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Early Extubation after Heart Surgery in New Tertiary Centre: Our Experience

Dharmendra Kumar Srivastava*, Bhuwan Tiwari, S.S. Nath***, Lata Khatnani****, Om Prkash Sanjeev*****, S.S. Rajput******

Authors Affiliation
*Associate Professor ****Senior Resident ******Professor Department of Cardiovascular and Thoracic Surgery, **Associate Professor, Department of Cardiology ***Assistant Professor, *****Senior Resident, Department of Anesthesia, Dr. RML Institute of Medical Sciences, Vibhuti Khand, Gomtinagar, Lucknow-226010, U.P. India.

Reprints Requests
Dharmendra Kumar Srivastava, Associate Professor, Department of Cardiovascular and Thoracic Surgery, Dr. RML Institute of Medical Sciences, Vibhuti Khand, Gomti Nagar, Lucknow-226010, U.P. India.
E-mail: drdks01@gmail.com

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Abstract

In the modern era, main emphasis has been placed on reducing the length of ICU stay without compromising quality of care in cardiac surgery; only early extubation protocol can meet expectations of today's heart surgery patients. In our prospective study we used multidisciplinary protocols for early extubation after heart surgery of 89 patients from May 2016 to December 2016. The patients were divided into two groups: Group A, those extubated within six hours of surgery (76.4% cases); Group B, those not extubated after six hours and electively ventilated overnight (23.5% cases). There was no significant difference in age, BSA, preoperative risk factors and left ventricular function in both groups, while female (71.4%) in group B had delayed extubation. Mean total CPB and cross clamp time in group B (187.14 & 139 minutes respectively) was higher than in group A (139.45 & 102.62 minutes respectively). In comparison of postoperative data we found that use of blood products, re-exploration for bleeding (19%) stay in ICU and step down was slightly higher in group B. High inotropic support (42.85%), deep coma (25%) were the two main factors for delayed extubation in our study. Hospital mortality was higher in group B (33.3%) than in group A (2.94%) patients. Due to successful early extubation, it is now common practice to aggressively wean and extubate in most of the patients after cardiac surgery.

Keywords: Cardiopulmonary Bypass; Extubation; Neurological Status; Bleeding.

Introduction

Early extubation is defined as extubation within six hours following the end of surgery. With the advancement of anaesthesia, perfusion and surgical procedures, early extubation is being practiced in almost all cardiac centre of the world for its major benefit in reducing cost without compromising patient care. Studies have shown that early extubation of elective cardiac surgery patients does not increase perioperative morbidity. In our study we used multidisciplinary protocols for early extubation in cardiac surgery patient selection, to ensure quality and effectiveness of care and its comparisons to delayed extubation.

Objective

Objective of our study is a well-planned early extubation after cardiac surgery within six hour of intensive care unit stay with cooperation of the cardiac surgeon, cardiologist, anaesthesiologist, perfusionist and nursing staffs and its comparison to delayed extubation. The secondary objective of study is to reduce ventilator associated complications/ infections, early mobilization, less hospital stay.

Design

Prospective study

Material and Methods

In our prospective study we used multidisciplinary protocols for early extubation after heart surgery of 89 patients from May 2016 to December 2016 in our new tertiary cardiac centre. The patients were divided into two groups: Group A, those extubated within six hours of surgery (n=68 cases); Group B, those not extubated after six hours, electively ventilated overnight (n=21 cases). After shifting the patient to operation theatre the non-invasive monitoring with electrocardiogram, pulse oximetry and non-invasive blood pressure was started. Under local anaesthesia left or right radial artery was cannulated with 22 Gauge arterial cannulae. Under local anaesthesia and ultrasonic color Doppler guidance right internal jugular vein was catheterised with 7 French triple lumen centre venous catheter. Invasive arterial blood pressure and central venous pressure monitoring and TTE used in all open heart cases.

Anaesthesia was induced with intravenous midazolam 1 mg/kg, fentanyl 2-3 microgram/kg and suitable doses of etomidate up to abolition of verbal communication and eye lash reflexes with maximum dose not more than 0.2 mg /kg was given for facilitation of endotracheal intubation. Trachea was intubated with appropriate size of endotracheal tube. Anaesthesia was maintained with oxygen 40% in air with isoflurane upto 1% and intermittent doses of vacuronium 0.01mg/kg every 30 minutes and fentanyl 50 microgram hourly up to weaning from cardiopulmonary bypass pump. After weaning from cardiopulmonary bypass pump only inhalational agent and intermittent doses of vacuronium 0.01mg/kg was continued up to skin closure. After weaning from cardiopulmonary bypass pump, traxenemic acid loading dose of 20 mg /kg was given in addition to protamine . Fresh frozen plasma and platelets were routinely used in every patient.

After shifting patient to intensive care unit no further anaesthetic agent was given. Patient was put on full mechanical ventilation with SIMV mode (synchronized intermittent mandatory ventilation) with tidal volume 8 ml /kg body weight, respiratory rate 12-16 with FiO2 40%. The patient is typically allowed to wake from anaesthesia, topical rewarming >36°C, acceptable hemodynamic stability with minimal chest tube bleeding and having adequate oxygenation and ventilation with evidence of acceptable lung compliance and medicine given for reversal of anaesthesia in those patients who are planned for early extubation. Once the patient is breathing spontaneously and ready for weaning, the ventilator mode is switched to T-piece trial for approximately one hour (either pressure- or volume-controlled synchronized intermittent mandatory ventilation tapering). Prophylactic hydrocortisone 100 mg is routinely administered before extubation. After extubation patient is kept in propped up position and observed under guidance of nursing staff to avoid the risk of aspiration and other respiratory problems. Vitals monitoring to maintain systolic blood pressure >90 mmhg, heart rate 100 beats /minute, arterial oxygen saturation >95% and respiratory rate <30 / minute and face mask/nasal cannula with oxygen support at rate of 6 litre/ minute.

Our multidisciplinary protocol for extubation includes- Adequate oxygenation on FiO_2 ≤40%, pO_2 >80 mmhg, maintenance of pH 7.34-7.43 and pCO_2 35-45 mmhg on positive end-expiratory pressure ≤ 5 cm H_2O, ventilator rate of ≤10 breaths/minute with pressure support ≤ 8 cm H_2O, bicarbonate 22-28 mmol/l, serum sodium 130-145 mmol/l, serum potassium 3.5-5.0 mmol/l, base excess < 5, ECG without major ectopics, haemodynamically stable with minimal inotropic support, rewarmed > 36 degree centigrade, adequate urine output, minimal and decreasing trend of chest tube drainage, acceptable chest X-ray findings (no mediastinal widening, expansion of both lungs, absence of major pleural fluid /air) level of consciousness consistent with adequate airway protective reflexes, and no involvement accessory respiratory muscles. Blood products used as necessary to maintain hematocrit at a value greater than 25%.

Observation

Both groups were analyzed in terms of preoperative, intraoperative, postoperative variables.

Results

A total of 89 patients underwent cardiac surgery were observed. The patients were divided into two groups: Group A, those extubated within six hours of surgery (76.4% cases); Group B, those not extubated after six hours and electively ventilated overnight (23.5% cases). There was no significant difference in age, BSA, preoperative risk factors and left ventricular function in both groups, while female (71.4%) in group B had delayed extubation. Haemoglobin was > 10 gm % in both groups (Table 1). We also did not find any significant difference in priming volume & activated clotting time on CPB, and type of surgical procedure. Mean total CPB and cross clamp time in

group B (187.14 & 139 minutes respectively) was higher than in group A (139.45 & 102.62 minutes respectively, Table 2). In comparison of postoperative data we found that use of blood products, re-exploration for bleeding (19%) stay in ICU and step down was slightly higher in group B. Re-intubation was done in 2.94% cases in group A patients. Bi-pap was used in 5.88 % cases in group A patients. High inotropic support (42.85%), deep coma (25%) were two main factors for delayed extubation in our study. Hospital mortality was higher in group B (33.3%) than in group A (2.94%) patients (Table 3).

Table 1: Demographic data of patients

Patients Variables	Group A (n = 68 cases 76.4%)	Group B (n = 21 cases 23.5%)
Age (range and mean in years)	7-61(37.35)	14-59(36.90)
Sex		
Male	32 (47.0 %)	06 (28.5%)
Female	36 (52.9%)	15 (71.4%)
Body surface area (mm^2in range)	1.60	1.47
Preoperative risk factors-		
Smoking	13 ((19.1%)	07 (33.3%)
Hypertension	09 (13.2%)	07 (33.3%)
Diabetes mellitus	06 (8.8%)	04 (19.0%)
Stroke	03(4.4%)	01 (4.7%)
Pulmonary hypertension		
No/Mild	18 (26.4%)	06 (28.5%)
Moderate	29 (42.6%)	14 (66.6%)
Severe	16 (23.5 %)	06 (28.5%)
Left ventricular ejection fraction (% in range)	38-60 %	40-60%
Haemoglobin (gm /dl mean)	12.8	13.1

Table 2: Intraoperative data of patients

Patients variables	Group A (n =68cases)	Group B (n=21cases)
Priming volume (mean in ml)	1288	1340
Activated clotting time (mean in second)		
Pre CPB	112.8	114.0
On CPB	502.1	547.70
Post CPB	108.20	111.32
Blood flow (mean L/min)	3.87	3.53
CPB time (range & mean in minutes)	35-298(139.45)	80-310(187.14)
Cross clamp time (range & mean in minutes)	34-227(102.62)	47-260(139)
Procedure (= n cases)		
MVR	36 (52.4%)	10 (47.6%)
AVR	10 (14.7%)	01 (4.76%)
DVR	07 (10.2%)	07 (33.3%)
ASD	10 (14.7%)	02 (9.52%)
CABG(off pump) TAR/ mixed grafts	04 (5.88%)	00 (00.0%)
Others	01 (1.47%)	01 (4.76%)

CPB= cardiopulmonary bypass, MVR= mitral valve replacement, AVR= aortic valve replacement, DVR= double valve replacement (both aortic and mitral), ASD= atrial septal defect, CABG= coronary artery bypass, TVR= total arterial revascularization.

Table 3: Postoperative data of patients

Patients Variables	Group A(n=68cases)	Group B (n=21cases)
Blood product used (range)		
PRBC(units)	00-03	04-07
FFP (units)	00-04	06-09
Platelets(units)	00-04	04-08
High inotropic support	03 (4.41%)	09(42.8%)
Haemoglobin (gm /dl mean)	8.9	7.6
Arterial blood gas (mixed acidosis)	Mild to moderate self correctable	moderate to severe correction required
Mediastinal bleeding (in ml mean)		
Decreasing trend	68 (100%)	
Increasing trend	00 (0.0%)	17 (80.9%)

BI-PAP used (= n cases)	04 (5.88%)	04 (19.0%)
Re-exploration for bleeding	00 (0.0%)	02 (9.52%)
Re-intubation	02 (2.94%)	04 (19.0%)
ICU stay (range in days)	2-3	00 (0.0%)
Step down area stay (range in days)	05-08	3-4
Complications-		07-12
Respiratory infections	06 (9.09%)	
Wound infections	04 (6.06%)	09 (56.25%)
Catheter related infections	01 (1.51%)	06 (37.5%)
Neurological complications		04 (25.0%)
Confusion	02 (3.03%)	00 (0.0%)
Deep coma	00 (0.0%)	04(25.0%)
Mortality	02 (2.94%)	07 (33.3%)

PRBC=packed red blood cell, FFP= fresh frozen plasma, BI-PAP =Bi-level positive airway pressure, ICU= intensive care unit

Discussion

Several clinical studies have aimed to identify the best approach for rapid postoperative weaning after cardiac surgery. In our study we have designed multidisciplinary protocols for early extubation of the patients, early after arrival in the intensive care unit (ICU). This protocol is followed whenever possible, even in some cases when a patient's spontaneous breathing is inadequate. Central nervous system dysfunction is an unavoidable complication following cardiac surgery and reported incidence of focal neurologic events is 0.4 to 9%. Westby et al [1] considered that, with modern perfusion equipment and mildly hypothermic cardiopulmonary bypass, protracted post-operative ventilation in an intensive care unit (ICU) is no longer required after most cardiac operations. He used a three-bedded cardiac recovery area (CRA) within the operating suite for 1,000 patients between January 1990 and June 1991. The time to extubation (T50%; range) for coronary bypass, aortic valve, mitral valve, and double-valve patients was 2.0 (0-42), 2.5 (0-12), 3.0 (0-15), and 3.0 (1-36) hours, respectively. Recovery beds were re-used allowing 5-6 operations daily. Patient management was done by nurse specialists supported by cardiac surgeons. Intervention by cardiac anaesthetists or intensivists was limited to specific ventilatory problems or renal failure. The early extubation policy failed in ten patients. The overall mortality in CRA was 1.4%. The mean duration of post-operative stay was 7 days (range 5-12). They concluded that a CRA staffed by nurse practitioners provides a safe and effective alternative to the anaesthetist-managed ICU. A rapid turnover of CRA beds removes the constraints of ICU bed availability. Cheng et al [2] did a controlled trial in 100 CABG patients and concluded that early extubation reduces cardiovascular intensive care unit (CVICU) and hospital length of stay but does not increase the rate of complications when compared with patients in the late extubation group. It shifts the high CVICU costs to the lower ward costs. Early extubation also improves resource use after cardiac surgery when compared with late extubation. Lee etal [3] have done a consecutive series of 690 patients undergoing coronary bypass surgery during a 24-month period to determine the effect of early extubation, defined as removal of the endotracheal tube within 8 hours of arrival to the intensive care unit. They concluded that early extubation after coronary bypass surgery is an effective strategy of reducing length of stay and does not appear to impact on either morbidity or mortality with additional benefit of significant cost savings. Cheng et al [4] did a clinical trial to evaluate morbidity outcomes and safety of a modified anaesthetic technique to provide shorter sedation and early extubation (1 to 6 hours) than those of the conventional anaesthetic protocol used for prolonged sedation and extubation (12 to 22 hours) in 120 patients after coronary artery bypass grafting assigned randomly to either an early extubation group (n = 60; 15 micrograms/kg fentanyl and 2 to 6 mg/kg/hour propofol and isoflurane) or to a conventional extubation group (n = 60; 50 micrograms/kg fentanyl and 0.1 mg/kg midazolam and isoflurane). They found that 51 of the 60 patients in each group (85%) were extubated within the defined time period. Postoperative extubation time and intensive care unit and hospital lengths of stay were significantly shorter in the early group. At 48 hours after operation, there were no significant differences between the two groups in myocardial ischemia incidences, ischemia burdens, creatine kinase isoenzyme MB levels. Four patients in the conventional group, but not in the early group, had postoperative myocardial infarction. Post-extubation apnoea characteristics were similar between the groups. Intrapulmonary shunt fraction improved significantly in the early group at 4 hours after

extubation. The incidences and degree of atelectasis did not differ significantly between the two groups. The incidences of treated postoperative complications were comparable between the two groups, but three patients in the conventional group died as a result of stroke or postoperative myocardial infarction. Cheng et al [5] studied 120 patients & found that fast-track cardiac anaesthesia is a safe practice that decreases resource use for a 1-yr period after index hospitalization. Reyes et al [6] concluded that out of 404 patients, Sixty percent of patients were extubated within 11 h of operation, as a result, the length of stay in ICU was reduced and the percentage of patients discharged within 24 h was increased & there was no increase in clinically important postoperative complications. Konstantakos et al [7] conducted retrospective cohort study in 412 consecutive patients undergoing isolated coronary artery bypass graft surgery between January 1996 and December 1997, constituting the experience of a single surgeon and found that extubation in fewer than 4 hours may offer a substantial advantage in terms of accelerated recovery compared with extubation between 4 to 8 hours. Very few differences in clinical parameters were noted between the two groups they studied, suggesting that efforts to reduce extubation times further might be worthwhile. Kilic et al [8] evaluated the use of Bi-level positive airway pressure (Bi-PAP) ventilation in early extubation after fast-track cardiac surgery in sixty consecutive patients and found that the early extubation and weaning to Bi-PAP ventilation after cardiac surgery is safe and effective. Santos et al [9] conducted a prospective, randomized, placebo-controlled, double-blind trial to determine the antifibrinolytic and haemostatic effect of tranexamic acid (TA) in 65 patients who underwent CABG, concluded that intraoperative use of TA in patients undergoing coronary artery bypass grafting with cardiopulmonary bypass is effective in reducing postoperative blood loss and fibrinolysis. Arom et al [10] examined predictors and cost-effectiveness of early extubation after coronary artery bypass grafting in 645 patients admitted to intensive care units and found that early extubation shortened the postoperative length of stay, resulting in reduction of cost, resource utilization and re-intubation rate for the entire group was less than 1%. Kloth et al [11] studied total of 102 consecutive children (age <18 yrs) undergoing cardiac surgery requiring cardiopulmonary bypass and noticed that successful early extubation of even young children is possible and easily accomplished in most children undergoing cardiopulmonary bypass, even with complex procedures, but advantages of extubation in the operating room versus immediate ICU extubation remain unclear. Jenkins [12] examined the implications for nursing practice in early extubation post-cardiac surgery and concluded that nurses need to re-examine their current practice in order to identify the changes required to develop evidence-based post-operative care. Irfan akthar and his colleague's [13] found that the common reasons for delayed extubation were deep sedation in 46.5%, confusion 25%, excessive bleeding in 11.3% and high inotropic support in 5.68%. Rashid et al [14] done a retrospective study in 86 patients who underwent cardiac surgery from August 2006 to January 2007 and divided into two groups following intensive care unit admission: Group A, duration of intubation <4 h (n=34); Group B, duration of intubation >4 h (n=52).Their results showed patients in Group A were younger (33.2+/-12 versus 45.8+/-13 years; p=0.001) and had better preoperative left ventricular ejection fraction (LVEF) (62.4+/-9.8 versus 44.6+/-9.4; p=0.003) than those in Group B. Moreover, Group A patients had a shorter intensive care unit length of stay (1.7+/-0.5 versus 2.2+/-0.8 days; p=0.006) and were discharged earlier than Group B patients (2.7+/-2.4 versus 4.01+/-3.96; p=0.014).

In our study, there was no significant difference in age, BSA, preoperative risk factors and left ventricular function in both groups, while female (71.4%) in group B had delayed extubation. We also did not find any significant difference in priming volume & activated clotting time on CPB, and type of surgical procedure. Mean total CPB and cross clamp time in group B (187.14 & 139 minutes respectively) was higher than in group A (139.45 & 102.62 minutes respectively). In comparison of postoperative data we found that use of blood products, re-exploration for bleeding (19%) stay in ICU and step down was slightly higher in group B. Re-intubation rate was very negligible. High inotropic support (42.85%), deep coma (25%) were two main factors for delayed extubation in our study. Hospital mortality was higher in group B (33.3%) than in group A (2.94%) patients. We also found that the excessive mediastinal bleeding requiring re-exploration and postoperative hypothermia is no more potential problem.

Conclusions

We can safely use early extubation in most of conventional cardiac surgical procedures, without additional cost, learning curve and compromising patient care. Despite advances in anaesthesia,

cardiopulmonary bypass (CPB), and surgical techniques, some patients still require a period of postoperative overnight mechanical ventilation. We also found that the two key factors like High inotropic support, deep coma is responsible for delayed in extubation of patients.

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