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A polymicrobial outbreak of surgical site infections following cardiac surgery at a community hospital in Florida, 2011–2012

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Abstract

We describe an outbreak of 22 sternal surgical site infections following cardiac surgery, including 4 *Gordonia* infections. Possible operation room environmental contamination and suboptimal infection control practices regarding scrub attire may have contributed to the outbreak.

Keywords

Gordonia; Environmental contamination; Infection control

Surgical site infections (SSIs) are an important cause of morbidity following cardiac surgeries, including coronary artery bypass grafting (CABG).¹ Staphylococci and *Enterobacteriaceae* account for approximately 65% of cardiac SSIs reported to the National Healthcare Safety Network surveillance system.² SSIs caused by environmental organisms are less commonly reported.²

On March 2, 2012, the Florida Department of Health and the Centers for Disease Control and Prevention (CDC) were notified of an outbreak of sternal SSIs among cardiac surgery patients in a community hospital, which performs approximately 400 open heart surgeries per year. Twenty-two infections were identified from August 1, 2011, through February 29,

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2012. Although more than 8 pathogens were identified, 4 case-patients' specimens grew *Gordonia* spp, gram-positive, slow-growing environmental bacteria that rarely cause hospital-acquired infections.³ This report describes this cluster of SSIs and the subsequent investigation.

METHODS

Case definition and description

A case-patient was defined as a patient diagnosed with a sternal SSI within 1 year following CABG or valve replacement surgery performed at hospital A between August 1, 2011, and February 29, 2012, and with at least 1 of the following at the time of diagnosis: (1) drainage from the incision; (2) pain, redness, or swelling at the incision; (3) any bacteria isolated from sternal wound fluid or tissue cultures. Case-patient charts were reviewed to obtain demographics, underlying conditions, clinical presentations, and surgery indicators.

Patient care and infection control observations

The cardiac surgeons and cardiovascular operating room (CVOR) staff were interviewed about routine clinical practices, and a mock surgery was observed by the investigation team. Postoperative wound care, environmental cleaning and disinfection, surgical equipment sterilization, and CVOR environmental indicators (air pressure, temperature, and relative humidity) were reviewed.

Laboratory analysis

Because other isolates were not saved, only 4 *Gordonia* isolates from surgical wound cultures were available and sent to the CDC for pulsed-field gel electrophoresis (PFGE). Hand cultures were collected from 23 CVOR staff participating in most of the cardiac surgeries during the investigation time period using a Handi-Wipe method.⁴ Sponge-Sticks (3M, St. Paul, MN) were used to collect surface samples from multiple CVOR surfaces. Air samples in the CVOR suite were collected using a SAS Super 90 microbiologic air sampler (PBI International, Milan, Italy).

RESULTS

Case description

There were 22 case-patients identified at hospital A from August 1, 2011, through February 29, 2012 (crude rate 10 per 100 surgeries) (Fig 1). No bacteria were recovered from wound cultures obtained from 8 case-patients (2 received antimicrobials prior to specimen collection). Organisms identified from the other 14 case-patients included *Gordonia bronchialis* (n = 3), *Gordonia terrae* (n = 1), *Pseudomonas aeruginosa* (n = 4), *Proteus mirabilis* (n = 3), methicillin-resistant *Staphylococcus aureus* (n = 3), methicillin-sensitive *Staphylococcus aureus* (n = 1), *Serratia marcescens* (n = 1), *Escherichia coli* (n = 1), and *Candida albicans* (n = 1). A description of cases, stratified by culture results, is provided in Table 1. Of note, the time from surgery to symptom onset was longer for *Gordonia* case-patients than case-patients with other organisms (34 vs 22 days, respectively).

Review of patient care and infection control practices

Patient care—Antimicrobial prophylaxis timing was appropriate for most cases; however, antimicrobial dosing was often inadequate primarily because of under-dosing of obese patients.⁵ The mock surgery did not identify any potential systematic breaches in sterility or preoperative skin care. Postoperative wound care was found to be consistent with guidelines.⁶

Infection control—Staff were observed wearing home-laundered scrub attire and fleece jackets in the CVOR. A blood stain found on a blood cell saver after cleaning, suggesting this process was insufficient. Cleaning of the substerile room was also inadequate. Two CVORs underwent remodeling in June and July 2011, just prior to the beginning of the outbreak. Review of the construction records and staff interview indicated that recommended infection control precautions regarding physical barriers between operating rooms (OR) and construction areas, air pressure, and construction personnel attire^{7,8} were not consistently followed. After construction, humidity in 1 CVOR was found to be higher than the recommended upper limit of 60%⁹; during our investigation, air pressure inside that CVOR was found to be lower than the pressure in the adjacent substerile room resulting in airflow into the CVOR from adjacent spaces.

Laboratory analysis

S aureus was identified from hand cultures of a nurse, a perfusionist, and a surgeon. *E coli* was identified from a hand culture sample of a nurse anesthetist. Two of the 3 *G bronchialis* isolates obtained from the case-patients were closely related by PFGE (Fig 2). Neither *Gordonia* spp nor any other organisms isolated from case-patients were recovered from any environmental samples (eg, CVOR air samples, surface swabs) or the hands cultures from health care workers sampled.

DISCUSSION

A polymicrobial and polyclonal cluster of sternal SSIs following cardiac surgery occurred at hospital A from August 2011 through February 2012, including 4 infections caused by *Gordonia* species. An on-site investigation suggested that multiple factors may have contributed to environmental contamination, including suboptimal CVOR pressure and humidity control, use of non-OR attire in the OR, inadequate cleaning, and failure to implement appropriate infection control precautions during construction.

Gordonia are gram-positive organisms found in soil and dust and have been identified only rarely as a cause of health care-associated infections, including SSIs.¹⁰ Isolation and identification of *Gordonia* from clinical cultures can be challenging.¹¹ In this investigation, *Gordonia* spp were identified in specimens from 4 of the 22 case-patients. In addition, 8 case-patients' specimens were culture negative and might have represented additional *Gordonia* infections; cultures that would detect these organisms were not routinely ordered. This is further supported by the fact that the culture-negative and *Gordonia* case-patients often appeared to present with milder symptoms than those with other pathogens (eg, often without fever and pain). Wound cultures from *Gordonia* case-patients were initially reported

as negative before being isolated after prolonged specimen incubation. When SSIs are identified and routine cultures are unrevealing, providers should consider the possibility that they are caused by atypical environmental organisms and consider appropriate cultures. This might include cultures for rapid growing, acid-fast bacilli; fungi; or other suspected organisms.

There have been 2 previous reports of clusters of *Gordonia* SSIs following cardiac surgeries. The first report described a cluster of 7 case-patients over an 8-month period in a hospital, in which an OR nurse and her dogs were found to be colonized with *Gordonia* strains matching the patient strains.¹⁰ A second outbreak of 3 *Gordonia bronchialis* SSIs among cardiac surgery patients occurred 1 year prior to our investigation in a hospital within the same state as hospital A.¹² In that investigation, a nurse anesthetist, who was involved in all 3 cases, was found to be colonized on her hands with the PFGE-matched outbreak strain. The strain was also recovered from the nurse's surgical scrubs. The nurse became negative after discarding her old washing machine, suggesting that home laundering of surgical attire might have contributed to contamination. No links were identified between this outbreak and the outbreak involving hospital A. In the outbreak at hospital A, home-laundered scrub attire and fleece jackets were used by CVOR staff and could have been contaminated with these organisms in a similar fashion. However, the use of home-laundered attire in the OR remains controversial; whereas CDC guidelines do not have recommendations on how or where to launder scrub attire,⁶ the Association of Operating Room Nurses recommends attire not be home laundered.¹³ Our investigation had some limitations. Because of the closure of all the CVOR as a result of this outbreak, we were unable to observe an actual surgery. Other positive clinical cultures were not available for analyses. Some SSI cases may not have been detected if they were treated in other facilities, especially given the long incubation period. Environmental testing occurred almost 2 months after the onset of case-patients' infections.

Following the investigation, the hospital worked to improve general infection control practices by strengthening hand hygiene, scrub attire, cleaning, and disinfection. The hospital also implemented interventions to address the identified CVOR environment issues, including fixing the air pressure and terminal cleaning of the CVOR. Hospital A's cardiac SSI rate returned to the preoutbreak level during the year after the investigation.

CONCLUSION

We describe a polymicrobial outbreak of sternal SSIs following cardiac surgery that included 4 *Gordonia* infections. The cause was likely multifactorial, including possible OR environmental contamination as a result of suboptimal OR pressure maintenance and infection control during construction and suboptimal infection control practices. These findings highlight the potential role of slow-growing environmental bacteria, such as *Gordonia* spp, in SSIs and highlight the importance of adhering to personal and environmental infection control standards.

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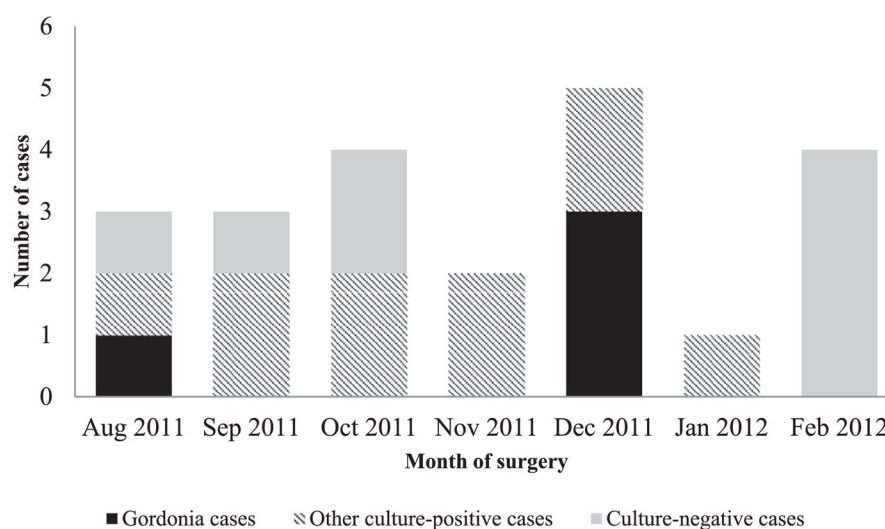


Fig 1.
Epidemic curve: sternal surgical site infections following cardiac surgery at hospital A from August 2011 through February 2012.



Fig 2.
PFGE results of 4 *Gordonia* isolates.

Table 1

Characteristics of case-patients and surgeries at hospital A from August 2011 through February 2012, stratified by culture results

	<i>Gordonia</i> cases (n = 4)	Other culture-positive cases (n = 10)	Culture-negative cases (n = 8)	All cases (N = 22)
Demographic and risk factors				
Sex, male, n (%)	3 (75)	2 (20)	6 (75)	11 (50)
Age, y, median (IQR)	59 (47–68)	64 (60–67)	59 (49–71)	64 (51–70)
Obesity, n (%) [*]	3 (75)	6 (60)	4 (50)	13 (59)
Diabetes, n (%)	1 (25)	9 (90)	5 (63)	15 (68)
Preoperative care				
Antimicrobial prophylaxis choice, n (%)				
Cefazolin	4 (100)	8 (80)	7 (88)	19 (86)
Vancomycin	1 (25)	4 (40)	1 (12)	6 (27)
Antimicrobial prophylaxis timing				
Appropriate timing, n (%) [†]	4 (100)	7 (70)	7 (88)	18 (82)
Duration (hours), median (IQR) [‡]	41 (39–51)	40 (38–52)	41 (40–43)	40 (40–45)
Antimicrobial prophylaxis dosing				
Appropriate dosing, n (%) [§]	0/2 (0)	0/5 (0)	1/4 (25)	1/11 (9)
Surgery and postoperative care				
CABG, n (%)	3 (75)	10 (100)	7 (88)	20 (91)
LIMA, n (%)	3 (100)	9 (90)	6 (86)	18 (90)
Length of surgery (min), median (IQR)	244 (214–311)	241 (225–251)	252 (247–271)	247 (228–260)
Had surgery in CVOR with recent construction, n (%)	3 (75)	9 (90)	8 (100)	20 (91)
Intraoperative glucose >180 mg/dL, n (%)	1 (33)	4 (40)	4 (50)	9 (43)
Highest glucose level 24 hours postoperatively > 180 mg/dL, n (%)	1 (25)	0 (0)	2 (25)	3 (14)
SSI characteristics				
Duration between surgery and SSI onset (days), median (range)	34 (29–47)	22 (21–105)	24 (12–102)	25 (12–105)
Symptom of SSI, n (%)				
Fever [¶]	0 (0)	3 (30)	1 (13)	4 (18)
Pain	1 (25)	6 (60)	0 (0)	7 (32)
Erythema	1 (25)	6 (60)	4 (50)	11 (50)
Drainage	4 (100)	8 (80)	8 (100)	20 (91)
Swelling	1 (25)	1 (10)	0 (0)	2 (9)
Treatment of SSI, n (%)				
Wound debridement	4 (100)	10 (100)	7 (88)	21 (95)
Negative-pressure wound therapy	4 (100)	8 (80)	8 (100)	20 (91)

CABG, coronary artery bypass graft; CVOR, cardiovascular operating room; IQR, interquartile range; LIMA, left internal mammary artery.

^{*} Obesity was defined as body mass index ≥ 30.

[†] Within 60 minutes prior to surgical incision for cefazolin and 120 minutes for vancomycin.

[‡] Antimicrobial prophylaxis duration following intraoperative closure of the surgical incision.

[§] Two grams for cefazolin and 15 mg/kg for vancomycin, according to the Clinical practice guidelines for antimicrobial prophylaxis in surgery⁵; frequencies showed for patients with available data.

^{||} One *Gordonia* case had missing data.

[¶] Two *Gordonia* cases had no information on fever; 2 had documentation of having no fever.