Original Article

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FAST TRACKING IN PEDIATRIC CARDIAC ANESTHESIA - A QUALITY IMPROVEMENT INITIATIVE AT A TERTIARY CARDIAC CARE CENTER

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ABSTRACT

Objective: To determine the outcome of fast tracking patients after congenital cardiac surgery and to evaluate the factors associated with delays in fast tracking and to identify the reasons for delays.

Study Design: Prospective descriptive cross-sectional study

Place and Duration of Study: The study was conducted at Department of Pediatric cardiac Anesthesiology and PICU at AFIC-NIHD Rawalpindi from Jan 2015 to Jan 2016.

Material and Methods: A total of 172 patients were selected through non-probability consecutive sampling over a period of 1 year i.e. from January 2015 to January 2016. Patients who met the inclusion criteria were selected and they were grouped as fast tracked and non-fast tracked. Data collection tool was developed to measure the demographics, clinical findings, complications and final outcome of patients who underwent congenital cardiac surgery. Data entries were done on SPSS version-22 and on excel sheets. Root cause analysis was done by applying statistical quality control tools.

Result: A total of 172 patients were enrolled in this study, this equates to around 15 patients per month. Included children had a mean age of 4.3 ± 3.5 years and mean weight 14.24 ± 9.7 kg. 110 (64%) were male and 62 (36%) were females. Mean length of hospital stay was 13.98 ± 7.1 days and median P.ICU stay was 2.1 ± 2.75 days. 87 (50.6%) patients fast tracked successfully and remaining 85(49.4%) stayed overnight in PICU due to some complications.

Conclusion: Fast tracking is feasible and beneficial in numerous studies, including ours. Fast tracked patients have overall good outcome by having less complications, shorter PICU and hospital stay.

Keywords: Fast track, Delayed fast track, Reintubation, Paeds intensive care unit (PICU).

INTRODUCTION

Fast-tracking in cardiac surgery refers to the concept of early extubation, mobilization and hospital discharge in an effort to reduce costs and peri-operative morbidity[1,2]. Fast-tracking in cardiac surgery refers to the concept of early extubation within 4-6hr of surgery, low inotropic score, early mobilization and hospital discharge in an effort to reduce costs and peri-operative morbidity[1,2]. Benchmarks for fast tracking: Patient must be mobile; ICU stay must be less than 3days and extubated within 4-6 hrs after cardiac surgery[1,2,5]. Outcome (primary and secondary) - An outcome variable of interest in the trial (also called an end point). Differences between groups in the outcome variable(s) are believed to be the result of the differing interventions. The primary outcome is the outcome of greatest importance. Data on secondary outcomes are used to evaluate additional effects of the intervention[7].

Fast tracking is not restricted to anesthetic management and is only made possible by using effective multidisciplinary patient management strategies. We will evaluate fast tracking of paediatric cardiac surgery patients by using relevant statistical quality control tools inclusive of currently used anesthetic techniques, patient selection, and available information about the safety and patient outcome associated with this approach. Mittnacht and Hollinger mentioned early extubation as almost a necessity as only unreliable ventilators not suitable for prolonged mechanical ventilation in small children, and sedative drugs with unknown effects in this patient population were available[3]. In most studies, early extubation refers to tracheal

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extubation within a few hours (4–8 hours) after surgery, although functionally it means the avoidance of routine, overnight mechanical ventilation[8]. Although highly individualized among the various heart surgery centers, the fast-track process is a team activity. It requires a team of health care providers to interact with the patient at various phases, from admission to discharge. The necessary elements of the fast-track program are choice and the titration of short-acting anesthetic drugs, standardized surgical procedures, early extubation, rewarming and sustained postoperative normothermia, postoperative pain control, early ambulation, alimentation and discharge, and follow-up after discharge. The factors influencing the decision to early extubation are summarized (fig-3).

Objectives

To determine the outcome of fast tracking patients after congenital cardiac surgery.

To evaluate the factors associated with delays in fast tracking and to identify the reasons for delays.

Table-1: Factors associated with delays in fast tracking (n=172).

Variables	Fast tracked (n=87)50.6%	Non-fast tracked (n=85) 49.4%	*p*-value
Demographics			
Age	59.89 ± 39.05	44.8 ± 42.8	0.014
Gender : Male Female	 53 (60.9%) 34 (30.1%)	 57 (67%) 28 (33%)	0.261
Procedural outcomes			
CPB time	54.87 ± 34.9	75.38 ± 59.5	0.009
Cross clamp time	30.97 ± 26.1	44.89 ± 41.9	0.014
PICU stay (hours)	48.3 ± 32.9	116.02 ± 74.05	<0.001
Hospital stay (days)	11.08 ± 4.74	16.95 ± 7.85	0.001
Ventilation time	8.72 ± 20.1	43.06±47.9	0.001
Mortality	02 (2.3%)	07 (8.2%)	0.166
Complications			
Pulmonary hypertension	05 (5.7%)	19 (22.35%)	0.003
Inotropic support: Mild Moderate High No ionotrope	 43 (49.4%) 27 (31.1%) 06 (6.89%) 11 (12.6%)	 28 (32.9%) 29 (34.1%) 26 (30.6%) 02 (2.35%)	<0.001
Pulmonary edema	01 (1.14%)	07 (8.23%)	0.032
Reintubation	04 (4.7%)	20 (23.5%)	0.001
Respiratory distress	02 (2.29%)	10 (11.76%)	0.032
sepsis	00	03 (3.53%)	0.246
Chest infection	00	02 (2.35%)	0.497
Low cardiac output	02 (2.29%)	11 (12.9%)	0.018
Bronchospasm	00	05 (5.9%)	0.029
Bleeding	00	06 (7.1%)	0.029
Arrhythmia	05 (5.74%)	19 (22.4%)	0.003

MATERIAL AND METHODS

Prospective data was collected and a total of 172 patients were selected through non-probability consecutive sampling over a period of 1 year.

Criteria for Extubation

Neurological: Awake, responding to verbal commands, co-operative, able to deep breath and cough in relatively elder children. Playful, eye to eye contact of children less than 2 years of age. Cardiac: MAP> or = 50mmHg, stable, no dysrrhythmias. Respiratory: respiratory rate between 12 to 40 per min, pH not < 7.30, MIP is equal to 25cm of H2O, acceptable chest X-ray, no pulmonary edema and pneumonic consolidation, no pneumothorax etc. Renal: urine output>=2 ml/Kg/hr, no signs of marked fluid overload. Hematological: minimal tube drainage i.e. not > 1ml/Kg/hr during last 2 hr. Temperature: core temperature between 35-38^{o} C, core peripheral temperature gap NOT > 4^{o}C. Selective patients less than 12 year of age have undergone congenital cardiac surgery in paeds cardiac department were included. Patients having complex congenital cases like: ASO (arterial switch operation), CAVSD, TOF with PA stenosis (PA patch plasty), hypoplastic left heart syndrome, rastelli procedures were excluded. Patients who meet the inclusion criteria were selected and they will be grouped as fast tracked and non-fast tracked. Data collection tool was developed to measure the demographics, clinical findings, complications and final outcome of patients who undergone congenital cardiac surgery. Data entries were done on SPSS version-22 and on excel sheets. Comparison was made between fast tracked and non-fast tracked group. *p*-value <0.05 was considered to be significant. Root cause analysis was done by applying statistical quality control tools including control chart, pareto chart and fishbone diagram[4].

Considerations, which influence the decision to early extubation	
Patient factors	Limited cardio respiratory reserve of the neonate and infant. Pathophysiology of specific congenital heart defects. Timing of surgery and preoperative management
Anaesthetic Factors	Premedication Haemodynamic stability and reserve Drug distribution and maintenance of anaesthesia on CPB Postoperative analgesia
Surgical Factors	Extent and complexity of surgery Residual defects Risks for bleeding and protection of suture lines
Conduct of CPB	Degree of hypothermia Level of haemodilution Myocardial protection Modulation of the inflammatory response and reperfusion injury
Postoperative Management	Myocardial function Cardiorespiratory interactions Neurological recovery Analgesia management

RESULTS

A total of 172 patients were enrolled in this study Included children had a mean age of 4.3 ± 3.5 years, mean height was 22.7± 26.02 inches and mean weight 14.24 ± 9.7 kg. No relationship was found between age, height or weight and fitness to fast track. 110 (64%) were male and 62 (36%) were females. Mean length of hospital stay for the whole cohort was 13.98± 7.1 days and median P.ICU stay was 2.1 ± 2.75 days. Mean CPB time and cross clamp time was 65.5 ± 50.4 min and 38.4 ± 36.1 min respectively.

We sought to determine that there was a difference in postoperative management and complication rates between patients who were fast-tracked and those who were not. Of the 172 patients, 87 (50.6%) fast tracked successfully and remaining 85(49.4%) extubated latterly (>8hrs) due to some complications or clinical requirement of surgery. As shown in table1 the had low cardiac output or problems with bleeding/coagulation 06 (3.5%), sepsis in 03 (1.7%), few patients were having anatomical deformities including dextrocardia 01 (0.6%), structural abnormality 04 (2.3%) and residual defect after congenital surgery 02 (1.2%). Control chart (fig-1) showed the extubation time of patients, higher peaks show longer

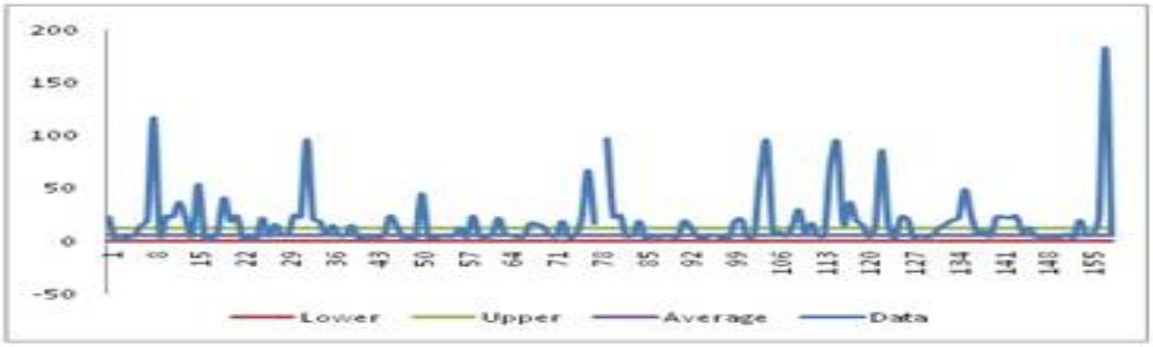

Figure-1: Control chart of extubation time (avg: 6, upper: 12, lower: 0).

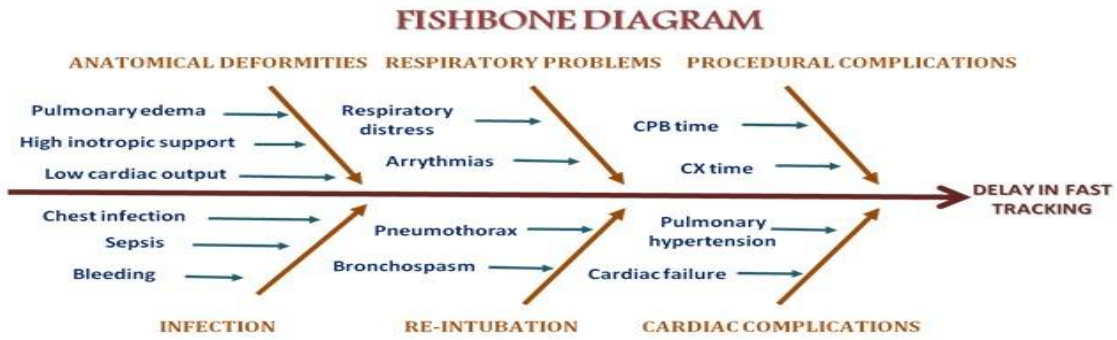

Figure-2: Fishbone diagram showing the factors which cause the delay in fast tracking.

cohort included 87 (50.6%) who were extubated within 6 hours after congenital heart surgery and 70 (40.7%) who were extubated in 12 hours. Therefore, overall, 112 patients (65.1%) were deemed clinically fit to fast track, out of which 04(4.7%) reintubated and 85 patients (49.4%) were unfit since they stayed overnight in PICU for clinical reasons. These were mainly respiratory complications including re-intubation 04 (4.7%), arrhythmia 24 (14%), bronchospasm 05 (2.9%) and respiratory distress 12(7%), chest infection was in 02 (1.2%), pneumothorax 01 (0.6%), cardiovascular instability requiring high inotropes or vasodilators 32 (18.6%), cardiac failure 08 (4.7%), pulmonary hypertension 24 (14%), pulmonary edema 08 (4.7%), 13 (7.6%) patients extubation time; 6hr was taken as the average limit and 12hr to be upper limit. Table-1 shows the results of factors potentially associated with delays to fast track. *p*-value <0.05 is find to be significant, as shown in table1 procedural outcomes and complications are the main causes of delayed fast tracking. Factors which are responsible for the delays in fast tracking has been shown in fishbone diagram (fig-2). The complications associated with delays in fast tracking are shown by pareto chart in fig-3.

DISCUSSION

Fast-track surgery is not a new concept; it was common practice in the UK in the 1960s and 1970s due to the older patient population, limited drug availability and inferior ventilator

technology of the time. For similar reasons, fast track practices remain a mainstay of treatment for congenital heart surgery in the developing world[6,14,15]. As the complexity of case mix and available technology have evolved in the 1990s and beyond, prolonged postoperative ventilation has become more common after open-heart surgery[10,12]. Over the past few years there has been a change in surgical management techniques for certain congenital heart defects, moving away from initial palliation with delayed repair towards early primary repair[16,17].

The aims of a fast-track program are the simplification of postoperative care[1,3] and, it is hoped, an increase patient and parent satisfaction. There are also economic considerations in terms ofcost effectiveness, associated with reduced consumption of intensive care and hospital resources. Any new program should ensure that the practice is safe, with no increased risk to patients, hence the need for a multidisciplinary audit[18].

No significant difference in the pre-operative condition or the co-morbidities of the patients. Early extubation reduces length of stay in both high dependency units and overall hospital stay. Early extubation has a lower re-intubation rate[10]. Much larger volume of IV fluids given in the first 12 hours in the CICU groups, Red blood cell transfusions associated with a greater risk of infection, ischemic postoperative morbidity, hospital stay and increased early and late mortality 11-13 Inotrope usage is also associated with increased hospital stay and mortality[6]. Prolonged length of time CVP lines are left in situ increases the risk of sepsis associated with multi-organ dysfunction, prolonged ITC stay and in hospital mortality[15,16]. Less time spent in a critical care environment by those fast tracked. No respiratory complications in those fast tracked due to early extubation. Early ambulation associated with early extubation and transfer to ward environment – less DVT/PE. Longer CPB time is also repeatedly reported to be associated with prolonged mechanical ventilation following CHD surgery[12,13,16]. This is not surprising; since longer CPB time is required for more complex cases or if unexpected difficulties occur. Furthermore, longer CPB time is associated with an increased risk of inflammatory response syndrome with generalized edema, decreased respiratory compliance, acute lung injury, and coagulopathy, all of which affect the ability to extubate a patient soon after surgery[19].

Preoperative pulmonary hypertension has not been consistently cited as risk factors for prolonged mechanical ventilation in children undergoing surgery for CHD[10], significant pulmonary hypertension (PHT) following CPB (e.g. greater than two third systemic right sided pressures) would probably be considered by most practitioners as a contraindication for an early extubation strategy. Down's syndrome has also been documented to be a predisposing risk factor for failure to extubate early[19]. Typically it is the younger child undergoing complex surgery requiring a long CPB/aortic cross clamp time, with significant hemodynamic support that requires prolonged mechanical ventilation[17,18]. Despite these

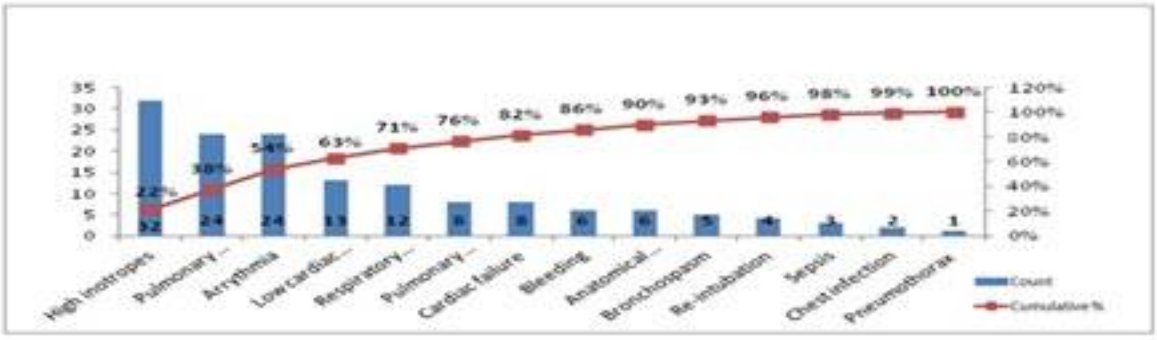

Figure-3: Pareto chart showing the complications associated with delays in fast tracking.

considerations, there are certain factors that are consistently associated with failure of early extubation and fast-tracking. Younger age is frequently found to be associated with prolonged mechanical ventilation following CHD surgery[15].

The Society of Thoracic Surgeons database was queried and 713 matched pairs were identified. Extubation in the operating room resulted in reductions in ICU and hospital LOS of almost 1 day each. The magnitude of reported cost reduction in adult cardiac surgery matches our findings as patients who were fast tracked within 4-6 hrs were having reduced hospital and ITC stay and were having very less complications. Cheng et al published their results of a prospective, randomized trial in adult patients undergoing coronary artery bypass grafting >20 years ago. Early endotracheal extubation and fast tracking resulted in a 25% reduction of costs and a 15% increase in case volume while slightly decreasing complications[6].

CONCLUSION

We determined that there was a difference in postoperative management and complication rates between patients who were fast-tracked and those who were not. Fast tracking is feasible and beneficial in numerous studies, including ours. Fast tracked patients have overall good outcome by having less complications, shorter PICU and hospital stay. All patients who are 'fast-trackable' should be fast-tracked whenever feasible. Time pressures in recovery should not preclude patients from being fast-tracked.

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CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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