Risk Factors for Failed "Fast-Tracking" After Cardiac Surgery in Patients Older Than 70 Years

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Objective: **"Fast-track" pathways have been successfully used in low-risk, relatively young patients after all types of surgical procedures including cardiac surgery. An increase in the number of referrals of older patients for cardiac surgery prompted the present study on the use of a "fast-track" pathway in septuagenarians and octogenarians. Risk factors for the unsuccessful application of the "fast-track" pathway in these elderly patients were determined.**

Design: **A retrospective observational study.**

Setting: **A single tertiary-care, university-affiliated center.**

Participants: **All 70-year-old or older patients undergoing cardiac surgery between January 1, 2004 and June 30, 2007 were included. Septuagenarians were compared with octogenarians.**

Measurements and Main Results: **During the 42-month period, 860 cardiac operations were performed on 576 septuagenarians and 284 octogenarians. The "fast-track" pathway was successful in 54.5% and 37.3%, respectively. On multiple logistic regression analyses, stroke, renal failure, and procedures other than primary isolated coronary artery bypass graft surgery were independently associated with failed early extubation, delayed intensive care unit discharge, and delayed hospital discharge in both groups. Infections and atrial fibrillation were independent risk factors for delayed hospital discharge in both groups and delayed intensive care unit discharge in the octogenarians. In the octogenarians only, congestive heart failure was an independent risk factor for failed early extubation, delayed intensive care unit discharge, and delayed hospital discharge.**

Conclusions: **A "fast-track" pathway may be applied in selected septuagenarians and octogenarians. Age alone should not exclude consideration for "fast-track" management.**

KEYWORDS: fast-track, cardiac surgery, elderly, complications

IN THE LAST 20 YEARS, the number of elderly people (aged 65+) in the Western world has grown at twice the rate of the general population.[1,2] This has prompted healthcare systems to develop new management strategies for the elderly designed to meet their changing needs. Today, cardiac surgery is an accepted practice in older patients.[3-8] Forty percent of elderly patients have symptomatic heart disease,[9] and cardiac surgery is one of the most often performed procedures in this age group. In Israel, patients older than 65 account for more than 50% of those hospitalized in cardiac surgical departments.[2] The concept of the "fast-track" pathway after cardiac surgery was introduced to expedite recovery and to make more efficient use of limited facilities and resources. It is now widely used in low-risk, relatively young patients.[10-12] Because cardiac surgery today is an accepted practice in older patients,[3-8] the present study sought to analyze its use and to identify the determinants of failure of the "fast-track" pathway in septuagenarians and octogenarians.

MATERIALS AND METHODS

A retrospective observational study that included all patients aged 70 years or older who underwent cardiac surgery between January 1, 2004 and June 30, 2007 at this tertiary-care, university-affiliated center was performed. Ethics committee approval was obtained. All patients were initially planned for the "fast-track" pathway, which involved the use of low-to-moderate dose fentanyl during anesthesia and early extubation within 10 hours after surgery, discharge from the intensive care unit (ICU) during the first 24 postoperative hours, and discharge from the hospital on postoperative day 6 or earlier.[10]

Patients who required coronary artery bypass graft (CABG) surgery and valve-related or combined procedures were included. Patients undergoing emergency procedures or aortic aneurysm/aortic dissection repairs were excluded.

All patients received a standard anesthetic. Diazepam, 5 to 10 mg, was used for premedication, and anesthesia was induced with fentanyl, 10 to 15 μg/kg, and midazolam, 0.02 to 0.04 mg/kg. Pancuronium, 0.1 mg/kg, was given to facilitate endotracheal intubation. The lungs were ventilated with an oxygen/air mixture to maintain normocapnia. Anesthesia was maintained with isoflurane, fentanyl, and midazolam. The total dose of fentanyl was 32.6 $\pm$ 13.3 μg/kg in the septuagenarians and 25.8 $\pm$ 12.9 μg/kg in the octogenarians ($p = 0.56$), and midazolam was 0.1 $\pm$ 0.05 mg/kg and 0.09 $\pm$ 0.04 mg/kg ($p = 0.6$), respectively. Monitoring included 5-lead electrocardiographic, pulse oximetry, nasal temperature, invasive arterial pressure, and central venous pressure. In patients with heart failure and/or pulmonary hypertension, a pulmonary artery catheter also was used. All patients undergoing valve procedures were assessed by transesophageal echocardiography.

The decision to perform the operation off pump or on pump (CABG) was made by the operating surgeon. For patients in the on-pump group, systemic heparinization was accomplished with a heparin dose of 400 U/kg. Additional heparin was administered during cardiopulmonary bypass (CPB) to maintain an activated coagulation time of more than 480 seconds. CPB was maintained at a cardiac index of 2.4 L/min/m^2 with a Sarns heart-lung roller pump (Terumo CV Systems, Ann Arbor, MI). Only the membrane oxygenator (Jostra-Bentley Corp, Irvine, CA) was heparin coated; circuit tubing and arterial filter (Jostra-Bentley Corp) were without heparin. The pump prime consisted of 1,000 mL of lactated Ringer's solution and 100 mL of 20% mannitol to which 10,000 U of heparin were added. The mean arterial pressure was maintained between 60 and 80 mmHg using boluses of phenylephrine as required. Serum glucose levels were controlled with intermittent administration of insulin. Hematocrit was maintained at $\geq$22% with the administration of packed red blood cells as necessary. Epsilon-aminocaproic acid was administered in doses of 100 to 150 mg/kg to all patients. Cardiac arrest was achieved by anterograde and/or retrograde blood cardioplegia. Topical cooling was not used, and core temperature was around 33°C. All patients were rewarmed to 37°C before discon-

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tinuation of CPB. Off-pump surgery was performed through a median sternotomy, and anastomoses were performed with the aid of the Octopus (Medtronic Inc, Minneapolis, MN) stabilization system. After surgery was completed, patients were returned to the cardiothoracic ICU while still intubated.

On arriving in the ICU, the patient was managed by an attending intensivist and/or surgical fellow. Standard postoperative care consisted of mechanical ventilation in the assist-control mode at 8 to 10 mL/kg, 10 to 12 breaths/min, positive end-expiratory pressure of 4 to 5 cmH_2O, and warm air heaters to maintain normothermia. Sedation was provided with propofol in a dose of 0.5 to 1.0 mg/kg and analgesia with morphine boluses as required. Cardioactive drugs were administered according to the hemodynamic status of the patient. Weaning from the ventilator was commenced in the presence of hemodynamic stability (no or decreasing use of cardioactive drugs), absence of significant bleeding (<100 mL/h), absence of significant arrhythmias, adequate urine output (>1 mL/kg/h), and oxygen saturation >95% with F_IO_2 <0.50. In addition, the patient had to be sufficiently awake. Delayed awakening was defined as the inability to follow simple commands 8 hours after the end of the operation. The authors did not use objective scoring for evaluation of consciousness. Patients were placed on pressure-support ventilation for 20 to 30 minutes, and, in the absence of respiratory or cardiac distress, extubation was performed immediately thereafter. One to 2 hours after extubation, the patient was seated on a chair and given clear liquids and started on oral medication.

Patients were discharged from the ICU at least 4 to 6 hours after extubation and transferred to the intermediate cardiothoracic surgical ward, which is immediately adjacent to the ICU for monitoring over the next 24 hours. If discharge criteria were met at night, discharge from the ICU to the ward was postponed until 8 AM. The discharge criteria from the ICU included the following: full consciousness, hemodynamic stability (no cardioactive drugs), absence of significant bleeding (<30 mL/h), absence of arrhythmias, adequate urine output (>1 mL/kg/h), oxygen saturation >95% with O_2 flow ≥3 L/min by nasal cannula, and beginning of oral medication.

Failed early extubation was defined as extubation after 10 hours or later.[4] Delayed discharge from the ICU was defined as discharge after 24 hours or later. Delayed discharge from the cardiothoracic ward was defined as discharge at 6 postoperative days or more. The reasons for delayed discharge at any point were documented.

The patients were grouped by age (70-79 years and ≥80 years) and compared for the following preoperative variables: sex, presence of congestive heart failure (New York Heart Association III-IV), neurologic dysfunction, need for intra-aortic balloon pump and/or inotropic support, presence of diabetes mellitus, presence of chronic obstructive pulmonary disease, presence and degree of renal failure or hemodialysis, left ventricular function, priority of surgery (elective or urgent), type of surgery, and duration of cross-clamping and CPB. Neurologic dysfunction was defined as the presence of any neurologic deficit. Preoperative renal failure was defined as creatinine greater than 1.4 mg/dL before surgery. Postoperative variables included the duration of mechanical ventilation, duration of initial ICU stay, volume of bleeding, need for revision, level of consciousness, presence of stroke, duration of inotropic support, presence of atrial fibrillation, infectious complications, and hospital mortality. Excessive bleeding was defined as bleeding more than 1,000 mL during 24 hours. Hemodynamic instability was defined as the use of inotropic drugs (epinephrine, dobutamine, or milrinone) more than 6 hours after surgery. Postoperative stroke was defined as new-onset neurologic deficit duration more than 24 hours. Outcome measures of the study were failed early extubation, delayed discharge from the ICU, and delayed discharge from the hospital to home or to a rehabilitation facility.

Numeric data are expressed as mean. A chi-square test was used for univariate analysis to identify risk factors associated with the failure of early extubation, delayed discharge from the ICU, and delayed discharge to home. The odds ratio was calculated. Variables found to be significant on univariate analyses were entered into a multiple logistic regression model to identify independent risk factors for failed fast-track management. The odds ratio, 95% confidence interval, and p values were calculated for each risk factor. A p value of <0.05 was considered statistically significant. All statis-

Table 1. Demographic and Operative Data

	Septuagenarians		Octogenarians	
	All Patients (%)	Fast-Track (%)	All Patients (%)	Fast-Track (%)
Total	576	314 (54.5)	284	106 (37.3)
Female	224 (38.9)	119 (37.9)	140 (49.3)	50 (47.2)
CHF	76 (13.2)		72 (25.3)	
Diabetes	218 (37.9)		111 (39.1)	
Hypertension	434 (75.4)		(77.6)	
Active smoking	80 (13.9)		23 (8.1)	
Obesity	92 (16)		32 (11.3)	
Past CVA	50 (8.7)		42 (14.9)	
PVD	65 (11.3)		45 (15.9)	
Chronic renal failure	48 (8.3)		31 (10.9)	
COPD	65 (11.3)		47 (16.6)	
Aspirin treatment	409 (71.1)			
All CABG surgeries	265 (46)	176 (56.1)	97 (34.2)	51 (48.1)
First isolated CABG surgery	260	172	96	51
AVR	63	31	74	25
CABG + AVR	65	33	47	14
MV surgery	47	18	17	4
MV surgery + CABG	26	9	7	1
Aortic surgery	49	24	15	5
Other	39	23	27	6

Abbreviations: CHF, congestive heart failure; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; AVR, aortic valve replacement; MV, mitral valve.