anesthesia (GA) with injection fentanyl for intraoperative analgesia and injection tramadol for postoperative analgesia intravenously and Group B (study group) received GA with 10 ml of 0.5% ropivacaine with 50 µg fentanyl as bolus dose epidurally and thereafter, continuous epidural infusion of 0.2% ropivacaine with 2 µg/ml fentanyl at the rate of 8ml/h till the end of surgery for intraoperative analgesia and then 6-10ml/h till 48hr for postoperative analgesia.

In Group B, One day prior to surgery patient was taken to preparation room, IV access obtained. Pulse rate, blood pressure, ECG and SpO<sub>2</sub> were recorded. Under all aseptic conditions, an epidural catheter was inserted through 18 G Touhy needle, at T2/T3 or T3/T4 intervertebral space in lateral decubitus position. The space was checked by loss of resistance technique using air. Epidural test dose was given with 3ml 2% lignocaine with adrenaline.

Next day, after confirming overnight fasting, premedication with injection morphine 0.1mg/kg IM and injection promethazine 0.5 mg IM were given 45 min prior to surgery in preparation room and then patients were taken in the operation theatre and ringer lactate solution 5-6 ml/kg/h was started in peripheral line. Three readings of PEFr (Peak Expiratory Flow Rate) were measured using a Mini Bells Peak flowmeter and best of three readings was taken. 5 lead ECG and pulse oxymeter were attached. Invasive blood pressure was obtained via right radial artery cannulation. Central venous catheter was inserted into right internal jugular vein and pulmonary artery catheter was placed via internal jugular vein. All cannulations were done under local anesthesia.

Baseline heart rate, mean blood pressure, and ABG (Arterial Blood Gases) finding (PaO<sub>2</sub>, PaCO<sub>2</sub>) were recorded.

In group B, 10 ml of 0.5% ropivacaine with 50 µg fentanyl bolus were administered and sensory block checked by loss of sensation to cold and pinprick. After induction of general anaesthesia, continuous epidural infusion of 0.2% ropivacaine with 2 µg/ml fentanyl at the

rate of 8ml/h started till the end of surgery and then 6-10ml/h to attain a sensory blockade of T1 to T10 and till 48 hour postoperatively.

In both groups, general anaesthesia was given with injection midazolam 0.05mg/kg and pre oxygenated with 100% oxygen. Then, induction was done with injection fentanyl 5 µg/kg and injection etomidate 0.3mg/kg intravenously. The drug was administered in small doses over a period of 60-90 seconds, until there was loss of eyelash reflex and lack of response to verbal commands. Injection rocuronium bromide 0.9mg/kg was given to facilitate tracheal intubation. Intubation was done at 2 min after the induction. Position of ET tube was confirmed and fixed. Foley's catheter and Ryle's tube were inserted. Anaesthesia maintained with O<sub>2</sub>, injection midazolam and injection vecuronium intravenously.

In group A, patient received injection fentanyl 1 µg/kg intravenously every hour for intraoperative analgesia.

After the end of surgery, Patient was shifted to ICU. HR and MAP were recorded postoperatively at the intervals of 1h till extubation and then just after extubation, 6, 12, 24, 36 h and at 48<sup>th</sup> h (the end point of the study). ABG analysis (PaO<sub>2</sub>, PaCO<sub>2</sub>) was done half an hour after extubation and post-extubation at 6, 12, 24, 36 h and at the end point of the study. Time of awakening and extubation were noted. Criteria for extubation was those standard used in surgical ICU. VAS score was noted just after extubation and post-extubation at 6, 12, 24, 36 h and at the end point of the study. Pain intensity was measured by using 0-10cm Visual analogue scale (VAS): 0cm- no pain and 10 cm-worst pain imaginable. Peak expiratory flow rate (PEFR) was measured at 3, 6, 12, 24 and 36 h post extubation and at the end point of the study. Spirometry (PEFR) was performed three times using a Mini Bells Peak flowmeter and the best measurement was recorded. Sensory level was checked every 3 hourly after extubation to maintain sensory blockade of T1 to T10 level. Injection tramadol 2mg/kg slowly was given as rescue analgesic intravenously whenever VAS score is >3 on numerical pain scale of 0-10 in the thoracic area in both groups. The rate of infusion was decreased if there is paraesthesia in dermatome C8 or higher in a painless patient or in case of uncontrollable hemodynamic variations like hypotension and bradycardia. Total requirement of injection tramadol in 48 h was calculated. Length of ICU stay, incidence of side effects and complications were noted. End point of the study was 48 hours into the post-operative period.

All findings were analysed using SPSS version 17.0.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were summarized in the form of mean ± standard deviation (SD) and qualitative data were summarized in the form of number and percentage. Unpaired *t*-test was used for analysis of difference in quantitative data between the two groups and Chi-square test was used for difference in qualitative data.

The *P* value < 0.05 was considered statistically significant.

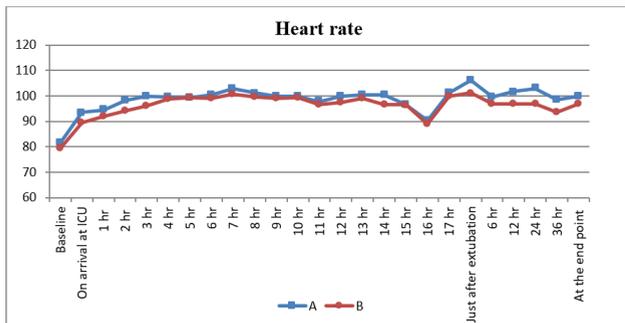
### 3. Results

Both groups were comparable in demographic profile. Baseline heart rate, mean arterial blood pressure, ABG values and PEFR were comparable between two groups.

In postoperative period, mean heart rate and mean arterial pressure were comparable in both the groups. Although, significant increase in heart rate from baseline [Figure 1] and decrease in MAP from baseline [Figure 2] found in both the groups.

VAS score was statistically significantly lower in the group B than in the group A both at the rest and at the time of coughing (Figures 3 and 4). Group B patients have significantly higher PaO<sub>2</sub> and lower PaCO<sub>2</sub> than Group A after extubation [Table 1]. Group B patients showed significant improvement in PEFR after extubation than group A [Figure 5].

With regard to ICU parameters, time to first awakening and to extubation was significantly lower Group B as compared to Group A. Total doses of tramadol given in the ICU were significantly lower in Group B than Group A. There was significant difference with regard to ICU stay between both the groups [Table 2].



**Fig. 1:** Trends of mean heart rate (beats/ min) changes postoperatively in both the groups

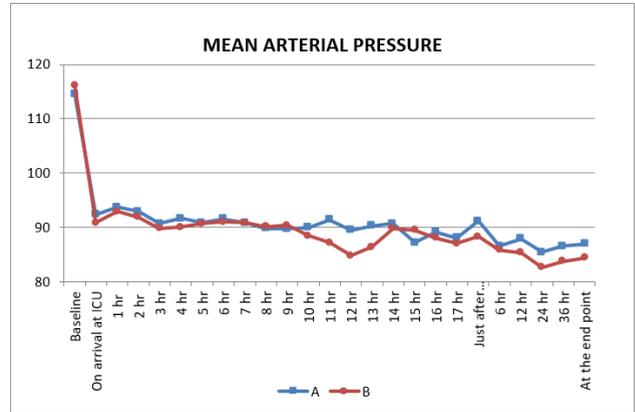
### 4. Discussion

General anaesthesia has been used for decades in cardiac anaesthesia and represents a well known and established standard anaesthesia technique for both on and off pump surgery.

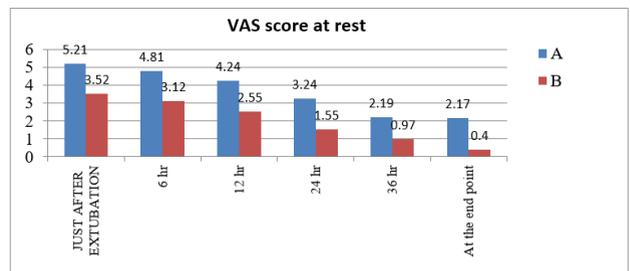
Epidural anaesthesia in combination with general anaesthesia for cardiac surgery has gained interest because of improved analgesia,<sup>7,8</sup> improved postoperative pulmonary function,<sup>1,9–11</sup> and allows early mobilization.

The risk of neuraxial hematoma, generally regarded as the most serious complication of epidural anaesthesia, has been thoroughly investigated.<sup>12–17</sup>

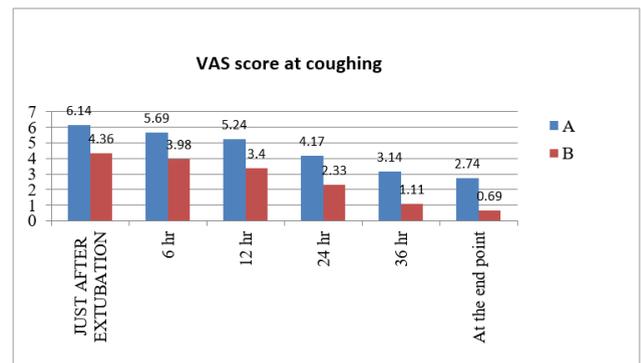
No patient in our study presented clinical signs suggestive of epidural hematoma or neuraxial injury.



**Fig. 2:** Trends of mean arterial blood pressure (mm of Hg) changes postoperatively in both the groups



**Fig. 3:** VAS score at rest in both the groups



**Fig. 4:** VAS score at coughing in both the groups

Infection is an ever-present threat when invasive procedures are performed. The potentially serious consequences of an epidural infection, which include epidural and paraspinal abscesses, as well as meningitis, must be kept in mind when adopting HTEA.<sup>18</sup> In our study, meticulous aseptic techniques were used, and, as an additional precautionary measure, we applied bacterial filters. No epidural catheter infection was observed.

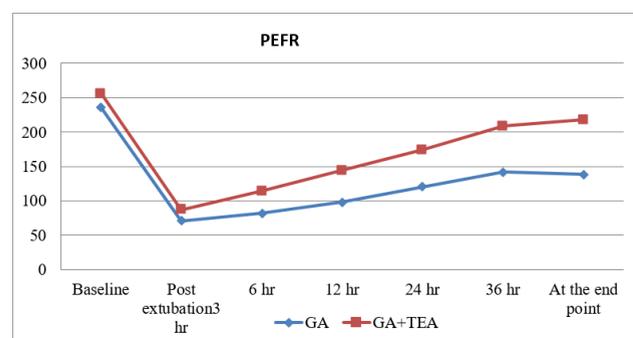
The present study showed that HR and MAP were comparable in both the groups in postoperative period with

**Table 1:** Postoperative changes in arterial blood gases (ABG) values in both the groups

Parameters	Group A	Group B	P value
Baseline			
PaO <sub>2</sub>	81.69±10.82	78.26±8.89	0.116
PaCO <sub>2</sub>	36.67±3.78	37.69±3.17	0.182
Half hour after extubation			
PaO <sub>2</sub>	264.12±49.19	288.71±47.79	0.022
PaCO <sub>2</sub>	39.45±3.51	37.90±1.68	0.011
6 h			
PaO <sub>2</sub>	218.38±67.75	246±54.94	0.042
PaCO <sub>2</sub>	39.76±4.07	37.93±2.34	0.013
12 h			
PaO <sub>2</sub>	190.19±67.37	227.38±66.36	0.012
PaCO <sub>2</sub>	39.02±3.12	36.95±1.97	0.0004
24 h			
PaO <sub>2</sub>			
PaCO <sub>2</sub>	163.83±36.06	144.86±43.17	0.032
36 h			
PaO <sub>2</sub>	37.80±2.80	36.12±1.60	0.001
PaCO <sub>2</sub>			
48 <sup>th</sup> h			
PaO <sub>2</sub>	141.04±27.45	124.91±30.21	0.046
PaCO <sub>2</sub>	38.05±4.31	35.18±0.94	0.0004
	104.50±10.91	96.79±8.89	0.006
	36.36±3.60	35.07±0.68	0.025

**Table 2:** Postoperative parameters in Intensive care unit (ICU)

	Group A		Group B		P value
	Mean	SD	Mean	SD	
Time of Awakening (h)	5.83	2.09	4.70	1.92	0.011
Time of Extubation (h)	11.84	3.60	9.98	2.72	0.0091
Tramadol consumption (mg)	603.81	116.86	137.67	47.96	0.000
ICU Stay (h)	98.10	10.46	71.83	6.91	0.000

**Fig. 5:** Peak expiratory flow rate (L/min) changes in both the groups

no significant difference in between two groups. Similar results were found in study conducted by Fillinger et al<sup>19</sup> and Mehta et al.<sup>20</sup> The HR was on the lower side both pre and post extubation, in the Group B due to sympathetic blockade with TEA, but this is also attributed to better

analgesia, as demonstrated by lower VAS.

In the present study, Group B shows PaCO<sub>2</sub> within normal range probably because of better pain control and quiet breathing with continuous epidural infusion, while Group A shows higher PaCO<sub>2</sub> as compared to Group B may be due to pain during respiration which may restrict chest movements during breathing and hypoventilation, therefore higher PaCO<sub>2</sub> in the Group A. The results of our study correlates with the study by Mandal et al,<sup>21</sup> Bakhtiari et al. and Tenling et al.<sup>22,23</sup>

We found that in group B only 13 patients out of 42 required rescue analgesic during first 6 hours postextubation with VAS score more than 3 just after extubation. Similar to our study, Morsy et al<sup>5</sup> showed that the TEA group had lower pain scores throughout the postoperative period compared with the GA group. Also, Kessler et al<sup>24</sup> showed that early and late postoperative pain at rest was significantly less in patients with an epidural catheter and pain reduction at exercise was more clinically remarkable after GA+TEA than after GA alone and significantly higher sedation score after GA alone at 6 hours postoperatively.

Liem et al and Hasenbos et al<sup>11,25</sup> have shown that patients receiving thoracic epidural anaesthesia also had lower pain and sedation scores in the postoperative period. Stenseth et al,<sup>1</sup> Royse et al,<sup>6</sup> Priestley et al,<sup>26</sup> also found lower VAS score suggesting significantly better analgesia in the TEA group.

In our study, Group B patients showed statistically significant improvement in PEFr compared to Group B, probably due to better analgesia. These findings are consistent with Stenseth et al,<sup>1</sup> who demonstrated an improvement in spirometric data on the 2nd and 3rd postoperative day in patients receiving epidural analgesia when compared with the control group. No residual respiratory effect of the higher fentanyl dose used intraoperatively can be expected more than 20 h after surgery, thus the better spirometric values are most likely explained by better pain relief in the epidural group. Morsy et al<sup>5</sup> and Royse et al<sup>6</sup> showed improved postoperative PEFr with TEA.

In our study, total dose of tramadol given in ICU as rescue analgesic were significantly lower in Group B as compared to Group A suggesting significantly better analgesia in the Group B. Priestley et al<sup>26</sup> in their study found less number of patients receiving rescue analgesia in TEA group than control group. Also, Morsy et al<sup>5</sup> found out that the TEA group provided lower pain scores throughout the postoperative period with subsequent lower dosage of tramadol consumption when compared with the GA group.

In our study, time to first awakening and extubation was significantly lower in the Group B than the Group A. Stenseth et al<sup>(1)</sup> and Liem et al<sup>(20)</sup> found that the epidural group patients who received less fentanyl during surgery, were extubated earlier than control group patients and also responded to verbal command earlier. These results are also in accordance with Royse et al<sup>6</sup> and Priestley et al.<sup>26</sup>

The results of our study showed significant difference in ICU stay between the both groups. Group B shows significantly less ICU stay as compared to Group A. Similar to our results, Mandal et al<sup>21</sup> found significant difference in two groups in respect to ICU stay in hours. These results also similar with study done by Bakhtiary et al. and Tenling et al.<sup>22,23</sup> In contrast to our study, Morsy et al,<sup>5</sup> Fillinger et al<sup>19</sup> and Kessler et al<sup>24</sup> found that there was no significant difference in ICU stay between the two groups.

In our study, in the group A two patients had incidence of arrhythmias and two had ectopics in postoperative, while in Group B less incidence of arrhythmias. This may be a result of the blockade of cardiac accelerator fibres, improvement of regional myocardial blood flow and attenuation of the stress response during surgery, in conjunction with postoperative sensory blockade preventing endocrine and autonomic responses to pain and trauma.<sup>27,28</sup>

## 5. Conclusion

TEA provides better analgesia with reduced severity of postoperative pulmonary function and their faster restora-

tion in postoperative period. Also, early extubation and shorter ICU stay with no significant adverse effects were seen with patients receiving thoracic epidural analgesia compared with conventional intravenous analgesics.

## 6. Source of funding

None.

## 7. Conflict of interest

None.

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