Early Post operative Pain Management and Early Extubation after Off-pump Coronary Artery Bypass Graft Surgery is better managed with Thoracic Epidural Analgesia

Naresh Chandra Mandal, Md. Fidah Hossain, Nirmal Kanti Dey, Md. Motiur Rahman Sarkar, Abdullah al-Mamun, Ashfaque Arif, Mohammad Enamul Hakim

Department of Vascular Surgery, National Institute of Cardiovascular Diseases, Dhaka

Abstract:

Keywords:
CABG, IHD, Pulmonary function, Thoracic epidural analgesia.

Background: *Off-pump coronary artery bypass (OPCAB) graft surgery is the commonest operation worldwide. Sternotomy, pleurotomy with opening of the pleural space, harvesting of internal mammary artery may lead to severe post-operative pain. Thoracic epidural analgesia (TEA) may reduced significant post-operative pain & allow the patient early extubation.*

Methods: *A total of 60 patients with ischaemic heart disease (IHD) were included in the study who were admitted in the Department of Cardiac Surgery in NICVD, Dhaka from July 2006 to June 2008 & underwent off-pump coronary artery bypass (OPCAB) graft surgery. Out of the total 60 patients, 30 were in the group-A receiving thoracic epidural analgesia along with general anaesthesia and the rest 30 were in the group-B receiving general anaesthesia alone.*

Results: *Patients in the epidural group had significantly less pain on the operative day and for the next 2 days. Total ventilation time in hours in Group-A was 6.4 + 1.0 and in Group-B was 10.1 +1.8 hours respectively. Postoperative X-ray chest revealed significant pulmonary complication in Group-B than Group-A. There were no complications related to epidural haematoma and no permanent neurological squeal.*

Conclusion: *Thoracic epidural analgesia reduced significant post-operative pain and improvement in pulmonary function and early extubation.*

(Cardiovasc. j. 2017; 9(2): 142-146)

Introduction:

Coronary artery disease is the most common form of heart disease and the single most important cause of premature death in the developed world.[1] Surgical management of IHD is coronary artery bypass graft surgery (CABG), which can be performed either under cardiopulmonary bypass (CPB) or by using off-pump technique. Impairment of pulmonary function after CABG is one of the most common complications in the early post-operative period.[2] Sternotomy, pleurotomy with opening of the pleural space, harvesting of internal mammary artery and pain may lead to deterioration of post-operative pulmonary function. In addition, the incidence of concurrent chronic lung disease is higher in the age group of patients who require revascularization of the myocardium. Combined these two factors indicate a need for documentation of pulmonary function pre-and postoperatively.[3]

Coronary revascularization procedure is done usually through median sternotomy incision and for this; impairment of pulmonary function is one of the most significant post-operative complications of CABG.[4] For revascularization, emphasis is given over internal mammary artery (IMA) graft. The mediastinum and thoracic cavity are traumatized more with IMA than with reverse saphenous vein graft (RSVG) procedure. Indeed, some reports have found that IMA patients have worse pulmonary functions than the RSVG patients in the postoperative period.[5]

Basal atelectasis develops early during anaesthesia and may persist in the post-operative period. After surgery both respiratory muscles

Address of Correspondence: Dr. Naresh Chandra Mandal, Department of Vascular Surgery, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh. Email-

weakness and reduced uncoordinated rib case expansion contribute to the restrictive ventilatory defect following median sternotomy. Post-operative pain may cause hypo-ventilation and insufficient cough, leading to retention of airway secretions and aggravation of the impaired lung function.[6] General Anaesthesia is the most commonly used anesthetic technique and is considered the gold standard for CABG, performed either on-pump or off-pump. Within the last few years, however, high TEA as an adjunct to General Anaesthesia has become more prevalent and has been shown to have potentially benefited in patients with coronary artery disease. Potential advantage of TEA include thoracic sympathicolysis with subsequent improvement of coronary perfusion, decrease heart rate, decrease endogenous stress response and reduced risk for pre-operative myocardial ischemia . Furthermore improved post-operative pulmonary function, additionally post-operative pain management is facilitated by continuous epidural application of analgesia; such effective pain management improves early post-operative mobilization & recovery.[7]

TEA decreases the post-operative hormonal stress response and improves cardiac & respiratory function. The epidural analgesia is an important adjunct to immediate extubation because the intra-operative anesthesia requirements are less and analgesia optimized. The potential benefits of early extubation include cost savings, lowered nursing dependency, reduced airway and lung trauma, improved cardiac output and renal perfusion with spontaneous respiration.[8]

Pulmonary function is preserved in patients receiving TEA, probably as a result of several factors, which include superior analgesia (allowing the patient to cooperate more fully with physiotherapy), the avoidance of parenteral opioids and their mood altering effects and the inhibition of bulbosplanchnic afferent nerve fibers .Maximal inspiratory lung volumes are approximately 30% larger in patients receiving TEA. Patients receiving TEA have 250-300ml of reserve lung volume. This volume increases the respiratory reserve and decreases the incidence or duration of atelectasis or pulmonary infection.[9]

Methods:
Study population: A total of 60 patients with IHD were included in the study who were admitted in the cardiac surgery department in NICVD, Dhaka from July 2006 to June 2008 & underwent OPCAB surgery were randomized to receive thoracic epidural analgesia along with general anaesthesia in Group-A (30 patients) and only GA in Group-B (30 patients).Patients associated with valvular heart disease, congenital cardiac anomaly, urgent CABG and re-exploration, associated other systemic (e.g. hepatic, renal, COPD) were excluded from the study.

Procedure and effect of TEA: All patients were premedicated Tab. Lorazepam 1 mg at bed time day before operation. On the arrival in the operation theater, intravenous cannulation and direct blood pressure monitoring using radial arterial catheterization will be established in both groups. In the Group-A (study group), a side holed multiport epidural catheter was inserted at the level of T1-2 or T2-3 interspaces in the morning on the day of surgery under local anesthesia using midline approach at right lateral decubitus position with the loss of resistance or hanging drop technique. The catheter was directed cephaled and advanced 3-4 cm into the epidural space. The initial bolus dose of 0.25% bupivacaine 10 ml 15 min before surgery will be given through epidural catheter followed by continuous epidural infusion with 0.25% bupivacaine will be maintained during operation at 8 ml / hr and post-operatively will be continued at 3-4 ml/hr up to 72 hours. Sensory block will be determined bilaterally using loss of warm- cold sensation as well pinprick discrimination. In both groups general anaesthesia would induced with fentanyl 10 µg/kg IV and with propofol 1.5 mg/kg IV.

Statistical Analysis:
 Data were collected by personal interview and hospital records. The collected data were complied and a data file was constructed. This data were analyzed by unpaired student t test and Chi square test (X2) using SPSS (Statistical Program for Social Science). The analyze data were presented by crossing of variables in the form of tables and graph etc. A p value equal to or less than 0.05 was considered significant.

Results:

Total 60 patients of off pump CABG, 30 were in Group-A and the rest 30 were in Group-B. The mean age in Group-A was 52.6±8.6 and that of in Group-B was 53.3± 6.6 years respectively. The mean age difference was not statistically significant (P>0.05).

Table-I

Age distribution of the patients between groups.

Age in years	Group A		Group B		p value
	n	%	n	%	
40 – 50	12	40.0	15	50.0	
51 – 60	9	30.0	9	30.0	
> 60	9	30.0	6	20.0	
Total	30	100	30	100	
Mean±SD	52.6±8.6		53.3±6.6		0.724
Range (Min, Max)	(40-65)		(45-67)		

Table-II

Sex distribution of the patients between groups.

Sex			Group A		Group B		p value
			n	%	n	%	
Male	55	91.66%	27	90.00	28	93.33	
Female	5	8.33%	3	10.00	2	6.66	0.500
Total	60	100%	30	100.0	30	100.0	

Among 60 patients, in group-A, 27 (90.00%) patients were male and 3 (10.00%) were female, and in Group-B, 28 (93.33%) were male and 2 (6.66%) were female patients. Male female ratio is 11:1. Male female difference was not statistically significant (P>0.05) in Chi square test.

Table-III

Total operation time in study population

	Group A		Group B		p value
Operation time (minute)	n	%	n	%	
Mean±SD	291.0±18.0		291.5±15.6		0.903[ns]

Total operation time in Group-A was 291.0±18.0 minutes and in Group-B was 291.5±15.6 minutes. There was no significant differences were found statistically in between groups.

Table-IV

Total ventilation time in hours in study population.

Ventilation time (hours)	Group A		Group B		p value
	n	%	n	%	
< 6 hours	6	20.0	3	10.0	
6 – 12	24	80.0	27	90.0	[a]0.235
Total	30	100.0	30	100.0	
Mean±SD	6.4	±1.0	10.1	±1.8	[b]0.001
Range (Min, Max)	(6	-9)	(5	-12)	

Total ventilation time in Group-A was 6.4±1.0 hours and in group-B was 10.1±1.8 hours respectively which was statistical significant (p<0.05).

Table-V

Total ICU Stay in hours of study population.

ICU stay (hours)	Group A		Group B		p value
	n	%	n	%	
39 – 48	27	90.0	3	10.0	
> 48	3	10.0	27	900	[a]0.001[s]
Total	30	100.0	30	100.0	
Mean±SD	43.4±3.0		52.9±5.0		[b]0.001[s]
Range (Min, Max)	(40-50)		(39-59)		

Table shows that median value of total ICU stay in hours in Group-A was 43.4±3.0 hours and in Group-B was 52.9±5.0 hours, which was statistical significant (p<0.05).

This table shows X-ray chest P/A view of both groups of patients in preoperative period and was found not statistically significant. But on the post-operative follow-up periods there were significant difference found in both groups of patients.

This table shows the total hospital stay in days in both groups of patients. The mean values are 8.7±1.8 days in group A and 11.7±2.7 days in group-B respectively. There was found statistically significant differences in respect to hospital stays in two groups (p<0.05).

Table-VI

X-Ray Chest P/A view in both groups of patients.

Variables	Group A	Group B	p Value
Pre Op. CXR (Normal)	30	30	0.026[s]
Post operative follow-up CXR Normal	29	23	
Abnormal	1	7	

p value reached from chi square test
Group A: Off-pump CABG patients with GA + TEA
Group B: Off-pump CABG patients with GA only.

Table-VII
Total Hospital Stay in Days in study population.

Post operative hospital stay (days)	Group A		Group B		p value
	n	%	n	%	
6 – 10	27	90.0	5	16.66	
11 – 15	3	10.0	25	83.33	[a]0.001
Total	30	100.0	30	100.0	
Mean±SD	8.7±1.8		11.7±2.7		[b]0.001
Range (Min, Max)	(6-12)		(6-15)		

Discussion:

In our current study we gave preference to this patient who had been underwent through OPCAB procedure using General Anaesthesia along with Thoracic Epidural Analgesia. However no previous study has performed in our country regarding this issue, our principal goal was the same as those studies mention above. This study was perform in NICVD, Dhaka, Bangladesh which included 60 patients of OPCAB with multivessel coronary artery disease, are divided into two groups , 30 patients in each group,(Group-A & Group-B). In Group-A, age range from 40-65 years with a mean ± SD of 52 .6 ± 8.6 years, the majority of the patients are in age group 40-65 years. In Group-B, the age ranged from 45-67 years with a mean ± SD of 53.3 ± 6.6 years majority of patient are in 40-50 years. There is no significance difference in age among groups. Similar type of several studies was done by other investigators. [7,10,11,]

Regarding distribution of sex among the patients, there were 27 male and 3 female in group-A and 28 male and 2 female in group-B. Chi square value reveals that there are no significance differences in between male and female. Other studies also support this result.[7,10]

There were 18 patients (60%) who had history of smoking, 12 patients were hypertensive, 6 patients are diabetes, three had family history of IHD and three patients had Dyslipidaemia and 8 patients had history of old MI in group-A whereas in group-B only 15 patients (50%) were smoker, 12 patients (33.33%) were hypertensive, 9 patients (30%) were diabetic, 3 patients (10%) were dyslipidaemic, 6 patients (20%) had family history and 7 patients were Old MI.

Regarding NYHA functional class, approximately 6.66% of the Group-A belonged to NYHA Class-I, followed by 66.66% NYHA Class-II and 26.66% NYHA Class-III. In Group-B, about 73.33% were classified as NYHA Class-II, 20% as NYHA Class-III and 6.66% belonged to NYHA class-I. So, majority of the patients of both groups belonged to NYHA class II & III.

Analysis of distribution of extent of disease between groups demonstrates that in Group-A, DVD, TVD and LM was 36.66%, 56.66% and 6.66% respectively and in Group-B, DVD, TVD and LM was 30.0%, 60.0% and 10.0% respectively.

The mean value of total operation time in group-A was 291.0±18.0 and in group B was 291.5±15.6 minutes. There was no statistically significant differences between two groups were observed. Study done by Bakhtiary et al. supports this result.[7]

The total ventilation time was observed in hours in both groups of patients. The median value of ventilation time in hours in Group-A was 6.4±1.0 minutes and in Group-B was 10.1±1.8 hours. The mean value of total ventilation time in both groups was found in unpaired t test which was found statistically significant in between groups. Study done by Bakhtiary et al. and Tenling et al. support this result.[7,10]

The mean value of total ICU stays in hours in Group-A was 43.4±3.0 and in Group-B was 52.9±5.0 hours. In statistical analysis there was significant difference was found in two groups in respect to ICU stay in hours.

The mean values of total hospital stay are 8.7±1.8 days in Group-A and 11.7±2.7 days in Group-B. There was found statistically significant differences in respect to hospital stays in two groups.

Study limitations:

There were a number of limitations with our data and results. i) All TEA was not performed by the same anaesthetics. ii) Patients were not randomly selected. iii) Sample size was small.

Conclusions:

It can be concluded that TEA in combination with General Anesthesia in OPCAB surgery is a safe procedure and epidural analgesia is an important adjunct to immediate extubation because the intra-operative anesthesia requirements are less and analgesia optimized. The potential benefits of early extubation include cost savings, lowered nursing dependency, reduced airway and lung trauma, improved cardiac output and renal perfusion with spontaneous respiration.

Conflict of Interest - None.

References:

1. Newby DR, Grubb NR, Bradbury A. Cardiovascular disease. In: Colledge NR, Walker BR, Ralston SH, Eds. *Davidson's Principles and Practice of Medicine. UK:* Churchill Livingstone, 2010:521-640.

2. Asimakopoulos G, Smith PLC, Ratnatunga CP, Taylor KM. Lung injury and acute respiratory distress syndrome after cardiopulmonary bypass. *Ann Thorac Sug 1999:* 68:1107-1115.

3. Hossain MZ. *Evaluation of pulmonary function after coronary artery bypass graft surgery,* MS thesis, Dhaka University, Dhaka,2004.

4. Vargas, FS, Torra-Filho M, Huch W, Teixeira LR, Cukier A, Light RW. Pulmonary function after coronary artery surgery. *Respir Med 1997;* 91: 629-633.

5. Jenkin SC, Soutar SA, Forsyth A, Keaters JRW, Moxhan J. Lung function after coronary artery surgery using the internal mammary artery and the saphenous vein. *Thorax* 1989; 44: 209-211.

6. Stenseth R, Bjella L, Berg EM, Christensen O, Levang OW, Gisvold SE. Effects of thoracic epidural analgesia on pulmonary function after coronary artery bypass surgery. *Eur J Cardio-Thorac Surg* 1996; 10: 859-865.

7. Bakhitary F, Therapidis P, Dzemali O, Koray AK, Ackermann H, Meininger D, et al. Impact of high thoracic epidural anesthesia on incidence of Perioperative atrial fibrillation in off- pump coronary bypass grafting. *J Thorac Cardiov Sur* 2007; 134: 460-464.

8. Royse CF, Royse AG, Soeding PF. Routine Immediate Extubation After Cardiac Operation. *Ann Thorac Surg* 1999; 68: 1326-1329.

9. Kessler P, Aybek T, Neidhast G, Dogan S, Lischke V, Bremerich DH, et al. Comparison of Three Anesthetic Techniques for Off-pump Coronary Artery Bypass Grafting: General Anesthesia , Combined General and High Thoracic Epidural Anesthesia ,or High Thoracic Epidural Anesthesia Alone', *Journal of Cardiothoracic and Vascular Anesthesia 2007;* 19: 32-39.

10. Tenling P, Joachimsson PO,Tyden H, Wegenius G, Hedenstierna G. Thoracic Epidural Anesthesia as an Adjunct to General Anesthesia for Cardiac Surgery : Effects on Ventilation- Perfusion Relationships. *J Cardiothor Vasc An* 1999;13: 258-264.

11. Tenenbein PK, Debrouwere R, Maguire D, Duke PC, Kowalski SE. Thoracic Epidural Analgesia Improves Postoperative Pulmonary Function in Patients Undergoing Coronary Artery Bypass Graft Surgery. *Anesthesiology* 2004; 101: 207.