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

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## 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.

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**Method:** This prospective study was carried out at tertiary hospital from January 2021 from 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 or a total allocated amount of time for a surgeon 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 post operation 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 post operation SAS score was 3.9 ± 0.5. MAP, HR and CVP between children outcome was measured based different time interval (T0 to T5) Moreover, no significant changes were noticed between two group.

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%.

**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; Riker Sedation-Agitation Scale (SAS).*

## 1. 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.

### 1.1 Objective

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

## 2. METHODOLOGY

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.

Before their respective procedures, the patients were randomly split into two groups of 97 (UFTA and conventional anesthesia, respectively). Surgeons, anesthesiologists, and post-operative doctors all worked together to carry out both operations. At rewarming, cis-atracurium was discontinued and remifentanil (0.3 g/kg/min) was administered for the UFTA group's children. Both propofol and remifentanil were stopped after skin closure had begun. Dexmedetomidine (1 g/kg/h) was continuously injected into the patients from the time of surgery until they were transferred to the intensive care unit. Ropinivacaine at a concentration of 0.375% was given to numb the area around the surgical incision after the procedure was complete. After a period of synchronized intermittent required breathing, patients were given the opportunity to breathe on their own (SIMV). Within 10 minutes of surgical completion, the patients were extubated and transferred to the intensive care unit (ICU) wearing a facemask to continue receiving oxygen ($SpO_2$ target: 94%-100%). At rewarming following cardiopulmonary bypass, children in the standard anesthetic group were given additional midazolam (0.05 mg/kg) and sufentanil (1 g/kg). Patients had their anesthetics tapered off after surgery and were sent to the intensive care unit to be fitted with a tracheal tube. Once vitals were reported to be normal, they were able to have the tubes removed. All kids had surgery without receiving any kind of pre-operative medication. In the operating room, vital signs such as heart rate, respiratory rate, and inspired oxygen saturation ($SPO_2$) were monitored. Inducing anesthesia was done using a combination of cis-atracurium (0.1-0.2 mg/kg), cis-atracurium, sufentanil, midazolam, atropine, and sufentanil (0.5-1.0 g/kg). Orotracheal intubation was used to provide mechanical ventilation. With a tidal volume (VT) of 10 ml/kg, a fraction of inspired oxygen ($FiO_2$) between 40 and 50%, a respiratory-exchange ratio (RR) between 22 and 24 breaths per minute, an inspiration-to-expiration (I:E) ratio of 1:2, and a partial pressure of carbon dioxide ($PETCO_2$) between 35 and 40 mm Hg, the patient was successfully ventilated. After the induction, the patient's blood pressure (BP) was measured with a radial artery catheter and central venous pressure (CVP) was monitored with a catheter in the right internal jugular vein. In addition to inhaling 1-2% sevoflurane, patients also received continuous infusions of propofol (3 mg/kg/h), cis-atracurium (0.1 mg/kg/h), and dexmedetomidine (1 g/kg/h) to maintain anesthesia during the procedure. According to the patient's hemodynamic status, the sevoflurane dosage was modified. Before the incision, the patient was given more midazolam (0.05 mg/kg) and sufentanil (1 g/kg).

When continuous positive airway pressure (CPB) began, sevoflurane was taken off the market. Statistics were performed using SPSS 20.0 for Windows (SPSS Inc., Chicago, IL, USA). One-sample Kolmogorov-Smirnov tests were used to examine whether or not continuous variables followed a normal distribution. Means and standard deviations (s.d.) were supplied for continuous variables following a normal distribution, whereas medians were given for those not following a normal distribution (interquartile range [IQR]). The independent samples Student's t test was used to compare the means of two continuous normally distributed variables. Pearson's 2 or Fisher's exact test was used to compare frequencies of categorical variables. For this study, significance was determined to exist when the P-value was less than 0.05.

## 3. 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 or a total allocated amount of time for a surgeon 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); A total allocated amount of time for a surgeon | 30.2 ± 8.9 | 31.5 ± 9.1 | 0.331 |

In Table 2 shows Comparison of MAP, HR and CVP between children undergoing fast track anesthesia and conventional anesthesia group where outcome was measured based different time interval ($T_0$ to $T_5$) Moreover, 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 in different time interval**

| Parameters | Anesthesia | $T_0$ | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
|---|---|---|---|---|---|---|---|
| MAP | 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 |
| (mmHg) | 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 | fast track | 130.4 ± 4.3 | 129.3 ± 4.3 | 124.4 ± 4.9 | 128.4 ± 4.3 | / | 136.4 ± 4.6 |
| (time/m) | Conventional | 129.4 ± 4.1 | 130.4 ± 4.1 | 131.4 ± 4.3 | 131.4 ± 4.3 | / | 137.2 ± 4.8 |
| CVP | fast track | 4.5 ± 0.9 | 4.9 ± 0.7 | 5.3 ± 1.0 | 5.3 ± 1.1 | / | 6.4 ± 0.3 |
| (mmHg) | 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 post operation 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 post operation 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 |
|---|---|---|
| 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- post operation | 3.9 ± 0.4 | 3.9 ± 0.6 |
| 12 h- post operation | 4.0 ± 0.6 | 4.0 ± 0.6 |
| 24 h- post operation | 4.0 ± 0.5 | 3.9 ± 0.5 |

In Fig. 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:

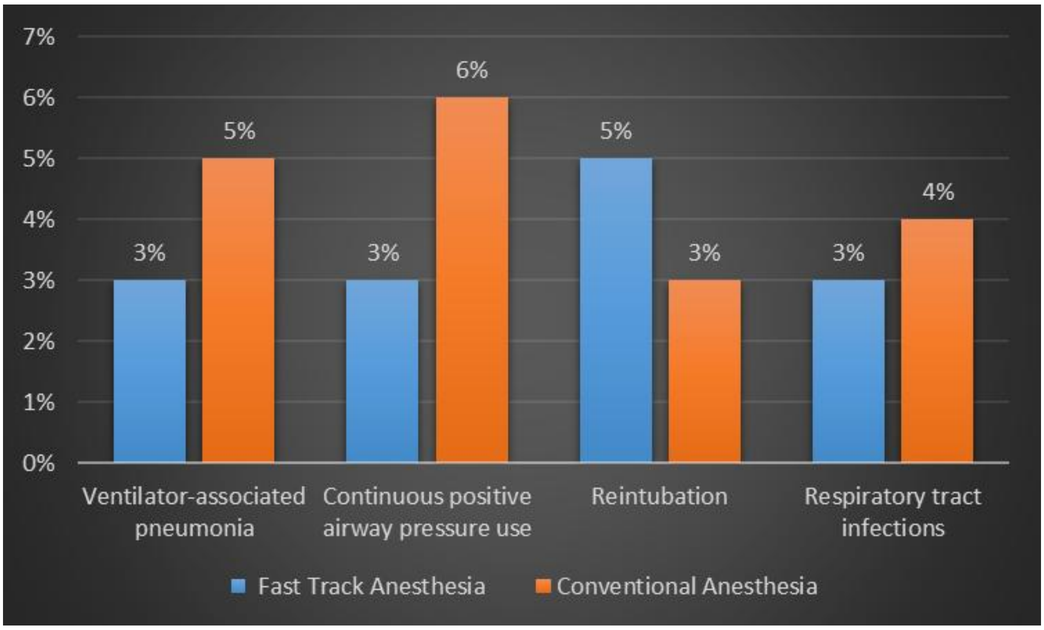


**Fig. 1. Comparison of ventilator-associated pneumonia and continuous positive airway pressure use and reintubation rate between children undergoing fast track anesthesia and conventional anesthesia**

In Fig. 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:

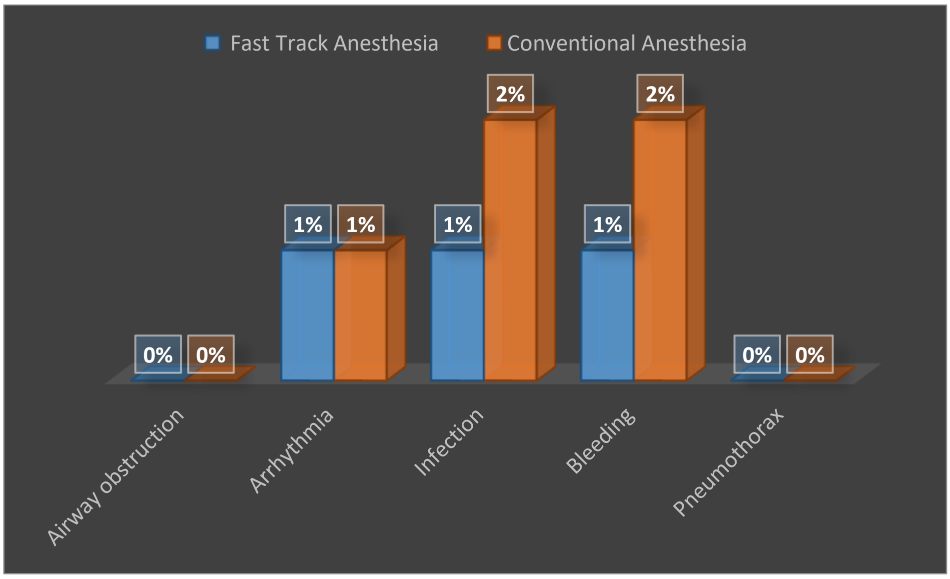


**Fig. 2. Comparison of adverse events between children undergoing fast track anesthesia and conventional anesthesia**

## 4. DISCUSSION

Our findings indicate that the fast track group's extubation time is much less than the conventional group's. Additionally, both the hospital stay and ICU stay are 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].

In our study, 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. which was quite similar to other study [11].

Besides that in one study, "extubation time, ICU stay and hospital stay were significantly shorter in the UFTA group than in conventional group" [12]. Which was quite similar to our study.

"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 an aesthetics, control of perioperative body temperature and postoperative analgesia [15]. All of the children in the current study received a combined intravenous-inhalational anaesthetic with sufentanil prior to CPB. In order to lessen the stress brought on the thoracotomy and extubation, the anesthetic depth was modified dependent on the circulation. "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 also reduce the dose of sufentanil during operation for better early extubating 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" [16].

"Perioperative body temperature is a major factor affecting extraction after cardiac surgery" [17]. 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.

## 5. CONCLUSION

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

## CONSENT

As per international standard or university standard, parental written consent has been collected and preserved by the author(s).

## ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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