American Journal of Infection Control 41 (2013) 1264-7

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Drainage days—an independent risk factor for serious sternal wound infections after cardiac surgery: A case control study

Sarah Tschudin-Sutter MD [a], Ruth Meinke MSc [a], Heinz Schuhmacher RN [a], Marc Dangel MPH [a], Friedrich Eckstein MD [b], Oliver Reuthebuch MD [b], Andreas Franz Widmer MD, MSc [a,*]

[a] Division of Infectious Diseases and Hospital Epidemiology, University Hospital, Basel, Switzerland
[b] Department of Surgery, University Hospital, Basel, Switzerland

Key Words:
Surgical site infections
Postoperative drainage
Sternotomy

Background: Postoperative sternal wound infections are a potentially devastating complication following cardiac surgery. The aim of our study was to determine risk factors associated with patients' baseline characteristics and peri- and postoperative management for the development of surgical site infections (SSIs) after cardiac surgery involving sternotomy.

Methods: Since 2009 the University Hospital of Basel, a tertiary care center in Switzerland, has participated in the national SSI-surveillance program by conducting postdischarge surveillance. We conducted a nested case-control study involving 30 consecutive patients with an organ/space SSI after cardiac surgery and 60 control patients.

Results: Receipt of antibiotics before operation (odds ratio [OR], 1.20; 95% confidence interval [CI], 1.02-1.41; $P = .032$), decreased albumin levels (OR, 0.87; 95% CI, 0.76-0.99; $P = .040$, respectively), time on extracorporal circulation (OR, 1.02; 95% CI, 1.00-1.03; $P = .012$), number of drainages (OR, 9.15; 95% CI, 2.01-41.76; $P = .004$), length of drain retention (OR, 1.44; 95% CI, 1.10-1.90; $P = .009$), and resuscitation (OR, 7.30; 95% CI, 1.53-34.71; $P = .012$) were associated with SSIs. Incidence density drainage days—accounting for both number of drains and length of retention—were the only independent risk factor (OR, 1.12; 95% CI, 1.02-1.11; $P = .018$).

Conclusions: Retention of drainages in the operative site longer than 48 hours was the only independent risk factor for the development of organ/space sternal wound infections after cardiac surgery.

Postoperative organ/space sternal wound infections are a potentially devastating complication following cardiac surgery. The idea of using median sternotomy as an approach to thoracic organs was conceived in the late 1800s.[1] More than a century later, prevention and treatment of infective complications related to this procedure remain a formidable challenge for cardiothoracic and plastic surgeons, as well as infectious diseases specialists.[2] The incidence of organ/space sternal infection after cardiac surgery is relatively low. The literature reports rates from 0.16%- 5%.[3-5] However, sternal wound infections lead to increased morbidity and mortality with rates ranging from 20%-50%,[2] as well as substantial health care-related expenditures. The average cost for hospitalization of patients with wound infection is 3 times that of patients with an uncomplicated postoperative course.[6,7] Excess costs are primarily due to associated high morbidity, prolonged hospital stay, and the need for repeated surgical procedures in these patients.[8,9]

To reduce morbidity, mortality, and costs, prevention of organ/space sternal wound infections in patients receiving cardiac surgery is of greatest importance. Some risk factors for the development of sternal wound infections have been well described, such as obesity, use of bilateral internal mammary arteries in coronary artery bypass grafting associated with diabetes,[10-12] prolonged operative time, and the need for repetitive blood transfusions in the early postoperative period.[2,6,10,13] However, many results of analyses of risk factors remain conflicting, especially regarding their independence. Furthermore, the population of patients undergoing cardiac surgery has changed substantially during the past decade, due to the broader application of percutaneous coronary intervention.[14] An increasing proportion of patients are referred for complex cardiac procedures such as multiple-valve surgery, combined valve and coronary artery bypass graft (CABG) surgery, or

* Address correspondence to Andreas F. Widmer, MD, MSc, Division of Infectious Diseases and Hospital Epidemiology, University Hospital Basel, Petersgraben 4, CH-4031 Basel, Switzerland.
E-mail address: widmerA@uhbs.ch (A.F. Widmer).

Conflicts of interest: None to report.

0196-6553/$36.00 - Copyright © 2013 by the Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ajic.2013.03.311

Table 1
Baseline characteristics and findings on admission

	Cases (n = 30)		Controls (n = 60)			
Preoperative characteristics and risk factors	n or mean	% or SD	n or mean	% or SD	OR	95% CI
Baseline characteristics on admission						
Age	65.50	11.98	66.13	11.31	NA	NA
Sex						
Man	20	66.7%	40	66.7%	NA	NA
Woman	10	33.3%	20	33.3%		
Underlying diseases						
Chronic obstructive pulmonary disease	4	13.3%	2	3.3%	6.61	0.72-60.86
Diabetes mellitus	11	36.7%	15	25.0%	1.95	0.69-5.48
Peripheral artery occlusive disease (stages III/IV)	1	3.3%	5	8.3%	0.35	0.04-3.35
Previous stroke	2	6.7%	3	5.0%	1.37	0.21-8.59
Cancer	2	6.7%	6	10.0%	0.67	0.13-3.30
Immunosuppression	1	3.3%	0	0.0%	NA	NA
Chronic renal failure	6	20.0%	7	11.7%	1.80	0.57-5.69
Dialysis	0	0.0%	1	1.7%	NA	NA
Smoking or alcohol consumption	11	36.7%	17	28.3%	1.44	0.58-3.60
Pacemaker	0	0.0%	0	0.0%	NA	NA
Body mass index	29.80	5.36	27.60	4.56	1.10	0.99-1.22
Receipt of antibiotics before operation	3	10.0%	0	0.0%	1.200	1.02-1.41
Known infection before operation	4	13.3%	3	5.0%	6.61	0.72-60.86
Length of preoperative hospital stay	3.27	4.27	3.57	5.91	0.89	0.61-1.30
Labaratory findings on admission						
C-reactive protein (mg/L)	15.53	45.54	4.07	8.27	1.04	0.99-1.09
Creatinine clearance (mL/min)	85.72	36.19	92.10	41.72	0.99	0.98-1.01
Hemoglobin (g/L)	135.40	21.04	136.80	15.50	0.99	0.97-1.02
Glucose >10 mmol/L	5	16.7%	6	10.0%	1.91	0.49-7.42
Albumin (g/L)	37.47	4.23	39.33	3.76	0.87	0.76-0.99

CI, confidence interval; *NA*, not applicable; *OR*, odds ratio.

aortic procedures, whereas the number of patients undergoing isolated CABG surgery has steadily decreased.[15] Therefore, risk factors identified by previous studies may not be applicable to current clinical practice.

The aim of our study was to determine independent risk factors associated with patients' baseline characteristics and the peri- and postoperative management for the development of organ/space sternal wound infections after cardiac surgery involving sternotomy by a case-control study design.

METHODS

Setting

The University Hospital of Basel is a 855-bed tertiary care center in Basel, Switzerland, performing up to 28,000 inpatient surgical interventions. Approximately 700 open heart procedures are performed annually.

Since 2009 the University Hospital of Basel has participated in the national surgical site infection (SSI) surveillance program with postdischarge surveillance, using the Centers for Disease Control and Prevention definitions of SSI.[16] The study was approved by our institutional review board as part of the quality improvement program.

Study design

To determine risk factors for deep sternal wound infections, we conducted a nested case control study from data generated by the prospective surveillance program. Thirty consecutive patients were included as cases after development of an organ/space SSI involving the sternum, as defined by Centers for Disease Control and Prevention definitions for SSIs[16] after cardiac surgery between January 2009 and May 2010 involving sternotomy. Sixty control patients after heart surgery via sternotomy without development of an SSI were frequency matched, according to age (± 10%), gender, identical kind of heart-surgery, and preoperative length of hospital stay (± 2 days).

Patient demographics and risk factors for SSI were prospectively collected using a standardized case report form as part of the ongoing surveillance of SSIs. Risk factors were assigned as preoperative, perioperative, and postoperative.

Preoperative characteristics and risk factors included the patients' baseline characteristics such as gender, age, underlying diseases (eg, chronic obstructive pulmonary disease, diabetes mellitus, vascular occlusive disease, previous stroke, cancer, chronic renal failure, obesity, and presence of a pacemaker), smoking or alcohol abuse (at the time of surgery), immunosuppressive medication (≥0.5 mg/kg prednisone, or equivalent doses of other steroids and other immunosuppressive agents), dialyses, laboratory findings on admission (eg, hemoglobin, C-reactive protein, creatinine clearance, glucose, and albumin), receipt of antibiotics and diagnosis of infections on admission before the operation, and length of preoperative hospital stay.

Perioperative characteristics and risk factors included type of surgery, emergency procedure, reoperation, foreign body implant, number and type of grafts, off-pump procedure, American Society of Anesthesiologists score, wound contamination class, time of administration of preoperative antibiotic prophylaxis, administration of a second dose of antibiotics during surgery, intraoperative blood loss, time on extracorporal circulation, intraoperative central temperature, type of sternum closure (wires or other means of osteosynthesis), and number of drains placed in the operative site.

The administration of preoperative antibiotic prophylaxis was classified as correct when it was administered 0-60 minutes before cut.[17,18]

Postoperative characteristics and risk factors recorded included postoperative complications other than infections, duration of retention of drainages placed in the operative site, incidence density of drainage days (calculated as number of drainages multiplied by the number of drainages in situ), number of pacing-wires