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REVIEW ARTICLE

# Early extubation protocol post-coronary artery bypass graft & open heart surgery

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## Abstract

Fast-tracking in cardiac care refers to the complex intervention including early extubation, care during anesthesia, mobilization and hospital discharge to reduce perioperative morbidity, costs, and length of stay in the intensive care unit and the hospital. This review was designed to evaluate early extubation protocols, the differences in early and late extubation, the safety and efficacy of early extubation among the patients in surgical intensive care after coronary artery bypass graft (CABG) surgery. The analyzed studies showed many significant differences in the mortality and postoperative complications of time-directed extubation practices and low dose-based general anesthesia in patients with low to moderate risk undergoing early extubation (fast-track) and the conventional care methods. Different fast-track interventions could diminish extubation time, costs, and the length of hospital stay. However, several factors including patient's stay in the intensive therapy ward vs general ward, patient selection, skills and experience of the staff, and fast-track anesthesia methods could be considered to perform safe fast-tracking in patients undergoing cardiac surgery. On the other hand, to achieve this safety for high-risk cardiosurgery patients multidisciplinary coordination is needed.

**Keywords:** early extubation · valve surgery · coronary artery bypass surgery

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## Introduction

Post-operative outcome improvement directly depends on fundamental alterations in anesthesia and surgery, extracorporeal perfusion methods and peri-operative care systems [1-2]. Fast-track cardiac care, also called early extubation, has been first described by Prakash et al. in 1977 [3]. Fast-tracking in cardiac care refers to the complex intervention including early extubation, care during anesthesia, mobilization and hospital discharge to reduce perioperative morbidity, costs, and length of stay in the intensive care unit and the hospital. Efforts have continued to reduce the risk of respiratory complications due to tracheal intubation, mechanical ventilation and other risk factors including age and several thoracic surgical approaches [1, 4-8] The main goal of the majority of fast-track protocols was to optimize the length of patients' stay (LOS) and to reduce total costs following the coronary artery bypass graft (CABG) surgery, by emphasizing on early and fast extubation at the surgical intensive care unit (SICU) [9-13].

Based on the Society of Thoracic Surgeons (STS) guidelines, a 6-hour time point is considered "early extubation" and "prolonged intubation" referred to the longer than 24 hours time points [14-17] There is an ongoing interest in early extubation due to prevent adverse effects associated with late extubation, as well as any extra costs [18-19] However, due to the heterogeneity in cardiac surgery patient populations, previously advocated practices and risk prediction protocols have not been very successful. There are some confusing points in terms of the increased complication rate time in CABG.

The aim of this review is to determine the effect of early intubation time on post-operative morbidity and mortality rate in patients undergoing general anesthesia following the valve and CABG surgery.

## Material and methods

In this review study, we evaluated all articles published from the year 2000 to 2021 related to early extubation protocols post-coronary artery bypass graft and open-heart surgery. Articles were searched by one researcher in PubMed, Web of Science, Scopus, Google Scholar, Science Direct and Cochrane Library using the keywords "early extubation", "early extubation protocol", "coronary artery bypass graft" and "open heart surgery."

## Results

A total of 296 articles were extracted in the initial search. After reviewing the abstracts of these articles, 76 articles were selected and their full texts were included in the analysis.

### History of early extubation following major surgery

Fast-track cardiac care has been applied in most of the study population (123 of 142 adult patients) after or within 3 h following open-heart surgery [3]. The best candidates for this approach were the patients who have been given minimal fluids and had a decrease in the cardiac index and ventricular filling pressures [20]. They reported immediate extubation in 5/36 patients and an average time of 6 h for the remainder of that group. Other researchers presented successful extubation 8 hours after surgery [21-22]. In another article, the best candidates for early extubation were hemodynamically stable, had an alveolar-arterial gradient of < 150 mmHg, good donor liver function and no encephalopathy [23]. In a combined strategy including all levels of care for the early 48 h after liver transplantation, the time to extubation and LOS at ICU were shorter, without changes in staff and intraoperative protocols [24].

### Fast-track in cardiac care

Fast-track cardiac care referred to the complex intervention including cardiac anesthesia care and the post-operative care with a special focus on early extubation after surgery to diminish hospital LOS and expenses [25-26] In conventional (not fast-track) care units, high-dose opioid-based anesthesia has been applied in cardiac surgery followed by overnight mechanical breathing support in ICU after cardiac surgery [25]. However, in the new fast-track care units mechanical breathing support is applied on the operating table or within hours after cardiac surgery via the time-directed protocols for breathing support removal [27]. A Cochrane review updated in 2016 included 28 trials with 4438 participants. Most participants have been considered to be at low to moderate risk of death after surgery. No differences in risk of mortality were observed between low-dose versus high-dose opioid-based general anesthesia groups (OR 0.53, 95% CI 0.25 to 1.12; 8 trials, 1994 participants, low level of evidence) within the first year of surgery. There were also no differences in risk of mortality between a time-directed extubation protocol versus conventional care (OR 0.80, 95% CI 0.45 to 1.45; 10 trials, 1802 participants, low level of evidence). They showed no significant differences in postoperative complications including myocardial infarction, stroke, and tracheal re-intubation between the mentioned study groups [27]. Application of low-dose opioid-based general anesthesia and time-directed extubation procedures using the fast-track method have major postoperative complications and mortality risk as well as conventional (not fast-track) method suggesting its safety for use in low to moderate risk patients [27].

### Opinions for and against fast-track anesthesia

Among the advantages of fast-track anesthesia are improved graft blood flow, decreased complications from

mechanical ventilation, fewer chest radiographs, improved resource utilization patient comfort, and cost containment [28]. Disadvantages include the chance of failed extubation and re-operation. In addition, there is a lack of large prospective studies regarding the benefits of the fast-track approach [28] (see Table 1).

Some concerns have been reported regarding the increased rate of re-intubation and the risk for perioperative adverse effects after early extubation, particularly among old or high-risk patients [29-32]. The safety of early extubation after CABG has been shown in a community practice of 6446 CABG patients from 35 hospitals, aged 65 years and older with shorter hospital stays without any adverse effect on postoperative outcomes between 1995 to 1998 [33]. In a retrospective analysis of findings in 1,904 patients undergoing CABG with different intubation times after surgery including 0-6, 6-9, 9-12, 12-24, and over 24 hours, there was no increase in postoperative complications before 12 hours of intubation [34]. It has been reported that prolonged intubation time can be increased mortality and morbidity rate in CABG patients [25] [27, 35]. Shorter ICU and hospital LOS were observed in patients who extubated earlier after the operation.

### Feasibility of fast-track approach in cardiac surgery

It has been reported that the fast-track approach could be feasible in both simple and complex surgical procedures in all age groups [26]. Although early extubation is a fundamental part of the fast-track approach, there is no universal definition of ”early” and currently it is referred to as 6-8 hours post-cardiac surgery) [26]. In a study of 197 pediatric patients the successful extubation rate was 61% in the operating room (OR) [42]. In another study, 67% of children were extubated in the OR following surgery for congenital heart disease or within 6 hours of admission to the ICU without complications [43]. The patient/parent satisfaction, the feasibility, and safety of the fast-track approach in cardiac surgery have been found in large-scale series of patients undergoing adult cardiac surgery [44]. In a retrospective study, the extubation rate of 73% was observed in the OR of 901 patients [45]. The findings of another study showed the extubation rate of 87% in OR as an ultra-fast track method in elective congenital cardiac surgery [46]. Mittnacht et al. showed 79% extubation rate in OR of 224 patients [47].

## Discussion

There is considerable disagreement regarding the classification of fast-track and ultrafast-track techniques. Several time points between 1 and 24 hours are considered for extubation following cardiac surgery [48]. However, careful patient selection is considered a critical aspect of fast-tracking in many patients undergoing cardiac surgery [49-50]. Early or fast extubation could be lessened the length of ICU

**Table 1. Summary of the pros and cons of the fast-track approaches**

| Ref. | Strategy for extubation | Findings |
|---|---|---|
| Bansal et al. [36] | Early extubation | Shorter ICU and hospital stay without any changes in re-intubation rates |
| Hiromoto et al. [37] | Early extubation in valve surgery | Patients after early extubation had shorter ICU and hospital stays |
| Quiroga et al. [38] | Early extubation and fast-track anesthesia | The decrease in the total cost for hospitalization, shorter duration of intensive care or avoiding the ICU |
| Taner et al. [39] | Early extubation and fast-track anesthesia | The decrease in total room charges, reduction in the number of chest radiographs and arterial blood sampling |
| Wu et al. [40] | Early extubation in patients with significant comorbidities | Common reasons for re-intubation after early extubation included respiratory insufficiency, pneumonia and reoperations |
| Glanemann et al. [41] | Early extubation | Increased re-intubation rate among patients extubated in the ICU versus patients extubated in the operating room |

and hospital stays [51-52]. However, multidisciplinary and coordinated approaches seem necessary to safely accomplish fast-tracking. The benefits of fast-tracking in cardiac surgery have been proven by mostly retrospective analyses compared to prospective randomized studies [1, 30-31, 38, 48, 51] In a survey of 10 randomized clinical trials, early extubation compared to late extubation after cardiac surgery and the beneficial effect of fast-tracking as a reduced time of mechanical ventilation, shorter times of ICU and hospital stay, and resource usage was observed between the studies [53]. Hiromoto et al. evaluated the benefits and predictive value of early extubation in valve surgery needing long cardiopulmonary bypass and reported that early extubation was achieved in 44.3% of patients without increasing adverse events. Patients with early extubation had shorter ICU and hospital stays [37]. Ellis et al. demonstrated that after implementing a fast-track extubation protocol, the number of early extubations after cardiac surgery was successfully improved and fast-track extubation did not increase the re-intubation risk and other adverse events [54].

To prevent major cardiorespiratory complications, it is important to shorten the duration of intensive hemodynamic monitoring and endotracheal intubation after cardiac surgery, particularly in some higher-risk patients [55-56]. On the other hand, there is wide heterogeneity in pre-and intra-operative risk factors of fast-tracking and prolonged mechanical ventilation observed in developing countries [57]. In addition, the application of low-dose anesthesia following the early cessation method combined with the rapid reversal of muscle paralysis is considered the main aspect of intervention in some RCTs [49, 58-59]. Bansal et al. showed that early extubation could be associated with a shorter ICU and hospital stay with any changes in re-intubation rates [36]. Findings obtained from six clinical trials in a Cochrane Review showed no differences in the re-intubation rate, 30-day mortality and intensive care mortality in patients who were extubated within 8 hours after cardiac surgery [60]. Factors such as higher body surface space and extended ischemic times are considered prognostics of longer extubation times [61-62]. Other published studies did not display the relation between early extubation and higher rates of re-intubation [60, 63].

## Conclusion

In conclusion, early extubation after cardiac surgeries reduces the length of ICU and hospital stay, reduces the total cost of care as well as the number of blood sampling and chest radiographs, however, it may increase the risk of re-intubation. No difference in mortality rate was observed due early extubation after cardiac surgeries.

## Conflicts of interest

None.

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