

# Independent Risk Factors for Fast-Track Failure Using a Predefined Fast-Track Protocol in Preselected Cardiac Surgery Patients

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**Objectives:** The purpose of this study was to identify the independent risk factors for fast-track failure (FTF) in cardiac surgery patients.

**Design:** A retrospective analysis.

**Setting:** A university-affiliated heart center.

**Participants:** In a 2-year period, 1,704 consecutive preselected patients undergoing elective cardiac surgery were treated according to the local fast-track protocol in the postanesthetic care unit (PACU), bypassing the intensive care unit (ICU).

**Measurements and Results:** Independent risk factors for FTF in the univariate regression analysis were tested in a multivariate regression analysis. FTF was defined as any transfer of the preselected patient to the ICU. FTF was primary when the patient was transferred directly from the postanesthetic care unit to the ICU and secondary when the patient was

transferred from the intermediate care unit or ward to the ICU. FTF rate was 11.6% for primary and 5.6% for secondary FTF. In the multivariate regression analysis, age >70 years, female sex, prolonged surgery, and prolonged cross-clamp time could be defined as independent risk factors for FTF.

**Conclusions:** In a preselected patient population, fast-track treatment could be done with a low FTF rate. Independent risk factors for FTF are age, female sex, prolonged surgery, and prolonged cross-clamp time.

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**KEY WORDS:** fast track, cardiac surgery, fast-track protocol, fast-track failure, intensive care unit, cardiac anesthesia, postoperative ventilation

**F**AST-TRACK (FT) ANESTHESIA in cardiac surgery is considered a standard of care in current practice.<sup>1</sup> A numbers of studies have demonstrated that there are no differences in mortality and morbidity rates between FT anesthesia and conventional anesthesia,<sup>2,3</sup> with the benefit of reduced costs of healthcare.<sup>4,5</sup>

Fast-track failure (FTF) rates reported in the literature vary from 15.6% to 45.5% in mixed-age populations,<sup>6,7</sup> depending on the definition of FTF and the patient population (ie, comorbidities and type of surgery). Most of the studies focused on coronary artery bypass grafting (CABG) procedures.<sup>8</sup> In an attempt to work out a standardized protocol for both patient selection and FT process, many studies have evaluated the variables for successful and failed FT treatment in the whole patient population.<sup>3,6,7,9</sup>

The aim of this study was 2-fold: To evaluate the rates of FTF and to identify independent risk factors for FTF in preselected FT patients undergoing elective cardiac surgery.

## MATERIALS AND METHODS

This retrospective observational study was performed in a single center and was approved by the local medical ethics committee (registration number: 322-10-08112010). In all, 1,704 consecutive patients who underwent cardiac surgery and FT treatment in a dedicated postanesthetic care unit (PACU) from January 2007 to December 2008 were included in this study.

Patients were admitted to the PACU if they were hemodynamically stable with or without low-dose vasopressor and/or inotropic support (continuous infusion of <0.1 µg/kg/min of norepinephrine and/or <0.05 µg/kg/min of epinephrine), without excessive bleeding (defined as bleeding that did not affect the hemodynamic stability and that was easy to control), and with a core temperature of at least 36°C. Transfusion requirement was not an exclusion criterion, per se, if the patient was stable hemodynamically and no clinical signs of bleeding were present before transfer to the PACU. Both elective and urgent

surgeries were included in the protocol, whereas emergency surgeries were excluded. The decision for FT treatment of the specific patient was made cooperatively at the end of the surgery by the cardiac anesthesiologist and the cardiac surgeon. If one or both declined, the patient was transferred to the intensive care unit (ICU; Table 1).

## Fast-Track Protocol

The patients were treated according to the Leipzig FT protocol published previously.<sup>10</sup> Criteria for extubation were fully awake and alert patients with completely (clinically) recovered motor power, no neurologic deficit, hemodynamically stable, bleeding <100 mL/h, core temperature ≥36°C, acceptable blood gases on F<sub>I</sub>O<sub>2</sub> <0.5, sufficient tidal volume on ventilator support (pressure support (PS) 8 cmH<sub>2</sub>O and positive end-expiratory pressure 5 cmH<sub>2</sub>O), normal lactate, mixed venous oxygen saturation (SvO<sub>2</sub>), electrocardiogram, and chest x-ray (Table 2). The PACU operated daily Monday to Friday from 10 AM to 6:30 PM.

All patients were transferred to the intermediate care unit (IMC) once a bed was available and the following criteria were fulfilled: Patients were awake and alert, had no neurologic deficit, had a pain score (visual analog scale) between 2 and 4,

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**Table 1. Inclusion Criteria for FT and PACU**

Hemodynamically stable ± low-dose inotropic support
No excessive bleeding
Core temperature ≥ 36°C
Elective or urgent surgeries (not emergency surgeries)
Clinical judgment and communication between anesthesiologist and the surgeon

Abbreviations: FT, fast track; PACU, postanesthesia care unit

were hemodynamically stable and without vasopressor and/or inotropic support, had acceptable blood gas analysis (PaO<sub>2</sub> > 90 mmHg and PaCO<sub>2</sub> < 46 mmHg, SaO<sub>2</sub> > 96% on oxygen flow 2-6 L/min), had no significant bleeding (< 50 mL/h), had urinary output > 0.5 mL/kg/h, and had normal serum lactate, SvO<sub>2</sub>, cardiac enzymes, and chest x-ray (Table 3).

IMC patients were discharged to the ordinary ward when they had a stable rhythm and were able to mobilize independently. The staff in the IMC unit was aware of which patients underwent FT treatment, whereas staff on the nursing ward were not.

In this study, FT was considered successful if patients were discharged from the hospital without admission to the ICU or readmission to the IMC during their primary stay in the hospital.

**Definition of Fast-Track Failure**

FTF was defined as any unplanned transfer of the preselected FT patient to the ICU. Patients transferred from the PACU directly to the ICU were defined as primary FTF, whereas patients transferred from either the IMC or ward to the ICU were defined as secondary FTF.

**Statistical Analysis**

Data are displayed throughout the article as median and interquartile range for all non-normally distributed continuous variables and mean and SD for normally distributed values.

A univariate logistic regression analysis using variables known in the literature as risk factors for FTF was performed (ie, age, sex, EuroSCORE, surgery time, aortic cross-clamp time, cardiopulmonary bypass time, preoperative ejection fraction, number of reoperations, impaired renal function, history of chronic obstructive pulmonary disease (COPD), diabetes, peripheral vascular disease, previous myocardial infarction, pulmonary hypertension, neurologic comorbidities, and urgent surgery).<sup>6</sup> Parameters found to be significant in the

**Table 2. Criteria for Extubation**

Full consciousness, no neurologic deficit
Hemodynamically stable
Core temperature ≥ 36°C
Arterial blood gas: PO <sub>2</sub> ≥ 100 mmHg, PCO <sub>2</sub> ≤ 40 mmHg on F <sub>I</sub> O <sub>2</sub> < 0.5
Respiratory parameters: sufficient tidal volume on ventilator support (P.S. 8 cmH <sub>2</sub> O and PEEP 5 cmH <sub>2</sub> O)
Bleeding: < 100mL/h
Normal serum lactate
Normal SvO <sub>2</sub>
No new ECG and CXR changes

Abbreviations: CXR, chest x-ray; ECG, electrocardiogram; PEEP, positive end-expiratory pressure SvO<sub>2</sub>, central venous oxygen saturation

**Table 3. Criteria for Transfer of Patients From PACU to IMC**

Fully awake and alert, no neurologic deficit
Hemodynamically stable, without inotropic support
Acceptable blood gas analysis (PaO <sub>2</sub> > 90 mmHg and PaCO <sub>2</sub> < 46 mmHg, SpO <sub>2</sub> > 96% on O <sub>2</sub> flow 2-6 L/min)
Urinary output > 0.5 mL/kg/h.
No significant bleeding (< 50 mL/h)
Normal serum lactate, normal SvO <sub>2</sub> , cardiac enzymes, and CXR

Abbreviations: CXR, chest x-ray; IMC, intermediate care; PACU, postanesthesia care unit; SvO<sub>2</sub>, central venous oxygen saturation

univariate analysis were used to perform a multivariate logistic regression model to identify independent risk factors for FTF. The primary events of interest were FTF and readmission to a higher dependency area during a patient’s stay in the hospital.

The odds ratio and p values were calculated for each variable. A p < 0.05 was considered statistically significant. Analysis was performed using the statistical analysis software SPSS version 16.0 for Windows (SPSS, Chicago, IL, USA).

**RESULTS**

Overall, 1,917 patients were admitted to the PACU between January 2007 and December 2008. Of these patients, 1,704 were treated using the FT concept; 213 patients were excluded as they were admitted to the PACU only for a short time until an ICU bed was available. The demographic and operative data are shown in Table 4.

Table 5 shows the results of the univariate analysis for the prediction of either primary or secondary FTF. The primary FTF rate was 11.6% compared with 5.6% for secondary. Univariate analysis revealed age, sex, EuroSCORE, surgery duration, aortic cross-clamp time, and diabetes as significant risk factors for primary FTF. For secondary FTF, renal impairment, COPD, peripheral vascular disease, previous myocardial infarction, and bypass time were shown to be the significant risk factors.

After performing a multivariate analysis for all patients (Table 6), age > 70 years, surgery duration, aortic cross-clamp time, and female sex were found to be independent risk factors for primary FTF. In comparison, independent risk factors for secondary FTF were duration of surgery, COPD, renal impairment, and diabetes.

In-hospital mortality for all FT patients was 0.9% (n = 17), of which 29% (n = 5) were primary FTF and 70% (n = 12) were secondary FTF. All secondary FTF patients were transferred from the IMC to the ICU. None of patients in the successful FT group died. On the other hand, almost 6% (n = 17) of the patients from the FTF group died. This difference was statistically significant (p < 0.00001).

The average ICU length of stay (LOS) for FTF patients was 66.2 ± 125 hours. The average IMC LOS for FTF patients was 53.7 ± 71 hours compared with 32.6 ± 32 hours for successful FT patients (p < 0.05). Average hospital LOS for FTF patients was significantly longer than that for successful FT patients (17.4 ± 17.2 v 9.9 ± 3.8 days, p < 0.05).

**DISCUSSION**

In this study, primary FTF occurred in 11.6% of patients and secondary FTF in 5.6%. Age > 70 years, female sex, and lengthy surgery (> 3 hours) and cross-clamp times (> 65 minutes) were

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