

ORIGINAL ARTICLE

FAST TRACK EXTUBATION IN ADULT PATIENTS ON PUMP OPEN HEART SURGERY AT A TERTIARY CARE HOSPITAL

Mohammad Irfan Akhtar, Hasanat Sharif*, Mohammad Hamid, Khalid Samad, Fazal Hameed Khan

Department of Anaesthesiology, *Department of Surgery, Aga Khan University Hospital, Karachi-Pakistan

Background: Fast-track cardiac surgery programs have been established as the standard of cardiac surgical care. Studies have shown that early extubation in elective cardiac surgery patients, including coronary and non-coronary open-heart surgery patients does not increase perioperative morbidity and mortality. The objective of this observational study was to determine the success and failure profile of fast track extubation (FTE) practice in adult open-heart surgical patients. **Methods:** The study was conducted at cardiac operating room and Cardiac Intensive Care Unit (CICU) of a tertiary care hospital for a period of nine months, i.e., from Oct 2014 to June-2015. All on pump elective adult cardiac surgery patients including isolated CABG, isolated Valve replacements, combined procedures and aortic root replacements were enrolled in the study. Standardized anesthetic technique was adopted. Surgical and bypass techniques were tailored according to the procedure. Success of Fast track extubation was defined as extubation within 6 hours of arrival in CICU. **Results:** A total of 290 patients were recruited. The average age of the patients was 56.3±10.5 years. There were 77.6% male and 22.4% female patients. Overall success rate was 51.9% and failure rate was 48.1%. The peri-operative renal insufficiency, cross clamp time and CICU stay (hours) were significantly lower in success group. Re-intubation rate was 0.74%. **Conclusion:** The perioperative parameters were significantly better in success group and the safety was also demonstrated in the patients who were fast tracked successfully. To implement the practice in its full capacity and benefit, a fast track protocol needs to be devised to standardize the current practices and to disseminate the strategy among junior anaesthesiologists, perfusionists and nursing staff.

Keywords: Fast Track Extubation; Adult; Open-heart surgery

J Ayub Med Coll Abbottabad 2016;28(4):639–43

INTRODUCTION

Fast track approach has been practiced for more than three decades. The “fast-track” protocols were developed and were associated with decreased lengths of stay (LOS) and potentially lowering rates of ventilator-associated pneumonia without negatively affecting outcomes.^{1,2}

Fast-track cardiac surgery programs have been established as the standard of cardiac surgical care.³ Studies have shown that early extubation in elective cardiac surgery patients, including coronary and non-coronary open-heart surgery patients does not increase perioperative morbidity and mortality.⁴

Anaesthesia for cardiac surgery has traditionally been provided with high-dose opioids and long-acting muscle relaxants, with the assumption that this technique was associated with better haemodynamic.

The conventional anaesthetic technique resulted in prolong postoperative ventilation and intensive care unit (ICU) length of stay (LOS). Rising costs and the need for faster ICU turnover due to increased demand and reduced resources led to reducing the length of ICU stay after cardiac surgery.^{5,6}

Fast track extubation (FTE) is currently being practiced in adult cardiac surgery patients at our institution, but

audits are not performed to validate its success and outcomes in all open-heart surgery patients.

The objective of the study was to determine profile of fast track extubation practice in terms of its success and reasons for its failure in adult open-heart surgical patients. Primary outcomes were the time to extubation and the reasons for failure of fast track extubation. Secondary outcomes were reintubation within 24 hours of extubation and total CICU stay in hours.

MATERIAL AND METHODS

This cross-sectional study was conducted at cardiac operating room and Cardiac Intensive Care Unit (CICU) of Aga Khan University Hospital for a period of nine months, i.e., from Oct 2014 to June-2015. All adult elective cardiac surgery patients aged 35–80 years of both genders including isolated on pump coronary artery bypass grafting (CABG), isolated valve (mitral or aortic or both) replacements, combined procedures (CABG plus Valve replacements) and aortic root replacements were enrolled in the study.

All Emergency cases with an Acute MI having persistent chest-pain despite pharmacological intervention scheduled for emergency CABG, acute MI with mechanical complications, Redo stuck valve cases with heart failure, already intubated and patients with

preoperative intraoperative balloon pump (IABP) were excluded. Success of FTE was defined as extubation within 6 hours of arrival in CICU.

After approval from institutional Ethical review committee and obtaining informed consent from the patients, study was conducted at cardiac operating rooms and CICU. All patients were pre-medicated with midazolam, 3.75–7.5 mg per oral. Standard American Society of Anaesthesiologist (ASA) monitoring guidelines was applied. Pre-induction, 20 G arterial line was inserted. Etomidate, 0.2–0.3 mg/kg intravenous (I/V) and Fentanyl, 5–10 µg/kg I/V were used for induction of anaesthesia. Rocuronium, 0.5–0.6 mg/kg I/V was used for intubation. Triple lumen central venous pressure (CVP) line was inserted in all cases. Pulmonary artery catheter was inserted in selected CABG, all valve replacements, all combined procedures and all aortic root replacements patients. Anaesthesia was maintained with Isoflurane, 1 Minimum Alveolar Concentration (MAC) in pre-cardiopulmonary bypass period (CPB) and Propofol infusion, 2 mg/kg/hour was used during cardio-pulmonary bypass (CPB) and post CPB and post-operative phase. Muscle relaxation was achieved with Atracurium infusion, 0.4 mg/kg/hour. Atracurium stopped after chest closure. Analgesia was maintained with Fentanyl increments of 50–100 µgm in the intra-operative period. After completion of revascularization or valve replacement or both, the patient was rewarmed to core temperature of 36°C and put off the bypass after fulfilling the standard criteria. Chest was closed after securing haemostasis. In the post-operative phase, multi-model analgesia with Tramadol 50 mg I/V 6 hourly, Paracetamol 1 gm I/V 4-6 hourly and Morphine as rescue analgesia in 0.5-2 mg I/V increments was administered

Communication form was sent to CICU staff with written extubation plan two hours before shifting the patient to CICU. In the CICU, the patients were rewarmed to core temperature of 36 °C with warming blanket. After 2 hours of observation, the patient was assessed and weaning was started if fulfilling the weaning criteria (Core temperature of 36 °C, hemodynamically stable with minimal inotropic support (Epinephrine: <0.08 µ/kg/min or nor-Epinephrine <0.05 µ /kg/min, chest tube output <100 mls/hour for two consecutive hours, normal PH (7.35-7.45), PO₂ (>60 on FIO₂ 0.4), PCO₂ (<45), HCO₃ (21–24), haemoglobin >8 gm/dl.

Extubation was done at CICU after fulfilling the standard extubation criteria (patient fully awake and cooperative, stable hemodynamics on minimal inotrope/vasopressor support, adequate tidal volume (>5 ml/kg) on Pressure support of 10 cm/H₂O on spontaneous mode, rapid shallow breathing index (RSBI) <80, normal ABGs (PaO₂ >60 mm/Hg on FIO₂ of 0.4, PaCO₂ <45 mm/Hg, PH 7.35–7.45).

Sample size calculation was based on previous studies in which success rates were reported to be 68–75% approximately.⁶ It was expected that 75% success rate would be estimated within ±5% level of precision with 95% confidence interval; so 290 cases were included in this study. Data was collected through a structured proforma by the designated nurse/resident/fellow/Medical officer. All statistical analyses were performed using SPSS-19. Primary outcome variable was extubation within specified period of time and explanatory variables were age, BMI, comorbid, total CICU stay, reasons for delays and re-intubation. Frequency and percentage was computed for categorical variables and compared by chi-square test between extubation within and after 6 hours of arrival in CICU. Mean and standard deviation were estimated for age, weight and height and compared by parametric independent sample *t*-test. Median and interquartile range was reported for bypass time and cross clamp time and compared by non-parametric Mann-Whitney test. A *p*-value of <0.05 was considered statistically significant.

RESULTS

A total of 290 open-heart cardiac surgery patients were included in this study and 270 eventually followed in fast track category because 20 patients diverted to conventional track due to eventful post-pump course before shifting to CICU. The mean age of the patients was 56.3±10.5 years. There were 77.6% male patients and 22.4% female patients. Demographic profile elaborated in table-1. About 80% of the procedures were CABGs, 16% were Valve replacements and remaining 4% were rest of the procedures (combined procedures, Redo CABG and aortic root).

Overall success rate of fast track extubation (within 6 hours) was 51.9% and failure rate was 48.1%. The major reasons for failure of fast track extubation were multifactorial with hemodynamic instability (high inotropic support) (36.9%), drowsiness (difficulty to arouse) (39.2%) and bleeding (21.5%) were among the major causes shown in figure-1. Re-intubation within 24 hours of extubation was observed only in two patients (0.74%). Preoperative and post-operative renal dysfunction was a significant co-morbid contributing to failure of FTE, (5.0 vs. 16.2%, *p*=0.003) and (28.6 vs. 49.2%; *p*=0.001), table-2.

Median bypass time was statistically higher in those cases whose extubation was accomplished after 6 hours (*p*=0.009), while cross clamp time was not statistically significant. Average duration of total CICU stay was significantly higher in cases that were extubated after 6 hours in comparison with those who extubated within 6 hour (*p*=0 .001) as shown in table-2.

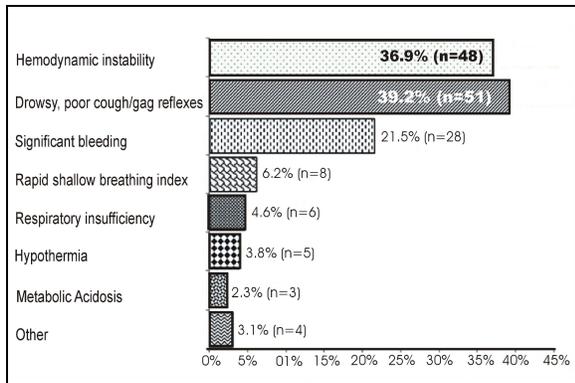


Figure-1: Reason of failure of fast track extubation, (n=130). Failure was multifactorial; rapid shallow breathing index >80–100

Table-1: Demographic and cardiac variables of the enrolled patients, n=290.

Variables	
Age (years) [†]	56.3±10.5
Weight (kg)	72.6±14.4
Height (cm)	164.0±8.0
BMI (kg/m ²)	26.9±4.8
Gender, n (%)	
-Male	225(77.6)
-Female	65(22.4)
Procedure, n (%)	
-CABG	231(79.7)
-Valve*	47(16.5)
-Redo CABG	2(0.7)
-Aortic Root replacement	2(0.7)
- Combined Procedure**	8(2.75)

[†]Mean±sd, *Valve procedure included: DVR+MVR+AVR.

**Combined procedures included: (CABG+AVR or MVR).

Table-2: Comparison of association of factors with success and failure rate of extubation in CICU, n=270.

Variables	Extubation time		p-value
	Success (Within 6 hrs.) (n=140)	Failure (After 6 hrs.) (n=130)	
Procedure, n (%)			
-CABG	112 (80.0)	105 (80.8)	0.874 ^b
-Valve*	21 (15.0)	20 (15.4)	0.930
-Redo CABG	2 (1.4)	0 (0.0)	0.499
-Aortic Root replacement	0 (0.0)	2 (1.5)	0.231
-Combined Procedure**	5 (3.6)	3 (2.3)	0.724
Preoperative renal dysfunction			
-Yes	7 (5.0)	21 (16.2)	0.003 ^b
-No	133 (95.0)	109 (83.8)	
Postoperative renal dysfunction			
-Yes	40 (28.6)	64 (49.2)	0.001 ^b
-No	100 (71.4)	66 (50.8)	
Bypass time (min)***	100 [75–120]	115 [90–135]	0.009 ^d
Cross Clamp time (min)	62.5 [50–84]	68 [55–95]	0.135 ^d
Total CICU stay (hrs) [‡]	41.0±10.9	51.9±17.0	0.001 [†]

*Valve included: DVR, MVR and AVR. **Combined included: CABG+AVR or MVR. Preoperative Renal Dysfunction defined as Serum-creatinine >1.5mg/dl. Post-operative Acute Kidney Injury defined as 50% increase in Serum-creatinine above preoperative normal value. ^bMann-Whitney U test; [†]Student t test; ^cChi-square or fisher exact test. ***[Inter Quartile Range]; [‡]Mean±SD.

DISCUSSION

This study is a continuum of our previous study done

about six years ago at our institution in CABG surgery patients.⁷ In the current study, all elective cardiac surgery patients were included, i.e., CABG, Valve replacements, combined procedures, aortic root replacements (involving proximal portion of Ascending aorta), hence broadening the application of FTE practice. Main bulk of the patients enrolled during the study period was CABG (80%).

Many of the anaesthesiologists show concern about the safety of FTE, particularly among high-risk populations.⁸ In the current study, it was observed that early extubation was associated with significantly shorter post-operative CICU stays and that it can be performed safely, without increasing the re-intubation rates. In this study, the re-intubation rate was only 0.74% validating the safety of fast track extubation in adult open-heart surgery patients in our institution.

Conventional methods of extubation (long acting drugs and prolong postoperative mechanical ventilation) are now being replaced with newer protocols. The safe practice of FTE is attributed to multiple factors. The most important factors are the usage of modern rapid turnover anaesthetics, modern surgical cardiopulmonary bypass techniques and multimodal effective analgesia. These advancements in cardiac perioperative care resulted in extubating the cardiac surgical patients within the span of six hours or even earlier. Rate of failure of FTE in multiple studies ranges between 11–49% depending upon the patient population.^{7,9} In our study, overall failure rate was 48%. Multiple factors were detected for the failure including hemodynamic instability, drowsiness and significant bleeding as the major factors. Hemodynamic instability was mostly due to hypotension secondary to low cardiac output or vasodilation leading to escalation of inotropes or vasopressors thus delaying extubation beyond 6 hours. Drowsiness was seen more in elderly patients especially above 65 years of age. The avoidable minor factors that contributed to delay in FTE were delayed rewarming, late arrival of the patient in the CICU, engagement of on call resident/fellow in the Cardiac Catheterization laboratory or operating room for emergency cases, and difference in opinion of the anaesthesia and surgical team regarding the FTE in cases with an eventful surgery like post-CPB pulmonary hypertension, significant arrhythmias, coagulopathy and deterioration of LV function on post-operative transthoracic echocardiography.

In comparison to other studies on FTE in cardiac surgery, which included only coronary artery bypass surgery (CABG) patients¹⁰⁻¹², however our study population was mixed in terms of type of the operations, but the main bulk of procedures were CABGs. In the selected 270 patients, 79.7% were 1st

time CABG patients, 16.5% valve cases (single and double valve replacements), 0.7% each of aortic root replacements, and Redo CABG and 2.8% was combined procedures. Multiple associations with success (FTE) were detected by means of the current audit. The peri-operative renal insufficiency, cross clamp time and CICU stay (hrs) were significantly low in success group; nevertheless, the success rate by procedure type was comparable. In CABG it was 51.6%, in valve cases 51.2%, in Redo CABG 100%, in combined procedures 62.5 and in aortic root it was none. It was observed that the majority of the patients scheduled for CABG had triple vessel coronary artery disease (83%) with median EF of 55%.

A study conducted at PIMS hospital Islamabad included all open-heart cases unless absolute contraindications were present,¹³ the Rapid recovery protocol was adopted from Oslo Hospital Norway in an attempt to achieve fast tracking at their setup.¹⁴ Two hundred and seventy-four consecutive cases out of total 400 operated cases were included in this study, where 86% patients were fast-tracked to be extubated within 6 hours and 85.4% patients remained free of post-op complications. Mean CICU stay was 2.59±0.95 days and in-hospital mortality was 2.2%. It was concluded that fast tracking with extubation within 6 hours is feasible approach, which minimizes the post-operative complications significantly in adult cardiac surgical patients. At our institution, the important variables to be followed in successful execution of fast track extubation were selection of patients according to inclusion criteria, mild to moderate hypothermia, minimal cross-clamp and pump time and last but not the least training of CICU staff to get the patients ready for early extubation under guidance of anaesthesia consultant/on-call resident/fellow. The success rate though was quite low than the referenced study, but it is at par with national and international statistics.^{7,9}

There is a paradigm shift towards shifting the elective open-heart cardiac surgical patients fulfilling the fast track protocol to specialized Fast track ward so as to curtail the CICU burden. This is an important advancement being practiced in high volume cardiac centres so as to cope with rapid patient turnover. This is also reported in a prospective, single-blinded, randomized study in which 200 adult patients undergoing elective cardiac surgery CABG, valve surgery or combined CABG and valve surgery, were selected to receive their postoperative treatment either in the CICU or in the Post Anaesthesia Care Unit (PACU), (n=100 each arm). They found a lower incidence of re-intubation in the PACU with 2.5% vs. 5% in the CICU patients and a lower readmission rate of the PACU (n=4) vs.

the CICU (n=7) patients from step-down unit (IMC) to the CICU without reaching to significance level.¹⁵ Zhu *et al* reported a risk of re-intubation in the fast-track group of 1.4% and in the conventional group of 1.7%, which is lower as in our study.³ However, this study is underpowered to allow any conclusion to the re-intubation rate compared to other studies.

The limitation of our study is that it is an observational study with no control group. The study is limited to CICU stay and hence 30-day post-operative morbidity or mortality was not recorded and analysed. The majority of the patients were CABG patients and hence the success and failure in other group of patients (valve plus combined procedures) could not be inferred due to scarce data.

CONCLUSION

This study has reinforced the safety of FTE in adult open-heart cardiac surgery patients predominantly the elective CABG and has determined success and failure rate as a preliminary estimate of FTE. The perioperative parameters were significantly better in success group. To implement the practice in its full capacity and benefit, a fast track protocol needs to be devised to standardize the current practices. Fast track practice implementation guidelines should be disseminated to CICU staff and junior anaesthesiologists to avoid undue delay in FTE and to utilize the operating room and CICU efficiently.

Acknowledgement: We would appreciate the support of Mr. Sadaqat Ali for data collection, Mr. Amir Raza and Ms. Feroza Nazir for data analysis and results finalization in tabulated format. Special thanks to Ms. Asma Husnain and Dr. Shiraz Hashmi for critical review of the scientific contents and proof reading.

AUTHORS' CONTRIBUTION

MIA: Conception of research question plus its completion (manuscript). HS: Review of scientific content of manuscript. MH: Review of scientific content/ writing of protocol. KS: Review of manuscript and writing of initial protocol. FHK: Review of manuscript

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Received: 29 October, 2016

Revised: 6 December, 2016

Accepted: 11 December, 2016

Address for Correspondence:

Dr. Mohammad Irfan Akhtar, Department of Anaesthesia, Aga Khan University Hospital, PO Box 3500, Stadium Road, Karachi-Pakistan

Cell: +92 334 370 1250

Email: mohammad.irfan@aku.edu