The Role of Fast Track Extubation in Enhance Recovery after Pediatric Cardiac Surgery

ABSTRACT:

Background: By allowing patients to be extubated from their ventilators in the intensive care unit (ICU) as soon as they have stabilized, fast-track anesthesia (FTA) hastens the return to full awareness and independent breathing after surgery.

Objective: In this study our main goa is to evaluate the role of fast track extubation in enhance recovery after pediatric cardiac surgery.

Method: This prospective study was carried out at tertiary hospital from January 2021 to January 2022 where total of 200 CHD children, aged 6 months to 2 years and admitted to tertiary hospital, were selected for this study. During the study, 200 patients were randomly divided into two groups each consisting of 100 patients, and were subjected to fast track anesthesia and conventional anesthesia before surgeries.

Results: During the study, in fast track anesthesia group mean age was 1.2 ± 0.5 years, followed by 55 cases were female, 47 were preterm patients, mean anesthesia times was 3.5 ± 1.2 h, mean surgery time was 295.1 ± 22.9 min, mean CPB time was 47.2 ± 11.8, mean block time was 30.2 ± 8.9. whereas in conventional anesthesia group, mean age was 1.1 ± 0.5 years, followed by 40 cases were female, 45 were preterm patients, mean anesthesia times was 3.2 ± 1.0 h, mean surgery time was 288.0 ± 20.5 min, mean CPB time was 46.2 ± 10.7, mean block time was 31.5 ± 9.1. in fast track group mean extubation time was 22.9 ± 3.5 min followed by mean postoperative hospital stay was 11.5 ± 3.0 days, besides that, at extubation SAS score was 3.8 ± 0.6a and 24h postoperation SAS score was 4.0 ± 0.5. Whereas in conventional group mean extubation time was 189.1 ± 31.2 min followed by mean postoperative hospital stay was 16.1 ± 2.4, besides that, at extubation SAS score was $4.8 \pm 0.7$and 24h postoperation SAS score was 3.9 ± 0.5. the number of patients with ventilator-associated pneumonia was less in fast track group than in conventional group ($P < 0.05$). In fast track group arrhythmia cases were seen in 1% cases followed by 1% infection cases were seen, bleeding seen in 1%. Whereas in conventional group arrhythmia cases were seen in 2% cases followed by 1% infection cases were seen, bleeding seen in 2%.

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Conclusion: Fast Track Anesthesia generates stable hemodynamics during operation, shorter extubation time, shorter ICU and hospitalization stay without increase in adverse reactions. It is worthy of recommendation for clinical practice.

Keywords: Fast Track Anesthesia, cardiac surgery, congenital anesthesia.

INTRODUCTION

For patients to regain awareness and control of their breathing as quickly as possible following surgery, fast-track anesthesia (FTA) allows for extubation in the intensive care unit (ICU) within 6 hours. Since the 1990s [1, 2], it has been used successfully in cardiac surgery without risk to patients. In addition to reducing ventilator-related problems, FTA also shortens the length of time patients spend in the intensive care unit (ICU), uses fewer resources, and costs less money [3, 4]. After fast-track anesthesia, ultra-fast tract anesthesia (UFTA) was created to make even better use of healthcare resources. In a UFTA, extubation occurs inside the operating room during the first hour following surgery [6]. UFTA has been shown to improve postoperative outcomes in terms of complication rate, hemodynamic performance, and length of intensive care unit (ICU) stay [7–9].

Up to one percent of all newborns are born with a congenital heart defect (CHD), making it the most frequent kind of fetal abnormalities. Brain damage and delays in brain development are common in children with congenital heart disease [10, 11]. Among the many possible therapies [12, 13], surgical intervention is quite prevalent. Medicinal and cardiac surgical treatments benefit greatly from anesthesia methods. Improvements in anesthetic care should lessen hazards associated with the operations, such as cardiovascular and pulmonary problems from anesthesia and sedation and a possibly underappreciated risk of neurocognitive impairment [14].

In this study our main goa is to evaluate the role of fast track extubation in enhance recovery after pediatric cardiac surgery.

OBJECTIVE

To asses the role of fast track extubation in enhance recovery after pediatric cardiac surgery.

METHODOLOGY

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This was a prospective study. Where total of 200 CHD children, aged 6 months to 2 years and admitted to tertiary hospital, were selected for this study. They weighted 5 to 10 kg with the American Society of Anesthesiologists (ASA) physical status III and IV. Children were excluded if they had respiratory tract infection within 2 weeks of surgery and organ complications. Children were also excluded if they could not interrupt ventilation during cardiopulmonary bypass (CPB) and had severe pulmonary hypertension before operation. During the study 200 patients were randomly divided into two groups each consisting of 100 patients, and were subjected to fast track anesthesia and conventional anesthesia before surgeries.

RESULTS

Table-1 shows demographic status of the patients where in fast track anesthesia group mean age was 1.2 ± 0.5 years, followed by 55 cases were female, 47 were preterm patients, mean anesthesia times was 3.5 ± 1.2 h, mean surgery time was 295.1 ± 22.9 min, mean CPB time was 47.2 ± 11.8, mean block time was 30.2 ± 8.9. whereas in conventional anesthesia group, mean age was 1.1 ± 0.5 years, followed by 40 cases were female, 45 were preterm patients, mean anesthesia times was 3.2 ± 1.0 h, mean surgery time was 288.0 ± 20.5 min, mean CPB time was 46.2 ± 10.7, mean block time was 31.5 ± 9.1. The following table is given below in detail:

Table-1: Demographic status of the patients

Variable	Fast track anesthesia, n=100	Conventional Anesthesia, n=100	P value
Mean Age	1.2 ± 0.5	1.1 ± 0.5	0.331
Male/Female	45/55	60/40	0.233
Body weight (kg)	9.5 ± 1.0	9.1 ± 1.1	0.289
No. pre-term patients	47	45	0.782
ASAIII /VI (no.)	55 / 45	47 / 53	0.254
Anesthesia time (h)	3.5 ± 1.2	3.2 ± 1.0	0.342
Surgery time (min)	295.1 ± 22.9	288.0 ± 20.5	0.551
CPB time (min)	47.2 ± 11.8	46.2 ± 10.7	0.234
Block time (min)	30.2 ± 8.9	31.5 ± 9.1	0.331

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In table-2 shows Comparison of MAP, HR and CVP between children undergoing fast track anesthesia and conventional anesthesia group where no significant changes were noticed between two group. The following table is given below in detail:

Table-2: Comparison of MAP, HR and CVP between children undergoing fast track anesthesia and conventional anesthesia group

Parameters	Anesthesia	T_0	T_1	T_2	T_3	T_4	T_5
MAP (mmHg)	fast track	60.9 ± 5.6	56.9 ± 4.2	56.6 ± 4.1	50.2 ± 5.4	30.1 ± 2.2	59.4 ± 3.9
	Conventional	60.5 ± 5.3	57.3 ± 4.0	56.4 ± 4.5	49.6 ± 4.8	29.5 ± 2.4	61.4 ± 4.2
HR (time/m)	fast track	130.4 ± 4.3	129.3 ± 4.3	124.4 ± 4.9	128.4 ± 4.3	/	136.4 ± 4.6
	Conventional	129.4 ± 4.1	130.4 ± 4.1	131.4 ± 4.3	131.4 ± 4.3	/	137.2 ± 4.8
CVP (mmHg)	fast track	4.5 ± 0.9	4.9 ± 0.7	5.3 ± 1.0	5.3 ± 1.1	/	6.4 ± 0.3
	Conventional	4.6 ± 0.8	5.0 ± 0.9	5.2 ± 1.2	5.2 ± 1.0	/	6.8 ± 0.5

In table-3 shows Comparison of extubation time, ICU stay, postoperative hospital stay and SAS scores in study group where in fast track group mean extubation time was 22.9 ± 3.5 min followed by mean postoperative hospital stay was 11.5 ± 3.0 days, besides that, at extubation SAS score was 3.8 ± 0.6a and 24h postoperation SAS score was 4.0 ± 0.5. Whereas in conventional group mean extubation time was 189.1 ± 31.2 min followed by mean postoperative hospital stay was 16.1 ± 2.4, besides that, at extubation SAS score was 4.8 ± 0.7and 24h postoperation SAS score was 3.9 ± 0.5.The following table is given below in detail:

Table-3: Comparison of extubation time, ICU stay, postoperative hospital stay and SAS scores in study group

Variable	Fast track group	Conventional group

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Extubation time (min)	22.9 ± 3.5	189.1 ± 31.2
Postoperative hospital stay (d)	11.5 ± 3.0[a]	16.1 ± 2.4
SAS score	**Fast track group**	**Conventional group**
At extubation	3.8 ± 0.6[a]	4.8 ± 0.7
6 h- postoperation	3.9 ± 0.4	3.9 ± 0.6
12 h- postoperation	4.0 ± 0.6	4.0 ± 0.6
24 h- postoperation	4.0 ± 0.5	3.9 ± 0.5

In figure-1 shows Comparison of ventilator-associated pneumonia and continuous positive airway pressure use and reintubation rate between children undergoing fast track anesthesia and conventional anesthesia where Other anesthesia-related parameters such as the incidence of continuous positive airway pressure (CPAP) use and reintubation rate were similar between the two groups, but the number of patients with ventilator-associated pneumonia was less in fast track group than in conventional group ($P < 0.05$). The following figure is given below in detail:

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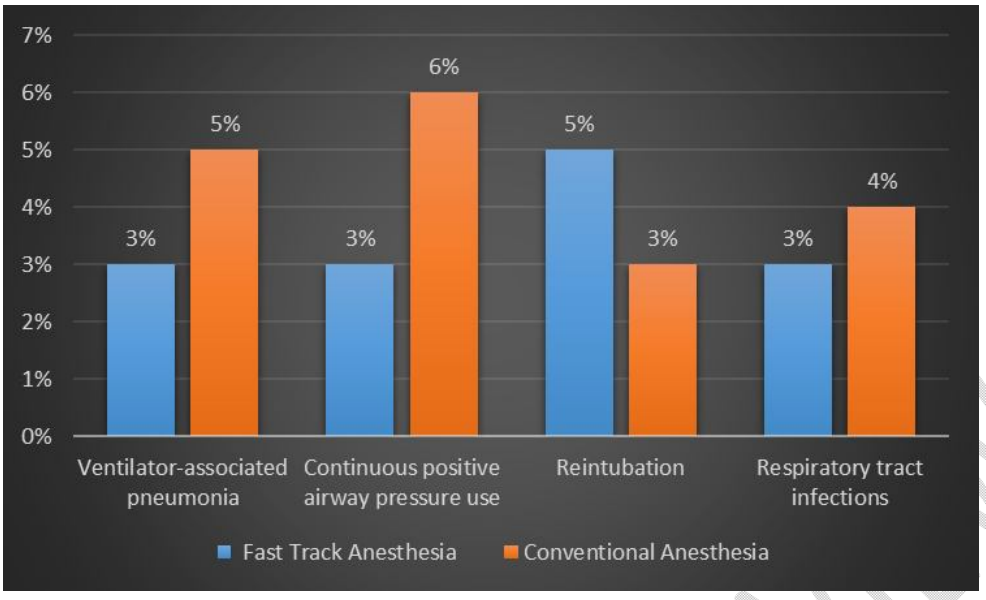

Figure-1: Comparison of ventilator-associated pneumonia and continuous positive airway pressure use and reintubation rate between children undergoing fast track anesthesia and conventional anesthesia

In figure-2 shows Comparison of adverse events between children undergoing fast track anesthesia and conventional anesthesia where in fast track group arrhythmia cases were seen in 1% cases followed by 1% infection cases were seen, bleeding seen in 1%. Whereas in conventional group arrhythmia cases were seen in 2% cases followed by 1% infection cases were seen, bleeding seen in 2%. The following figure is given below in detail:

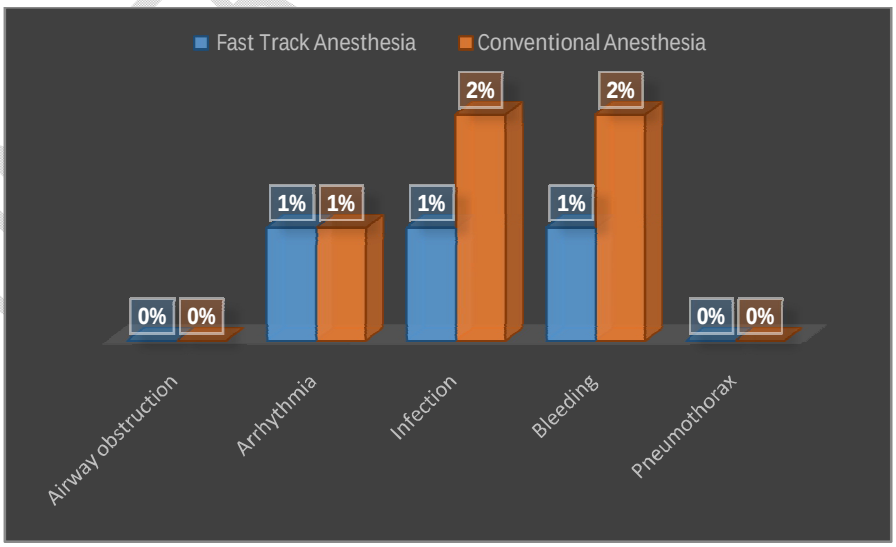

Figure-2: Comparison of adverse events between children undergoing fast track anesthesia and conventional anesthesia

DISCUSSION

Our results show that the extubation time is significantly shorter in the fast track group than in conventional group. Furthermore, the ICU stay and hospitalization stay are also shorter. No serious hemodynamic changes, nor serious complications are observed in neither groups, confirming that fast track anesthesia is safe for anesthesia management in CHD operation.

Fast Track anesthesia was developed to optimize perioperative anesthesia operations and management to shorten intubation time after operation for fast recovery of patients. A Meta-analysis of randomized controlled trials with large sample size showed that compared with conventional anesthesia management, UFTA is relatively low-risk and safe in terms of fatality and mortality with shorter extubation time and ICU stay. [10]

Prolonged tracheal intubation and mechanical ventilation are major risk factors for respiratory-related complications. [11] A large number of studies have shown that compared with conventional anesthesia management for cardiac surgery, extubation in the operating room after surgery reduces the use of muscle relaxants, facilitates the restoration of spontaneous breathing, decreases the risks of ventilator-related iatrogenic lung inflammation, respiratory tract damage and other pulmonary complications. [12]

A propensity score matching analysis showed that the use of fast track anesthesia in patients with low to moderate risks of cardiac surgery would improve cost-effectiveness and outcomes as compared to conventional anesthesia management . [13] A prospective observational study showed that extubation in the operating room was successful in 87.1% of the patients without any increase in mortality and morbidity, but with a decrease in ICU length of stay and less use of hospital resources. [14]

For CHD surgery, the optimization in fast track anesthesia mainly includes perioperative anesthesia managements, such as anesthesia method, selection of anaesthetics, control of perioperative body temperature and postoperative analgesia. In the present study, all children were given a combined intravenous-inhalational anesthesia with sufentanil before CPB. The anesthetic depth was adjusted based on the circulation to reduce the stress induced by extubation and thoracotomy.

Remifentanil and propofol infused through the veins after postoperative rewarming in the fast track anesthesia group, which was used to provide sedative and analgesic effect and minimize surgical stimulation-induced stress and intraoperative awareness, are ultra-short-acting. They

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also reduce the dose of sufentanil during operation for better early extubation and postoperative respiratory depression and duration of ventilation time. Studies have also shown that reducing the use of narcotics and analgesics help the recovery of pulmonary function and gastrointestinal function. [15]

Perioperative body temperature is a major factor affecting extraction after cardiac surgery. [16] In the present study, body temperature was kept above 36.0 °C. This would accelerate the metabolism of anesthetics and muscle relaxants for better homeostasis of internal environment. Postoperative analgesia can affect extubation and prognosis after cardiac surgery. We used ropivacaine and dexmedetomidine combined with morphine for analgesia in UTFA group. The outcomes are satisfactory and no adverse events such as post-operative agitation were observed. This is important for better and early recovery of pulmonary function.

CONCLUSION

Fast Track Anesthesia generates stable hemodynamics during operation, shorter extubation time, shorter ICU and hospitalization stay without increase in adverse reactions. It is worthy of recommendation for clinical practice.

REFERENCE

1. Akhtar MI, Hamid M, Minai F, Wali AR, Anwar Ul H, Aman-Ullah M, Ahsan K. Safety profile of fast-track extubation in pediatric congenital heart disease surgery patients in a tertiary care hospital of a developing country: an observational prospective study. J Anaesthesiol Clin Pharmacol. 2014;30(3):355–9.
2. van Mastrigt GA, Maessen JG, Heijmans J, Severens JL, Prins MH. Does fast-track treatment lead to a decrease of intensive care unit and hospital length of stay in coronary artery bypass patients? A meta-regression of randomized clinical trials. Crit Care Med. 2006;34(6):1624–34.
3. Zhu F, Lee A, Chee YE. Fast-track cardiac care for adult cardiac surgical patients. Cochrane Database Syst Rev. 2012;10:CD003587.
4. Svircevic V, Nierich AP, Moons KG, Brandon Bravo Bruinsma GJ, Kalkman CJ, van Dijk D. Fast-track anesthesia and cardiac surgery: a retrospective cohort study of 7989 patients. Anesth Analg. 2009;108(3):727–33.

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5. Cheng DC, Wall C, Djaiani G, Peragallo RA, Carroll J, Li C, Naylor D. Randomized assessment of resource use in fast-track cardiac surgery 1-year after hospital discharge. Anesthesiology. 2003;98(3):651–7.

6. Djaiani GN, Ali M, Heinrich L, Bruce J, Carroll J, Karski J, Cusimano RJ, Cheng DC. Ultra-fast-track anesthetic technique facilitates operating room extubation in patients undergoing off-pump coronary revascularization surgery. J Cardiothorac Vasc Anesth. 2001;15(2):152–7.

7. Zayat R, Menon AK, Goetzenich A, Schaelte G, Autschbach R, Stoppe C, Simon TP, Tewarie L, Moza A. Benefits of ultra-fast-track anesthesia in left ventricular assist device implantation: a retrospective, propensity score matched cohort study of a four-year single center experience. J Cardiothorac Surg. 2017;12(1):10.

8. Kianfar AA, Ahmadi ZH, Mirhossein SM, Jamaati H, Kashani BS, Mohajerani SA, Firoozi E, Salehi F, Radmand G, Hashemian SM. Ultra fast-track extubation in heart transplant surgery patients. Int J Crit Illn Inj Sci. 2015;5(2):89–92.

9. Meissner U, Scharf J, Dotsch J, Schroth M. Very early extubation after open-heart surgery in children does not influence cardiac function. Pediatr Cardiol. 2008;29(2):317–20.

10. Andropoulos DB, Hunter JV, Nelson DP, Stayer SA, Stark AR, McKenzie ED, Heinle JS, Graves DE, Fraser CD Jr. Brain immaturity is associated with brain injury before and after neonatal cardiac surgery with high-flow bypass and cerebral oxygenation monitoring. J Thorac Cardiovasc Surg. 2010;139(3):543–56.

11. Miller SP, McQuillen PS, Hamrick S, Xu D, Glidden DV, Charlton N, Karl T, Azakie A, Ferriero DM, Barkovich AJ, et al. Abnormal brain development in newborns with congenital heart disease. N Engl J Med. 2007;357(19):1928–38.

12. Miatton M, De Wolf D, Francois K, Thiery E, Vingerhoets G. Neuropsychological performance in school-aged children with surgically corrected congenital heart disease. J Pediatr. 2007;151(1):73–8 78 e71.

13. Larsen SH, Emmertsen K, Johnsen SP, Pedersen J, Hjortholm K, Hjortdal VE. Survival and morbidity following congenital heart surgery in a population-based cohort of children--up to 12 years of follow-up. Congenit Heart Dis. 2011;6(4):322–9.

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14. Char D, Ramamoorthy C, Wise-Faberowski L. Cognitive dysfunction in children with heart disease: the role of anesthesia and sedation. Congenit Heart Dis. 2016;11(3):221–9.

15. Borracci RA, Ochoa G, Ingino CA, Lebus JM, Grimaldi SV, Gambetta MX. Routine operation theatre extubation after cardiac surgery in the elderly. Interact Cardiovasc Thorac Surg. 2016;22(5):627–32.

16. Berghmans JM, Poley MJ, van der Ende J, Weber F, Van de Velde M, Adriaenssens P, Himpe D, Verhulst FC, Utens E. A visual analog scale to assess anxiety in children during anesthesia induction (VAS-I): results supporting its validity in a sample of day care surgery patients. Paediatr Anaesth. 2017;27(9):955–61

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