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ORIGINAL ARTICLE

Role of Fast Tract Extubation in Enhanced Recovery after Cardiac Surgery: Associated Factors and Outcomes

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ABSTRACT

Objective: To assess the impact of fast track extubation versus late extubation in cardiac surgery patients being operated in Bahawal Victoria hospital, Bahawalpur, Pakistan.

Methods: This analytical cross-sectional study was conducted in department of cardiac surgery, Bahawal Victoria Hospital, Bahawalpur, from March 2018 to March 2020. All patients who underwent cardiac surgical procedures were consecutively enrolled. Fast-track extubation (FTE) and delayed extubation (DE) in these patients were recorded. Moreover, information regarding baseline and clinical characteristics was collected and outcome like reintubations, hospital stay, and mortality were observed.

Results: Of 86 patients, FTE was successful in 70 (80.14%) patients, while DE was observed in 16 (18.6%) patients. High dose inotropes 6 (37.50%) and increase drain output 5 (31.25%) were the most common cause of FTE failure among 16 patients. NYHA class was found to be significantly higher in DE group as compared to FTE group (p-value 0.002). The mean ventilation time in FTE group was significantly higher as compared to DE group, i.e., 2.7±1.6 hours vs. 6.5±4.4 hours respectively (p-value 0.001). While, inotropic support (p-value 0.047), drain volume at 4 hours (p-value 0.039), and drain at the time of removal (p-value 0.002) were significantly lower in FTE group as compared to DE group. There was a single reintubation (1.16%) and mortality (1.16%).

Conclusion: FTE is a safer technique in planned cardiac surgical procedures resulting in least morbidity and mortality.

Keywords: Fast track extubation, delayed extubation, cardiac surgery, reintubation.

INTRODUCTION

Cardiac surgery is a multidisciplinary approach requiring extensive and timely inputs from surgeon, anesthetists, cardiac perfusionists and intensivists throughout the period of patient stay in hospital to produce a complication free outcome. Condoning the meager details of different patient variables preoperatively or incompetently dealing with slight changes in patient hemodynamic and other variables pre-operatively and post operatively will not only prolong patients stay but also can sometime prove havoc within no time. Minimizing patient stay in hospital serves many purposes like reducing the complications, lessening the patient's and family anxiety, concerns of health care provider and cutting down the hospital cost.[1] The fast track program entails exquisite preoperative assessment of risk factors, effective patient education and physiotherapy, fastidious coverage of surgical procedure by surgeon, perfusionists and anesthetists, meticulous appraisal of postoperative complication and excellent management by intensive care unit (ICU) staff. Fast track extubation, an essential component of enhanced recovery after surgery, is becoming a standard practice after cardiac surgery.[2] Various newer trends have made fast track extubation a more feasible approach than past. Reduction in use of various drugs like halothane and long acting opioids and use of newer drugs like Dexmedetomidine not only reduce analgesic and sedative requirements but also associated with decreased ventilation times and postoperative delirium.[3,4] Newer cardioplegia like Del nido reduces cardiopulmonary bypass (CPB) and cross clamp times (CCT) and offer better myocardial protection than conventional cardioplegias.[5] Postoperative hemostasis improved by procedures like cell saver effectively reduce blood transfusion requirements which in turn lessen infection rate and various respiratory complications like acute lung injury.[6] All these factors are making fast track extubation a safe, reproducible and cost-effective technique.[7]

Cardiac surgery department of Bahawal Victoria

hospital Bahawalpur is a remote and newly built center in an economically challenged and enormously populous country, i.e. Pakistan that requires finding such procedures that decrease economic burden and resolute the issue of shortage of health staff. Fast track recovery after cardiac surgery is one of such techniques, of which, fast track extubation is an integral part.

In this study, we have tried to search role of fast track extubation in early recovery of different cardiac surgical patients, to discover its governing factor, to explore reasons for its failure and to find the outcomes of this novel approach.

METHODS

The analytical cross-sectional study was carried out by compiling data from March 2018 to March 2020 from cardiac surgery Department of Bahawal Victoria hospital, Bahawalpur, Pakistan. Ethical approval was obtained from ethical review committee of Qaid-e-Azam Medical College (Cardiac center Bahawalpur /QMC) Bahawalpur (Ref # 393/DME/QAMC Bahawalpur).

All patients scheduled for isolated Cardiac Artery Bypass Grafting (CABG), isolated valve replacement, or non-complex adult congenital cardiac surgical procedures, i.e., closure of Atrial Septal Defect (ASD), aged between 20 and 70 years were consecutively included.

Patients were excluded from the study that required Intra-aortic balloon pump (IABP) before surgery, having recent myocardial infraction (MI), heart failure, hepatic and renal dysfunctions (serum creatinine ≥165 mmol)/L, heigh Body Mass Index (≥30kg/m^2), severe COPD (Global Initiative for Chronic Obstructive Lung Disease class ≥2), EF ≤40% and uncontrolled diabetes mellitus (HbA1c >7.5%).

Sample size was calculated on the basis of preceding researches in which rates of success were declared to be 65 to 80%. It was expected that 80%success rate be estimated with 95% confidence interval within ±5% level of precision; thus, eighty-six cases were included in this study.[8]

A pre-structured proforma was used to record the data. Patients were segregated into two groups 70 (81.4%) from FTE-group (fast-tract extubation, extubated within 4 hours) and 16 (18.6%) from DE-group (delayed extubation, extubated after 4hours).

All data were compiled in terms of pre-operative factors i.e., age, body mass index, sex, ejection fraction, presence of COPD, diabetes mellitus (DM), hypertension (HTN), pulmonary hypertension, New York heart association (NYHA class), preoperative use of different drugs and Euro SCORE II. Per operative factors like CCT and CPB times were observed. Post-operative variables like, total duration of ventilation, Heart rate, systolic blood pressure and diastolic pressures (for 8 hours), chest drain output at 4 hours and at removal time, and number of inotropic supports were recorded. Re-intubations, mortality, any blood transfusion, pulmonary complications (collapse / consolidation, pneumonia, pleural effusion) and total hospital stay were noted.

Preoperative medications were pursued as per anesthesia protocol policy. Each patient was premedicated with capsule omeprazole (40mg), tablet alprazolam (0.5mg) and cardiac medications at 6.00 am with a sip of water and injection Cefoperazone and tazobactam. Standard intra- and postoperative monitoring was attached for invasive radial artery pressure, central venous pressure access with a 9-French catheter, electrocardiogram, temperature, and peripheral oxygen saturation (SpO2) monitoring.

All patients were given general anesthesia and similar techniques were utilized in every patient by giving a loading dose of 0.7µg/kg dexmedetomidine before induction and they were intubated and mechanically ventilated. Induction was done by using propofol and atracurium by selate and maintained with continuous use of dexmedetomidine (0.3µg/kg/hour) along with 1-2% of sevoflurane in 50% of O_2 in air, supplemented analgesia with fentanyl. Cis-Atracurium (2mg) was given to maintain muscular relaxation after every 20 minutes. Patients were shifted to ICU after completion of procedures.

Mechanical ventilation was applied with Synchronized intermittent mandatory ventilation (SIMV) and Tidal volume (VT) of ≥7ml/kg ideal body weight to maintain plateau pressures ≤25cm H_2O and respiratory rate for keeping end tidal carbon dioxide ($EtCO_{2)}$ <45mmHg.

All anesthetic medications were ceased before shifting the patient in ICU. Inj. Paracetamol 1000 mg and inj. ketorolac 30 mg were utilized for post-operative pain management immediately after shifting and after extubation. When patients commenced spontaneous breathing, anesthetist prepared the patients for fast track extubation following standard protocols of weaning and extubation,

Hemodynamics (heart rate, systolic blood pressure, diastolic blood pressure) were within normal limits, when patients established a tidal volume of ≥5ml/kg with a pressure support of 10cm H_2O and PEEP of 4 cm H_2O on SIMV mode of ventilation, patients can obey

commands, normal respiratory function with SpO2 of ≥95% at FiO_2 0.4, normal pH, HCO_3 & PO_2 (≥70), Hct>27 and PaCO2 of <45 mmHg on ABGs results, blood loss of less than 50 cc/h via the chest tubes, measure of hourly urinary volume of more than or equal to 0.5cc/kg/hour, temperature ≥ 36.5C ,rapid Shallow Breathing Index (RSBI) ≤100.

Fast track extubation (FTE) was defined as extubation within 4 hours while delayed extubation (DE) as extubation after 4 hours. Patients were considered successful when there is no reopening and no reintubation within ICU stay.

Statistical analysis was performed using the Statistical Package for Social Science (SPSS) software, version 20.0. All quantitative variables like age, preoperative and postoperative variables were expressed as the mean ± standard deviation (SD). Frequencies and percentages were calculated for qualitative variables like comorbid, blood transfusion, pleural effusion, collapse. Inferential statistics were explored using Chi-square test and independent t-test. p-value ≤ 0.05 was taken as significant.

RESULTS

Of 86 patients, FTE was successful in 70 (80.14%) patients, while 16 (18.6%) patients who could not undergo FTE were placed in DE group. An insignificant difference of age (p-value 0.370), sex (p-value 0.391), Euro scores (p-value 0.741), BMI (p-value 0.263), and EF (p-value 0.160) were observed in between FTE and DE group. Whereas NYHA was found to be significantly higher in DE group as compared to FTE group (p-value 0.002). Furthermore, comorbidities like COPD (p-value 0.512), DM (p-value 0.284), HTN (p-value 0.505), and pulmonary hypertension (p-value 0.563) were insignificantly higher in FTE group as compared to DE group. (Table 1)

The most common cause of FTE failure in 16 patients who underwent DE were high dose inotropes 6 (37.5%), increase drain output 5 (31.2%), respiratory insufficiency 2 (12.5%) while 3 (18.7%) patients had miscellaneous causes. (Figure 1) The mean difference of clinical parameters in between fast track and DE showed that the mean ventilation time in FTE group was significantly higher as compared to DE group, i.e., 2.7±1.6 hours vs. 6.5±4.4 hours respectively (p-value 0.001). In addition, inotropic support (p-value 0.047), drain volume in 4 hours (p-value 0.039), and drain volume at the time of removal (p-value 0.002) were significantly lower in FTE group as compared to DE group. While, hospital stay (p-value 0.169), CCT (p-value 0.528), CPB Time (p-value 0.458), heart rate (p-value 0.528), SBP (p-value 0.188), and DBP (p-value 0.958) were found statistically insignificant. (Table 2)

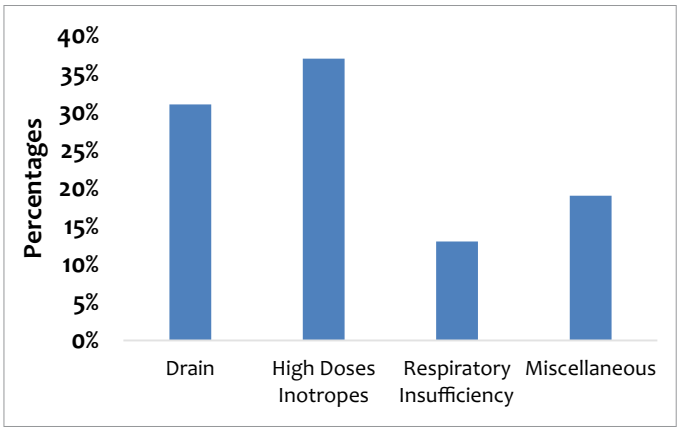

Figure 1: Causes of FTE failure (n=16)

DISCUSSION

Fast track extubation after cardiac surgery is an important intervention in low resource country like Pakistan where extreme shortage of staff in number and training were faced by most of the healthcare institutions. In the current study, majority of the patients were included in fast track extubation group with significantly improved ventilation time. Studies report 11% to 28% failure rate of early extubation in adult cardiac surgery.[8-10]

In the current study, none of the baseline characteristics like demographic characteristics and co-morbidities were statistically significant between both groups. However, NYHA class was observed a statistically significant factor. Similar to the current study findings, various previous studies have found NYHA class as a significant factor in between group.[11-13]

This study did not find co-morbidities, a risk factor for failure to fast track extubation. Strict control of all preoperative risk factors, deferring cases with low EF, morbid conditions (e.g., BMI≥ 30 kg/m^2) and extremes of ages to higher centers with more skilled staff, no operations for complex and urgent cases, were, probably the reasons, though, Bansal *et al*[12] also reported that co-morbidities are neither a contraindication nor a risk factor for fast track extubation. Albeit, some studies report co morbidities as risk factors for failure to fast track extubation.[14,15]

Among the preoperative medications, all medications, except statins, did not show statistically significant difference between both groups. We are not the first researchers who showed statins a statistically significant factor between fast track and delayed extubation groups. Wise *et al* [16] also showed statistically

Table 1: Mean difference of baseline variables in between fast-track and delayed-extubation (n=86)

Variables	Fast Track Extubation (within 4hours)	Delayed Extubation (after 4hours)	
	mean ± SD	mean ± SD	p-value
Age (Years)	43 ± 16	47 ± 16	0.370~
Sex (Male: Female)	43:27	12:45	0.391~
NYHA	2.2 ± 0.4	2.7 ± 0.9	0.002*~
Euro Scores	1.7 ± 6	1.1 ± 0.4	0.741~
BMI (kg/m^2)	22 ± 3	23 ± 4	0.263~
EF%	58 ± 10	54 ± 11	0.160~
	n (%)	n (%)	p-value
COPD	15 (16.3)	5 (5.8)	0.512^
DM	14 (14.0)	1 (2.3)	0.284^
HTN	17 (20.9)	2 (4.7)	0.505^
Pulmonary Hypertension	21(24.4)	6 (7.0)	0.563^

BMI: Body mass index, COPD: Chronic Obstructive Pulmonary Disease, DM: Diabetes Mellitus, EF: Ejection Fraction, NYHA: New York heart association

~Independent sample t -Test applied, ^chi-square test applied, *p-value ≤0.05

Table 2: Mean difference of clinical parameters in between fast track and delayed extubation (n=86)

Variables	Fast Track Extubation (within 4hours)	Delayed Extubation (after 4hours)	
	mean ± SD	mean ± SD	p-value
Ventilation Time (Hours)	2.70 ± 1.6	6.5 ± 4.4	0.001~*
Hospital Stay (Days)	6.0 ± 1.9	6.7 ± 1.4	0.169~
Cross Clamp Time (Min)	66.8 ± 23.2	62.9 ± 17.1	0.528~
CPB Time (Min)	97.8 ± 33.5	104.9 ± 38.2	0.458~
Heart Rate (Beats/Min)	87.0 ± 18.5	90.0 ± 8.0	0.528~
Systolic Pressure (mmHg)	103.0 ± 12.6	97.9 ± 18.6	0.188~
Diastolic Pressure (mmHg)	58.6 ± 11.9	58.4 ± 13.7	0.958~
Inotropic Support	2.6 ± 3.5	4.8 ± 5.5	0.047~*
Drain in 4 hours (ml)	327.4 ± 160	434.0 ± 289	0.039~*
Drain at time of removal (ml)	497.0 ± 436	858.0 ± 374	0.002~*
	n (%)	n (%)	p-value
Blood Transfusion	44 (62.85)	10 (62.5)	0.596^
Pleural Effusion	24 (37.71)	8 (50)	0.391^
Collapse/Consolidation/ pneumonia	20 (28.57)	6 (37.5)	0.550^

CPB: Cardiopulmonary bypass time

~Independent sample t -test applied, ^chi-square test applied, *p-value ≤0.05

significant findings for statins while comparing early and delayed extubation groups. While Komsatsu *et al* [17] and chee *et al* [18] showed opposite results as compared to the current study findings.

Per operative factors i.e., CCT and CPB time did not show statistical difference between both groups in the current study. Similarly, Kianfar *et al* [19], Neirotti *et al* [20], and Totonchi *et al* [21] also showed that CCT and CPB time did not differ significantly between early extubation group and delayed extubation group. Nevertheless,

studies that included complex cases and cases with more co-morbidities showed significant difference between early and delayed extubation groups in terms of cross clamp time and CPB time.[14-16]

Haemodynamic instability requiring increased inotropic support and significant mediastinal bleeding were most important postoperative factors delaying extubation with in our study. This finding is also supported by Akhtar et al.[22]

Only one of our patients underwent reintubation and reason was acute renal failure post operatively. Various studies[13,16,17] have proved that early extubation was not a risk factor for re intubation. Likewise, there was a single mortality in whole cohort. And though, the ventilation time differed significantly between FTE and DE group, both the groups did not differ significantly in pulmonary and other complications. In our institute, we had the protocol of discharging the patient from the ICU without shifting to step down unit considering the lack of manpower, so the comparison of ICU stay was meaningless. But still, hospital stay was short in FTE group than in DE group, but difference was not significant. Richey et al also showed findings consistent with our results.[23] Similarly, a meta-analysis showed that fast track extubation may lessen ICU stay but not morbidity and mortality.[24] Furthermore, ERAS (Enhanced Recovery after Surgery Society) guidelines states that fast track extubation may reduce ICU stay but benefits of reducing postoperative complications is not clearly demonstrated.[2]

The reasons for FTE failure in our study in decreasing order were requirement of high inotropic support, increased drain output, respiratory insufficiency, and miscellaneous causes. Athar et al[22] reported 48% incidence of FTE failure. They found drowsiness most significant reason for failure to undergo fast track extubation followed by hemodynamic instability and then mediastinal bleeding.

While conducting a study at newly established center, we had to encounter few limitations. We could not include patients with increased ASA class, complex cardiac surgical cases, and emergency surgeries. Though age is not a valid risk factor for early extubation failure but still we did not include patients with extreme of ages (<20 and >70).[16] Although, anesthesia management was done by a single anesthetist, postoperative care was provided by different health care providers so were the capabilities, inclinations, and observations. Finally, results of this study require external validation as it was a single center and short sample-based study.

CONCLUSION

We conclude that fast track extubation after cardiac surgery in stable and less co-morbid patients is a safe and reliable technique and may reduce the workload and ICU stay.

ETHICAL APPROVAL: The study was approved by Institutional Ethical Review Board, Quaid e Azam Medical College Bahawalpur (Ref # 393/DME/QAMC Bahawalpur).

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