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Sternal surgical site infection in Egypt following coronary artery bypass graft surgery: incidence and risk factors

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Sir,

Sternal wound surgical site infection (SSI) following coronary artery bypass graft (CABG) is a serious but preventable surgical complication [1]. Whereas evidence suggests that the burden of sternal SSI is greatest in low- and middle-income settings, the majority of published incidence measure and risk factor assessment is limited to high-income/ high-resource settings [2,3]. Here we present 12-month sternal SSI incidence following CABG surgery with associated risk factors in a high-functioning, but resource-limited, healthcare setting. The study was conducted between July 2015 and June 2016 at the 200-bed Cardiovascular Hospital at Ain Shams University Hospitals (CVH-ASUHs). The study population was restricted to adult patients (aged ≥18 years) who underwent a scheduled, non-emergent, CABG procedure. Only the sternal surgical wound was assessed for infection.

Infection control staff prospectively monitored post-CABG patients throughout their inpatient stay for signs suggesting sternal SSI through regular wound assessment and medical record review. Data were collected on perioperative risk factors, patient preparation before surgery, and patients' clinical outcomes. Active case-finding post-discharge was not done; however, staff did monitor for readmission or relevant clinic visits for up to 90 days.

Case determination was based on diagnosis by the attending surgeon or through case review performed by the hospital infection control team. Infections were categorized as superficial (superficial incision) or deep (deep incisional SSI or organ/ space SSI) guided by the Centers for Disease Control and Prevention National Healthcare Safety Network 2014 definitions. All patients with sternal SSI had clinical specimens obtained for culture. Association with

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Conflict of interest statement

E.A., M.W., S.A., M.S., O.S., M.T. have no conflicts of interest to declare. E.A., O.S., M.T. are contractors of the US Government and this work was prepared as part of their work.

sternal SSI was assessed by Student's *t*-test, Mann–Whitney *U*-test, or Pearson's χ^2-test as appropriate. Logistic regression was used to account for multiple predictors of infection.

Based on hospital policy, patients were instructed to shower the night before surgery using either soap or a povidone-iodine solution provided. Sternal site preparation was done with a povidone-iodine skin preparation immediately prior to incision. Patients received pre-procedure antibiotic prophylaxis with cefazolin, 2 g intravenously, within 60 min of their procedure but there was no standard policy regarding postoperative antibiotic prophylaxis.

During the study period, 552 adult patients underwent a CABG procedure. Most patients were male (75.7%; 418/552), had an American Society of Anesthesiologists score ≥3 (85.0%; 469/552), and a median age of 54 years (range: 19–73). Sternal SSI developed in 45/552 patients (8.2%) with 21/45 (46.7%) classified as superficial and 24/45 (53.3%) as deep. The median duration between surgery and infection symptom onset was six days (range: 2–70 days) and 75.5% (34/45) of infections were identified prior to discharge. Median inpatient length of stay for patients with sternal SSI was 16 days (range: 7–33) with one inpatient death (case fatality rate: 2.1%). Patients with sternal SSI had significantly longer hospitalization but did not have increased inpatient mortality (Table I). Microbial aetiology was identified in 30/45 (66.7%) of sternal wounds. *Staphylococcus aureus* (31%; 14/30) and Enterobacteriaceae (27%; 8/30) were the most frequent isolates. Meticillin-resistant *Staphylococcus aureus* was identified in 57.1% (8/14).

In univariate analysis, sternal SSI was associated with preoperative shaving, preoperative showering with soap alone, higher preoperative blood sugar, shorter intubation period, reexploration within 24 h, and longer post-surgical antibiotic prophylaxis. Sternal SSI was not associated with patient sex, smoking, diabetes, body mass index, or any measured intraoperative factors (Table I).

Multivariate analysis revealed longer antibiotic prophylaxis post surgery (odds ratio: 1.08; 95% confidence interval: 1.01–1.04; $P < 0.001$), preoperative bathing with soap compared to povidone-iodine (3.7; 1.8–7.3; $P < 0.001$), and preoperative blood sugar >180 mg/dL (2.1; 1.1–4.0; $P = 0.03$) as independent predictors of sternal SSI infection in this population.

The observed 8.2% overall incidence of sternal SSI is in line with general SSI rates (3–9%) cited from high-resource European settings, but is notably lower than SSI rates published from comparable regions [1,4]. Whereas the lower-than-expected sternal SSI rate observed may be attributed to differences in surveillance methodology, our study was done in the context of an ongoing healthcare-associated infection (HCAI) prevention programme at CVH-ASUH since 2014.

The study has several limitations. Because we relied on data collected through an established surveillance system, possible predictors of infection such as patient comorbidities and details from the intraoperative period were limited. Additionally, facility-wide HCAI prevention and infection prevention and control activities throughout the study period were not well characterized and may have impacted observed associations in unpredictable ways. With these limitations accepted, the observed SSI rate of 8.2% provides a measure of SSI risk in a resource-limited setting with an engaged and active infection prevention control programme.

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Table I

Univariate association of perioperative factors and diagnosis of a sternal SSI within 90 days of a coronary artery bypass graft procedure – Cardiovascular Hospital at Ain Shams University Hospital, Cairo, Egypt

Factor	All patients	SSI	No SSI	OR (95% CI)	*P*-value
Total no. of patients	552 (100%)	45 (100%)	507 (100%)	–	–
Patient characteristics					
Age (years)[a]	54 (19–73)	56 (40–69)	54 (19–73)	–	0.07
Sex (male)	418 (75.7%)	36 (80.0%)	382 (75.3%)	1.3 (0.6–2.7%)	0.50
History of smoking (ever)	379 (68.7%)	33 (73.3%)	346 (68.2%)	1.1 (0.6–2.3%)	0.70
Diabetes (yes)	276 (50.0%)	27 (60.0%)	249 (49.1%)	1.4 (0.7–2.6%)	0.30
Body mass index (kg/m^2)[a]	30.4 (19.1–50.7)	31.2 (21.5–47.9)	30.4 (19.1–50.7)	–	0.20
Preoperative factors					
Hair removal					
Shaved	241 (43.6%)	27 (60.0%)	214 (42.2%)	2.1 (1.1–3.9)	0.02
Clipped	300 (54.3%)	17 (37.8%)	283 (55.8%)	Reference	
Hair removal					
Surgical ward	171 (31.0%)	20 (44.4%)	151 (29.8%)	1.8 (0.9–3.4)	0.06
Operating room	373 (67.6%)	25 (55.5%)	348 (68.6%)	Reference	
Preoperative shower					
Soap	125 (22.6%)	21 (46.7%)	104 (20.5%)	3.4 (1.8–6.4)	<0.001
Povidone iodine	409 (74.1%)	23 (51.1%)	386 (76.1%)	Reference	
ASA score ≥3	469 (85.0%)	44 (97.8%)	425 (83.8%)	7.7 (1.1–56.5)	<0.01
Haemoglobin (g/dL)[a]	13 (5–16)	13 (9–16)	13 (5–16)	–	0.70
Serum creatinine (mg/dL)[a]	1 (1–9)	1 (1–9)	1 (1–9)		0.4
Left ventricular ejection fraction[a]	60 (19–80)	59 (22–74)	60 (19–80)	–	0.17
Preoperative blood sugar (mg/dL)[a]	155.6 (59–579)	156 (60–466)	128 (59–579)	–	0.008
Preoperative hospital stay (days)[a]	3 (0–43)	2 (0–43)	3 (0–34)	–	0.6
Intraoperative factors					
Surgery time (min)[a]	315 (195–470)	315 (250–390)	315 (195–470)	–	0.7
Cardiopulmonary bypass time (min)[a]	96 (60–150)	100 (60–135)	95 (36–150)	–	0.9

Factor	All patients	SSI	No SSI	OR (95% CI)	*P*-value
Aortic cross-clamp time (min)[a]	60 (37–110)	60 (36–105)	60 (37–110)	–	0.8
Blood products					
RBCs (units)[a]	2 (1–4)	2 (1–4)	2 (1 –4)	–	0.16
Plasma (units)[a]	2 (1–3)	2 (1–3)	2 (1 –3)		0.40
Postoperative factors					
Day 1 blood sugar (mg/dL)[a]	193.2 (85–400)	200 (85–350)	192 (89–400)	–	0.06
Intubation period (days)[a]	1 (1–37)	1 (1 –27)	1 (1–37)	–	0.04
No. of drains placed[a]	1 (1–4)	1 (1–3)	1 (1–4)	–	0.3
Re-exploration (within 24 h)	43 (7.8%)	8 (17.8%)	35 (7.0%)	2.7 (1.2–6.3)	0.02
Antimicrobial prophylaxis agents					
First-generation cephalosporin	459 (83.1%)	36 (80.0%)	423 (83.4%)	0.8 (0.4–1.7)	0.5
Third-generation cephalosporin	60 (10.9%)	12 (26.7%)	48 (9.5%)	3.5 (1.7–7.2)	<0.001
Quinolone	203 (36.8%)	23 (51.1%)	180 (35.5%)	1.9 (1.1–3.5)	0.04
Carbapenem	72 (13.0%)	13 (28.9%)	59 (11.6%)	3.1 (1.5–6.2)	0.01
Vancomycin	287 (52.0%)	25 (55.6%)	262 (51.7%)	1.2 (0.6–2.1)	0.6
Antimicrobial prophylaxis					
Duration days[a]	9 (2–39)	11 (2–39)	8 (2–38)	–	0.004
Outcomes					
Inpatient days[a]	13 (5–33)	16 (7–33)	12 (5–17)		0.009
Deaths	49	1 (2.1%)	41 (8.5%)		0.1

SSI, surgical site infection; OR, odds ratio; CI, confidence interval; ASA, American Society of Anesthesiologists; RBCs, red blood cells.

[a]Median (range).