Tracheostomy After Cardiac Surgery: Timing of Tracheostomy as a Risk Factor for Mortality

Ronny Ben-Avi, MD,* Alon Ben-Nun, MD,* Shany Levin, MA,† David Simansky, MD,* Nonna Zeitlin, MD,* Leonid Sternik, MD,† Ehud Raanani, MD,† and Alexander Kogan, MD†

Objectives: The optimal timing for tracheostomy after cardiac surgery in patients undergoing prolonged ventilation is controversial. The aim of this study was to assess the effect of tracheostomy timing on short- and long-term mortality of these patients.

Design: Retrospective study of prospectively collected data.

Setting: Cardiac surgical intensive care unit (ICU) in a tertiary-care, university-affiliated hospital.

Participants: All patients undergoing tracheostomy after cardiac surgery between September 2004 and March 2013 were included.

Interventions: The authors compared the outcome in 2 groups of patients according to the timing of tracheostomy: Group I, early-intermediate tracheostomy (0-14 days) and Group II, late tracheostomy ($\geq$15 days).

Measurements and Main Results: During the study period, 6,069 patients underwent cardiac surgery; among them, 199 patients (3.26%) received a tracheostomy. There were 90 patients in Group I and 109 patients in Group II. There was no significant difference in the severity of the patients' illness between the groups. The mortality rate at 3 months, 6 months, 1 year, and 2 years was 37%, 48%, 56%, and 58% in Group I, respectively, and 58%, 70%, 74%, and 77% in Group II, respectively ($p < 0.01$).

Conclusions: Early-intermediate (0-14 days) tracheostomy after cardiac surgery in patients requiring prolonged mechanical ventilation was associated with reduced mortality compared with late tracheostomy ($\geq$15 days).

***KEY WORDS:** tracheostomy, intensive care unit, prolonged ventilation, mortality, cardiac surgery*

A REGULAR POST-CARDIAC surgery course does not require a prolonged stay in the cardiac surgery intensive care unit (ICU). A complicated postoperative period, on the other hand, due to infection, cardiac failure, respiratory distress, or other complications can lead to prolonged ICU stay and prolonged ventilation and may require a tracheostomy.

Tracheostomy is a safer and more comfortable way for mechanical ventilation and is indicated in such cases of prolonged ventilation.[1] It was first described after cardiac surgery in 1964.[2] The possible predictors of early- and long-term survival in these patients are not yet well established.[3] Devarian et al[4] concluded that early tracheostomy after cardiac surgery was associated with reduced morbidity and mortality. This present report was the first research that defined the effect of tracheostomy timing on short- and long-term mortality. The second aim was to determine overall mortality of these patients.

METHODS

This was a retrospective, observational study that included prospectively collected data from consecutive patients who had undergone cardiac surgery at a large tertiary university hospital. Data from collection forms were entered into a computerized department database, which was approved by the ethics committee of the authors' medical center as an information source. Using nonidentifiable patient data from the authors' department's database, they evaluated the following variables: Sex, age, chronic obstructive pulmonary disease, congestive heart failure (New York Heart Association [NIHA] III–IV), diabetes mellitus, dialysis-dependent renal failure, peripheral vascular disease, previous myocardial infarction, previous cerebrovascular accident (CVA)/transient ischemic attack (TIA), systemic and pulmonary hypertension, left ventricular function, previous cardiac surgery, priority of surgery (elective, urgent, or emergent), and logistic and standard EuroSCORE. Perioperative variables included the type of surgery, duration of cross-clamping, and bypass. Complex surgery was defined as concomitant coronary artery bypass grafting (CABG) and valve surgery or double and more valve surgery. Postoperative variables included the type of tracheostomy, open surgical or percutaneous, and complication rate. From February 2007, all tracheostomies were performed at the bedside by an experienced thoracic surgical team, using the percutaneous dilatation technique (Portex® Griggs™ Forceps Percutaneous Dilation Tracheostomy Kits, Smith Medical, St. Paul, MN).

The study population comprised all patients who had undergone cardiac surgery over an 8.5-year period, from September 1, 2004 to March 31, 2013. During the initial period of the study, from September 1, 2004 to December 31, 2006, the ICU functioned by an open model, under the supervision of a cardiac surgeon. During the next period, from January 1, 2007 to March 31, 2013, the ICU was converted to a semi-closed model under the supervision of a board-certified intensivist. Throughout the study period, the same surgical and anesthesiology team performed all procedures, and no major changes in surgical or anesthesia technique were introduced. Patients undergoing tracheostomy after cardiac surgery were assigned to 2 groups, according to the time interval between surgery and tracheostomy: Group I: early-intermediate (0-14 days); and Group II: late ($\geq$15 days). Tracheostomy only was performed in the 7 patients in the first 7 days, and, therefore, the authors did not separate groups early (0-7 days) and intermediate (8-14 days). According to the authors' departmental policy, the decision pertaining to tracheostomy was made after at least 5 days of ventilation and at least 1 failure-to-wean event. Outcome variables included hospital and ICU length of stay, ventilation time, and 30-day, 3-month, 6-month, 1-year, and 2-year mortality rate.

At discharge, all patient data were checked, corrected, and entered into a database, which was programmed to disqualify entry of out-of-scale values. Descriptive statistics were used to summarize the data, and numerical data were expressed as mean (standard deviation [SD]). Outcome variables were compared between 2 groups of patients belonging

*From the Departments of *Thoracic Surgery and †Cardiac Surgery, Sheba Medical Center, Tel Hashomer, Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel.*

Address reprint requests to Alexander Kogan, MD, Sheba Medical Center, Department of Cardiac Surgery, Tel Hashomer 52621, Tel Aviv, Israel. E-mail: Alexander.Kogan@sheba.health.gov.il

1053-0770/2601-0001$36.00/0

http://dx.doi.org/10.1053/j.jvca.2013.10.031

Table 1. Baseline Characteristics

	Group I 0-14 days	Group II ≥15 days	p Value
Number of patients	90	109	
Sex (male)	69 ± 12	71 ± 12	0.304
Age, y	48 (53%)	51 (47%)	0.394
COPD, n (%)	15 (17%)	16 (15%)	0.700
Diabetes, n (%)	35 (39%)	49 (45%)	0.471
Dialysis-dependent renal failure, n (%)	4 (4%)	7 (6%)	0.757
NYHA class III-IV, n (%)	50 (56%)	60 (55%)	0.778
LVEF, % (mean ± SD)	46 ± 15	45 ± 15	0.724
Previous CVA/TIA, n (%)	12 (13%)	16 (15%)	0.840
PVD, n (%)	9 (10%)	17 (16%)	0.294
Pulmonary hypertension, n (%)	18 (20%)	16 (15%)	0.349
Systemic hypertension, n (%)	58 (64%)	64 (59%)	0.466
Previous myocardial infarction, n (%)	29 (32%)	40 (38%)	0.551
Standard EuroSCORE (mean ± SD)	8.82 ± 3.67	8.96 ± 3.33	0.598
Logistic EuroSCORE (mean ± SD)	22.1 ± 19.39	20.14 ± 17.77	0.875
Urgent and emergent surgery, n (%)	52 (58%)	66 (61%)	0.654
Previous surgery, n (%)	31 (34%)	32 (29%)	0.449
Isolated CABG, n (%)	14 (16%)	28 (26%)	0.116
Isolated valve surgery, n (%)	18 (20%)	26 (24%)	0.607
Complex and combined cases, n (%)	53 (59%)	44 (41%)	0.015
Other procedures, n (%)	5 (6%)	10 (9%)	0.422
CPB time, min (mean ± SD)	131 ± 55	118 ± 49	0.115
X-clamp time, min (mean ± SD)	88 ± 37	81 ± 39	0.262
Open surgical tracheostomy/ Percutaneous tracheostomy	12/78	20/89	0.091

Abbreviations: CABG, coronary artery bypass graft; CPB, cardiopulmonary bypass; COPD, chronic obstructive pulmonary disease; CVA/TIA, cerebrovascular accident/transient ischemic attack; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association; PVD, peripheral vascular disease; SD, standard deviation.

to 2 different time periods. Multivariate stepwise forward logistic regression analysis then was performed with univariate predictors of statistical significance to find the independent predictors of mortality. All p values of 0.05 and less were considered as statistically significant. Statistical analysis was performed using SPSS 11.5 for Windows.

RESULTS

During the study period, 6,069 patients underwent cardiac surgery; among them, 199 patients (3.26%) received a tracheostomy. In 32 patients, the tracheostomy was performed using an open surgical technique, and in 167 patients, a percutaneous technique was used. There were 90 patients in Group I and 109 patients in Group II. There was no significant difference in the severity of the patients' illness between the groups (Table 1). Mortality at 3 months, 6 months, 1 year, and 2 years was significantly higher in Group II (≥15 days) compared to Group I (0-14 days). Mortality at 30 days, hospital and ICU stay, and ventilation time were similar in both groups (Table 2). Overall mortality is shown in Table 2. Univariate analysis identified 7 risk factors for 1-year mortality (Table 3). When these risk factors were entered into the multiple logistic regression models, the authors found 2 risk factors for 1-year mortality, late tracheostomy, and nonelective, urgent, or emergent surgery (Table 4). Survival functions for the 2 groups of patients are shown in Figure 1. Maximal mortality was observed in the period between 1 month and 6 months. The complication rate was 6.1%. The authors observed 9 episodes of minor bleeding and one episode of death on day 56 due to massive bleeding, probably from the innominate artery. In the 2 patients, they performed re-tracheostomy because of cannula dislodgement. Incidence of deep

Table 2. Outcome Parameters

	All Patients	Group I 0-14 days	Group II ≥15 days	p Value
Number of patients		90	109	
Hospital stay, days (mean ± SD)		31 ± 32	39 ± 45	0.154*
ICU stay, days (mean ± SD)		27 ± 21	31 ± 23	0.169*
Ventilation time, days (mean ± SD)		16 ± 11	21 ± 14	0.165*
Deep sternal wound infection, n (%)		1 (1.11%)	9 (8.26%)	0.007*
30-day mortality, n (%)	33 (16.6%)	16 (17.8%)	17 (15.6%)	0.705*
3-month mortality, n (%)	96 (48.2%)	33 (36.7%)	63 (57.8%)	0.004*
6-month mortality, n (%)	119 (59.8%)	43 (47.8%)	76 (69.7%)	0.002*
1-year mortality, n (%)	131 (65.8%)	50 (55.6%)	81 (74.3%)	0.007*
2-year mortality, n (%)	136 (68.3%)	52 (57.8%)	84 (77%)	0.006*

Abbreviations: ICU, intensive care unit; SD, standard deviation.

*Group I *v* Group II