Tracheostomy after cardiovascular surgery: An assessment of long-term outcome

Peter A. Walts, MD,[a] Sudish C. Murthy, MD, PhD,[a] Alejandro C. Arroliga, MD,[b] Jean-Pierre Yared, MD,[c] Jeevanantham Rajeswaran, MSc,[d] Thomas W. Rice, MD,[a] Bruce W. Lytle, MD,[a] and Eugene H. Blackstone, MD[a,d]

Supplemental material is available online.

Objective: To ascertain long-term survival, identify risk factors for death, and document complications of tracheostomy after cardiovascular surgery.

Methods: Between January 1, 1998, and September 1, 2001, 188 (1.4%) of 13,191 patients undergoing cardiovascular surgery had tracheostomy for respiratory failure 5 to 79 days (median, 14 days) after surgery. Factors associated with mortality were identified in the hazard function domain, and mode of death and complications of tracheostomy were determined by follow-up.

Results: Survival was 75%, 50%, and 31% at 30 days, 3 months, and 2 years, respectively. The most important risk factors for death were older age ($P = .004$) and variables representing deteriorating hemodynamic ($P < .0001$), respiratory ($P < .0001$), and renal ($P = .0001$) function between the index cardiovascular operation and tracheostomy. The mode of death was isolated respiratory failure in only 21 (16%) of 130 patients, but multisystem organ failure in 71 (55%). Follow-up of 58 survivors identified voice complaints in 13 (24%), tracheal stenosis in 5 (9.2%), and permanent tracheostomy in 3 (6%).

Conclusions: Only one third of patients undergoing tracheostomy after cardiovascular surgery survive, because it is used primarily in those with deteriorating function of multiple organ systems. Although tracheostomy may enhance patient comfort and simplify nursing care, selection algorithms need to be developed if survival is the goal of the intervention.

GTS

From the Departments of Thoracic and Cardiovascular Surgery,[a] Pulmonary and Critical Care Medicine,[b] Cardiothoracic Anesthesia,[c] and Quantitative Health Sciences,[d] The Cleveland Clinic Foundation, Cleveland, Ohio.

Received for publication May 20, 2005; revisions received Aug 12, 2005; accepted for publication Sept 9, 2005

Address for reprints: Sudish C. Murthy, MD, PhD, Department of Thoracic and Cardiovascular Surgery, The Cleveland Clinic Foundation, 9500 Euclid Ave/Desk F24, Cleveland, OH 44195 (E-mail: murthys1@ccf.org).

J Thorac Cardiovasc Surg 2006;131:830-7

0022-5223/$32.00

doi:10.1016/j.jtcvs.2005.09.038

Tracheostomy for patients admitted to medical intensive care units (ICUs) is associated with favorable short-term outcomes.[1-4] In contrast, few data are available on the short- and long-term outcome of tracheostomy in the cardiovascular surgery ICU setting.[5,6] In medical ICUs, a favorable short-term outcome may reflect careful triage; in cardiovascular surgery ICUs, respiratory failure is a less anticipated event for which tracheostomy may be more liberally used. Therefore, the purposes of this study were to determine time-related survival after tracheostomy after cardiovascular surgery, identify risk factors for death and ascertain mode of death, and document early and late complications of tracheostomy. With this information, we sought to identify patients most likely to survive tracheostomy after cardiovascular surgery.

Patients and Methods

Patients

Between January 1, 1998, and September 1, 2001, 188 (1.4%) of 13,191 patients undergoing cardiovascular surgery at The Cleveland Clinic Foundation received 189 tracheostomies (1 patient had 2 tracheostomies 6 months apart, and these were considered as independent occurrences). Cardiac transplant patients and those with ventricular assist devices were not included.

Abbreviations and Acronyms
CL = confidence limit
ICU = intensive care unit
MSOF = multisystem organ failure
PEEP = positive end-expiratory pressure

To appreciate the changing nature of patient condition from initial operation to tracheostomy, information was gathered (1) before surgery, through the cardiovascular operation (Tables 1 and 2), and immediately after the operation (initial admission to ICU; Tables 3 and 4) and (2) at tracheostomy, including interim events and changes in measurements and medications occurring between ICU admission and tracheostomy (Tables 5 and 6). Data were collected prospectively and concurrently with patient care and recorded in the Cardiothoracic Anesthesia Database, which has been approved for research by the institutional review board. These data were supplemented by a detailed review of medical records.

Technique of Tracheostomy

Tracheostomy was performed by an open technique, described previously.[7] With few exceptions, the procedure was performed in the operating room.

Follow-up

Follow-up was 93% complete (175 of 188 patients) and was obtained by review of medical records and telephone interviews with patients, their families, or referring physicians by using institutional review board–approved protocols and questionnaires. For patients not traced, a search of the Social Security Death Index was used to determine vital status.[8,9] The mean and standard deviation of follow-up among survivors was 2.1 ± 0.99 years; 10% were followed more than 3.5 years. Outcome measures are defined in Appendix 1.

TABLE 1. Preoperative and intraoperative characteristics of tracheostomy patients: categorical variables (n = 189)

Characteristic	No. (%)
Male	103 (55)
Emergency operation	12 (6)
Cardiac status	
Severe LV dysfunction (EF <35%)	43 (23)
Pulmonary hypertension	36 (19)
Previous cardiac operation	71 (38)
Noncardiac comorbidity	
History of smoking	119 (63)
COPD/asthma	41 (22)
Hypertension	117 (62)
Stroke	34 (18)
Renal failure requiring dialysis	7 (4)
Diabetes	45 (24)
Cardiac procedure	
CABG	111 (59)
AV repair or replacement	62 (33)
Myectomy	2 (1)
MV repair or replacement	73 (39)
Thoracic aortic surgery	44 (23)

AV, Aortic valve; *CABG,* coronary artery bypass grafting; *COPD,* chronic obstructive pulmonary disease; *EF,* ejection fraction; *LV,* left ventricular; *MV,* mitral valve.

TABLE 2. Preoperative characteristics of tracheostomy patients: continuous variables

Characteristic	Mean ± SD
Demography	
Age (y)	69 ± 11
BMI (kg/m^2)	27 ± 6
Serum chemistries	
Albumin (g/dL)	3.6 ± 0.68
Creatinine (mg/dL)	1.5 ± 1.3
Bilirubin (mg/dL)	0.87 ± 0.83*

BMI, Body mass index. *Median (15th, 85th percentiles): 0.6 (0.4, 1.2).

Data Analysis

Descriptive statistics. Categorical variables are summarized by frequencies and percentages, and continuous variables are summarized by means and standard deviations or medians and 15th and 85th percentiles. For consistency, coefficients in multivariable models are presented with 1 SE of the estimates, and probabilities and hazard estimates are accompanied by asymmetric 68% confidence limits (CLs) equivalent to 1 SE.

Survival after tracheostomy. Estimates of survival were obtained by the Kaplan-Meier method and by a parametric method that resolves the number of phases of instantaneous risk and estimates shaping parameters.[10] (For additional details, see http://www.clevelandclinic.org/heartcenter/hazard.)

TABLE 3. Characteristics of patients upon admission to the intensive care unit: categorical variables (n = 189)

Characteristic	No. (%)
Medications given during first 24 h in ICU	
Epinephrine	110 (58)
Milrinone	62 (33)
Dobutamine	17 (9)
Norepinephrine	89 (47)
Phenylephrine	11 (6)
Vasopressin	15 (8)
Lidocaine	16 (8)
Amiodarone	18 (10)
Ventilatory settings	
Pressure control	25 (13)
CPAP	25 (13)
Assist control	5 (3)
SIMV	134 (71)

CPAP, Continuous positive airway pressure; *ICU,* intensive care unit; *SIMV,* synchronized intermittent mandatory ventilation.

GTS