

FAST-TRACK EXTUBATION IN RESOURCE LIMITED SETTING IN CARDIAC SURGERY: A RETROSPECTIVE ANALYSIS

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Abstract

Background: Fast-track extubation following cardiac surgery is gaining acceptance as a strategy for enhancing postoperative recovery and optimising resource utilisation. This retrospective study evaluated the safety and efficacy of fast-track extubation compared with conventional overnight ventilation in patients undergoing non-complex cardiac surgery. **Materials and Methods:** This retrospective, single-centre study was conducted at the Tamil Nadu Government Multi-Super-Speciality Hospital, Chennai, India, including 39 consecutive patients who underwent elective, non-complex cardiac surgery between January 2023 and April 2023. Patients were categorised into two groups: the fast-track extubation group (extubated within six hours postoperatively) and the conventional ventilation group. The baseline characteristics, intraoperative parameters, and postoperative outcomes, including ventilation duration, reintubation rate, and major adverse events, were compared. **Result:** Mean age was comparable between the groups ($p=0.616$). The cardiopulmonary bypass duration was longer in the conventional ventilation group, although the difference was not significant ($p=0.129$). Fast-track patients had a significantly lower mean ventilation time (316.00 ± 44.49 min) than the conventional group (414.17 ± 50.71 minutes) ($p<0.0001$). No significant differences were observed in the postoperative blood pressure, bleeding volume, blood transfusion, or preoperative ejection fraction. Importantly, no complications or reintubation events occurred in either group. **Conclusion:** Fast-track extubation following non-complex cardiac surgery is a safe and effective strategy even in resource-limited settings. It does not increase postoperative complications or reintubation rates, making it a viable alternative to the conventional overnight ventilation.

INTRODUCTION

Cardiopulmonary bypass (CPB) in cardiac surgery causes considerable physiological changes not only in the cardiovascular system but also in other organ systems. Even in individuals with an otherwise easy surgical course, resolving these alterations might take hours or days.^[1] As a result, it is usual clinical practice to keep patients sedated with artificial breathing until the morning following surgery. This approach mitigates the increased work of breathing, which would otherwise impose an additional burden on the myocardium during the period when cardiac function may still be compromised. Furthermore, continuous postoperative opioid sedation in patients following coronary surgery has been linked to a reduction in the incidence and severity of early postoperative myocardial ischaemia events, which

are associated with poor cardiac outcomes.^[2,3] Despite these issues, some studies have suggested that early extubation after cardiac surgery is possible and may even reduce the risk of complications. If proven effective, this technique might considerably improve the efficient use of intensive care resources during the critical postoperative period.^[4] Prolonged mechanical ventilation after heart surgery has been associated with poorer clinical outcomes, such as increased morbidity, higher healthcare expenditures, longer hospital stays, an increased risk of ventilator-associated infections, and higher risk-adjusted all-cause death.^[4,5] To assist early extubation, a variety of measures have been developed, including the use of short-acting, opioid-free anaesthetic procedures, implementation of early ventilator weaning protocols, and creation of extubation within 6 to 24 hours as a critical quality

benchmark. These efforts have resulted in extubation throughout the day, even overnight, despite possible resource constraints at these times.^[6] However, accumulating data show that overnight extubation may be linked with poor outcomes, such as an increased chance of reintubation and greater ICU and in-hospital death rates in mixed medical-surgical ICU populations. Whether these findings apply to heart surgery patients, who generally have shorter intubation times than medical ICU patients, remains unknown. Smaller research with a large number of postoperative cardiac surgery patients found no significant differences in outcomes between day and night extubations.^[7] Furthermore, the existence of 24-hour intensivists coverage in cardiothoracic surgery ICUs has been linked to better patient outcomes, indicating that continuing daily clinical procedures throughout nocturnal hours may benefit this patient population.^[8]

For decades, high-dose opioid anaesthesia has been the preferred aesthetic strategy in cardiac surgery because of its ability to preserve haemodynamic stability while also decreasing the hormonal and metabolic stress response to surgery. However, administering significant doses of long-acting opioids requires 12-24 hours of postoperative artificial breathing. Rising healthcare expenses for longer ventilation, intensive care unit (ICU) stays, and total hospitalization have prompted changes in this practice.^[5-9] With the advancement and widespread adoption of enhanced recovery protocols, there has been growing interest in facilitating the rapid resumption of spontaneous breathing and early tracheal extubation following cardiac surgery.^[10]

Fast-track cardiac anaesthesia, which strives for extubation within six hours of operation, has developed into ultra-fast-track anaesthesia (UFTA), a strategy that improves surgical and anaesthetic procedures to allow immediate or early (within one hour) extubation following surgery. The primary premise of UFTA is to minimise opioid doses while selecting suitable sedative and analgesic medications to enable early postoperative extubation and reduce mechanical ventilation time.^[10,11] Thoracoscopic closure of congenital heart abnormalities, such as atrial septal defect (ASD), is now a viable alternative to traditional cardiac surgery in the paediatric and young adult populations. Compared with typical sternotomy-based operations, thoracoscopic ASD closure has been linked to quicker postoperative recovery. Recently, total thoracoscopic closure of ventricular septal defects (VSD) without robotic assistance has also been reported. General anaesthesia remains necessary for thoracoscopic ASD and VSD closures, with extubation typically performed in the ICU in most previously documented cases.^[12]

Delayed extubation in these patients has been linked to several problems, including inadvertent tracheal tube dislodgement, pulmonary hypertension crises caused by sputum aspiration, increased sedation and analgesic needs, and ventilator-associated

infections.^[13] While UFTA has shown promise for quick extubation following surgery, there is still a lack of evidence on its use in thoracoscopic surgeries for congenital heart defect repair.

Aim: This study aimed to determine the non-inferiority of fast-track extubation of patients undergoing cardiac surgery compared to conventional overnight ventilation.

MATERIALS AND METHODS

This retrospective, single-centre study was conducted on thirty nine consecutive patients who underwent non-complex cardiac procedures at the Tamil Nadu Government Multi-Super-Speciality Hospital in Chennai. between January 2023 and April 2023. Before the initiation of the study, the Institutional Ethics Committee approved the study, and all patients provided informed consent.

Inclusion Criteria

Patients who underwent elective, non-complex cardiac surgery during the study period were included.

Exclusion Criteria

Patients with emergency procedures, the presence of associated respiratory comorbidities, haemodynamic instability, and postoperative excessive bleeding (>100 mL/hour) were excluded.

Methods

Thirty-nine patients who underwent non-complex cardiac surgery were included in the study and categorised into two groups: the conventional/overnight ventilation group (n=24) and the fast-track extubation group (n=15). Baseline demographic characteristics, intraoperative parameters, and postoperative outcomes, including reintubation rates and in-hospital major adverse events, were recorded and compared between the two groups. The primary outcome measures were as follows: Reintubation rate, Postoperative morbidity and mortality until hospital discharge

Fast-Tracking Protocol

During the study period, no major modifications were made to the institution's fast-track extubation protocol. The attending surgeon remained the primary decision maker throughout the patient's ICU stay and determined whether the patient was eligible for fast-track extubation or required overnight mechanical ventilation. The decision to initiate the fast-track extubation pathway was patient-specific and based on intraoperative events, haemodynamic stability, and the degree of postoperative bleeding. No formal protocol was used to standardise fast-track decision-making. Patients were classified as successfully fast-tracked if they were extubated within six hours of arrival in the postoperative ICU.

RESULTS

The mean age was comparable between the two groups, with 41.79 ± 12.76 years in the conventional

ventilation group and 39.60 ± 13.78 years in the fast-track extubation group ($p = 0.616$). The mean cardiopulmonary bypass duration was longer in the conventional ventilation group (83.88 ± 63.13 minutes) than in the fast-track group (54.40 ± 47.49 minutes), although this difference was not significant ($p = 0.129$). The postoperative systolic and diastolic blood pressures were similar between the groups, with no significant differences ($p = 0.329$ and $p = 0.676$, respectively). The mean postoperative bleeding volume was 247.92 ± 124.66 mL in the conventional ventilation group and 220.00 ± 104.88

mL in the fast-track group ($p = 0.638$). The mean ventilation time was significantly lower in the fast-track extubation group (316.00 ± 44.49 min) than in the conventional ventilation group (414.17 ± 50.71 minutes) ($p < 0.0001$). The number of transfused blood units did not differ significantly between groups ($p = 0.700$). The preoperative ejection fraction was slightly higher in the fast-track group ($59.67 \pm 4.19\%$) than in the conventional ventilation group ($54.75 \pm 9.57\%$); however, this difference was not significant ($p = 0.191$) [Table 1].

Table 1: Comparison of perioperative and postoperative parameters between the groups.

| | Conventional/Overnight ventilation | Fast track extubation | P value |
|----------------------------|------------------------------------|-----------------------|---------|
| Age (years) | 41.79 ± 12.76 | 39.6 ± 13.78 | 0.616 |
| CPB duration (mins) | 83.88 ± 63.13 | 54.4 ± 47.49 | 0.129 |
| Post OP SBP (mmHg) | 114.38 ± 15.21 | 119.27 ± 14.71 | 0.329 |
| Post OP DBP (mmHg) | 61.38 ± 5.92 | 60.6 ± 4.98 | 0.676 |
| Bleeding (ml) | 247.92 ± 124.66 | 220 ± 104.88 | 0.638 |
| Ventilation Time (mins) | 414.17 ± 50.71 | 316 ± 44.49 | <0.0001 |
| No. of blood units (count) | 0.46 ± 0.66 | 0.53 ± 1.13 | 0.7 |
| Pre-OP EF (%) | 54.75 ± 9.57 | 59.67 ± 4.19 | 0.191 |

Gender distribution was similar between the groups, with 41.7% females and 58.3% males in the conventional ventilation group and 46.7% females and 53.3% males in the fast-track extubation group (p

$= 0.759$). No complications were recorded in either group. Additionally, no reintubation cases were reported in either group. [Table 2]

Table 2: Comparison of demographic and clinical characteristics between the groups.

| | | Conventional/Overnight ventilation | Fast track extubation | P value |
|-------------------|--------|------------------------------------|-----------------------|---------|
| Sex | Female | 10 (41.7%) | 7 (46.7%) | 0.759 |
| | Male | 14 (58.3%) | 8 (53.3%) | |
| Blood transfusion | No | 15 (62.5%) | 11 (73.3%) | 0.485 |
| | Yes | 9 (37.5%) | 4 (26.7%) | |
| Complications | Nil | 24 (100%) | 15 (100%) | NA |
| Reintubation | Nil | 24 (100%) | 15 (100%) | NA |

DISCUSSION

Fast-tracking is used in post-cardiac surgery patients to provide the fastest possible return to spontaneous breathing with the fewest problems. This strategy also helps to minimise ICU stay duration, which saves valuable resources and staff. When the extubation timing was compared between the groups, it was discovered that while some patients in the traditional ventilation group were extubated reasonably early, their timing was not similar to that in the fast-track group. This disparity might be attributable to non-clinical factors, such as practitioner discretion, support staff availability, and time of day. In our trial, none of the patients in the fast-track group required reintubation or ICU readmission throughout their stay. Furthermore, the fast-tracked patients experienced no serious adverse events, which was equivalent to the outcomes in the normally ventilated group.

Our data indicate that fast-tracking is a safe and successful method for selected cardiac surgery patients, even in situations with limited resources, and it does not jeopardise patient safety. Serena G revealed in pilot research that early extubation is a

critical component of fast-track care procedures following cardiac surgery, and it has been thoroughly tested in specialized PACU settings. The study found that using a nurse-led approach allows for early extubation in a cardiovascular ICU setting, potentially boosting the incidence of early extubation episodes.^[14]

Evidence-based postoperative treatment of patients undergoing cardiac surgery is critical for providing high-quality care. Early extubation after cardiac surgery improves postoperative outcomes and reduces healthcare expenses.^[15] Early extubation has been related to a decreased incidence of ventilator-associated pneumonia,^[16,17] less reliance on sedatives¹⁸, faster rehabilitation, and shorter intensive care unit (ICU) length of stay (LOS).^[4,5,19] In a high-demand ICU, doctors frequently prioritise essential matters, which might divert their focus away from timely decisions like early sedative weaning, potentially resulting in lost chances for early extubation.^[20] Furthermore, the National Quality Forum in the United States recognises postoperative ventilation that lasts more than 24 hours as a performance metric.^[21] Additionally, the Society of Thoracic Surgeons' quality measures are planned to include extubation within six hours of coronary artery

bypass grafting (CABG), aortic valve replacement (AVR), or combination CABG/AVR surgeries.^[22] Probst et al.^[23] recently compared post-cardiac surgery treatment in the post-anaesthesia care unit (PACU) and cardiac intensive care unit (ICU). Their study found that haemodynamically stable, normothermic, and non-bleeding patients brought to the PACU had a considerably shorter extubation time and a greater rate of extubation during the first six postoperative hours than comparable patients maintained in the ICU. Furthermore, patients in the PACU had a shorter length of stay (LOS) before step-down and a decreased incidence of arrhythmic problems, with no significant differences in other postoperative sequelae. These findings can be attributed to key structural differences between the two settings, such as (1) a smaller, dedicated 3-bed PACU versus a larger 21-bed mixed ICU, (2) specialised post-cardiac surgery care in the PACU than in a general ICU setting, and (3) a higher consultant-to-patient ratio in the PACU (1:3) versus the ICU (1:12). Given these contrasts and the PACU staff's better airway management skills, the observed advantages of PACU-based treatment are expected. Similarly, in our study, none of the patients in the fast-track extubation group required reintubation or ICU readmission during hospitalisation. Additionally, no major adverse events were observed in fast-tracked patients, with outcomes comparable to those of the conventionally ventilated group. These findings support the safety and efficacy of fast tracking in selected cardiac surgery patients, even within resource-limited settings, without compromising patient safety. The consistency of our results with those reported by Probst et al. reinforces the feasibility of implementing fast-track extubation strategies in appropriately selected patients, potentially optimizing ICU resource utilization and postoperative recovery.^[23]

The length of artificial breathing was strongly affected by the anaesthesiologist's choice of postoperative sedative medications. Based on previous studies, anaesthesiologists were recommended, but not obliged, to provide dexmedetomidine for postoperative sedation prior to ICU transfer. Dexmedetomidine was related with earlier extubation than propofol, which is consistent with the findings of a previous meta-analysis that showed shortened extubation times with dexmedetomidine.^[24] This impact might be attributable to its lower respiratory depressing effects compared to propofol, as well as its sedative and analgesic qualities at typical dosages. However, the advantages of dexmedetomidine remain unconfirmed. A large retrospective investigation found a link between dexmedetomidine use and increased postoperative delirium, pain ratings, and reintubation rates. Furthermore, the anxiolytic effect of dexmedetomidine was noticeable in agitated patients, as 12.2% (43 of 353) of those originally sedated with propofol required switching to dexmedetomidine for easier extubation. The

necessity for conversion may have led to longer extubation delays in the propofol group.^[25]

Limitations

A larger study population is required to enhance the generalisability of our findings and to improve the robustness of our conclusions.

CONCLUSION

Our study demonstrated that fast-track extubation was as effective as conventional overnight ventilation, yielding comparable clinical outcomes. Based on our findings, we encourage fellow surgeons to consider implementing fast-tracking protocols, even in resource-limited ICU settings, as they can be safely performed in post-cardiac surgery patients without increasing the risk of major complications or reintubation.

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