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Variation in Antibiotic Prophylaxis Selection for Coronary Artery Bypass Graft Procedures in an Era of Increasing Methicillin-Resistant *Staphylococcus aureus* Prevalence

Approximately 400,000 coronary artery bypass graft (CABG) procedures are performed annually in the United States.[1] Infection is the second most common complication, but appropriate preoperative antibiotic prophylaxis reduces the risk of surgical site infections (SSIs).[2]

There is no consensus on routine vancomycin use for CABG prophylaxis. National guidelines from the Infectious Diseases Society of America (IDSA), Society for Healthcare Epidemiology (SHEA), and others state, "there is no clear evidence to support the use of vancomycin, alone or in combination ... for routine antimicrobial prophylaxis in institutions that have a high prevalence of MRSA."[3(p219)] The IDSA/SHEA reserves vancomycin for individual patients at high risk for methicillin-resistant *Staphylococcus aureus* (MRSA) infection.[3] In contrast, the Society for Thoracic Surgery (STS) guidelines state, "it would appear most reasonable to employ a cephalosporin as the primary prophylactic agent ... [and vancomycin as] an adjuvant agent ... where there is a high prevalence of MRSA isolates from infections."[4(p1571)] To understand current practice, we conducted a survey of antibiotic prophylaxis for CABG among California hospitals (Appendix A, available online as a PDF). We surveyed all medical centers

that perform CABG surgery in California. Questions relating to prophylaxis included the following: (i) Which antibiotics are standard for isolated CABG?; (ii) What is the duration of prophylaxis? (iii) Are any individual patients given broader-spectrum prophylaxis to prevent infection? (iv) What is the frequency of broader-spectrum prophylaxis? v) Which antibiotics are used for broader-spectrum prophylaxis? Broader-spectrum prophylaxis was defined as anti-MRSA prophylaxis, anti-pseudomonal cephalosporins, carbapenems, or double gram-negative prophylaxis. Broader-spectrum prophylaxis excluded changes due to allergy. Respondents included healthcare professionals familiar with clinical practices (Table 1).

We collected hospital information from the California Department of Public Health (CA-DPH)[5] and the California Office of Statewide Health Planning and Development.[6] Hospitals were classified as high, normal, or low MRSA burden facilities using hospital MRSA bloodstream infection rates, as described by CA-DPH.[5] We collected the number of CABG procedures performed from 2009 to 2010, the geographic location of hospitals, and teaching hospital versus community.[6]

Bivariate analyses were performed using 2-sided Pearson χ^2 test, Fisher exact test, Student t test, or one-way analysis of variance. We used logistic regression to model i) predictors of routine vancomycin use and ii) predictors of prophylaxis, including vancomycin for individual patients. Variables significant at $\alpha = 0.20$ were included, and P values less than or equal to .05 were considered significant.

Eighty (67%) of 120 medical centers responded, including 70 community and 10 teaching hospitals. Surveys were completed by STS database managers (41%), cardiac surgery nurse practitioners (37%), infection control personnel (20%), and surgeons (2%). Respondents performed a mean of 140 procedures per year (minimum, 18 procedures; maximum, 793 procedures) with a mean hospital size of 358 beds (minimum, 60 beds; maximum, 900 beds). Seven hospitals (9%) had high MRSA bloodstream infection incidence, 62 hospitals (83%) had normal incidence, and 6 hospitals (8%) had low incidence.

The majority of hospitals (63 [79%] of 80) used a cephalosporin alone for routine CABG prophylaxis (cefazolin, 61 hospitals; ceftriaxone, 2 hospitals). Few hospitals (17 [21%] of 80) used vancomycin routinely; 3 hospitals used vancomycin alone, and 14 hospitals used vancomycin combined with a cephalosporin (vancomycin and cefazolin, 9 hospitals; vancomycin and ceftriaxone, 2 hospitals; vancomycin and cefuroxime, 3 hospitals).

In bivariate analysis, routine vancomycin use was associated with higher case volume ($P = .05$) and inversely associated with Southern California ($P = .05$). Hospitals with a low burden of MRSA were more likely to use vancomycin (4 [67%] of 6) than were those with a normal (11 [18%] of 62) or high (2 [29%] of 7; $P = .03$) burden of MRSA.

TABLE 1. Characteristics of Hospitals That Use Cephalosporin Alone Compared with Hospitals that use Vancomycin Alone or in Combination for Routine Prophylaxis of Coronary Artery Bypass Graft (CABG) Procedures

Hospital characteristic	Cephalosporin alone ($n = 58$)	Vancomycin alone or in combination ($n = 17$)	P
MRSA-BSI incidence, mean ± SD[1]	0.59 ± 0.43	0.56 ± 0.57	.84
MRSA-BSI incidence category[2]			**.02**
High	5 (71)	2 (29)	
Normal	51 (82)	11 (18)	
Low	2 (33)	4 (67)	
Bed size, mean ± SD	356 ± 163	362 ± 172	.9
Geography			
Northern California	18 (72)	7 (28)	.07
Central California	11 (65)	6 (35)	
Southern California[a]	34 (89)	4 (11)	
Hospital type			.21
Community	57 (81)	13 (19)	
Teaching[a]	6 (60)	4 (40)	
No. of procedures, mean ± SD	127 ± 93	188 ± 169	.05

NOTE. Data are no. (%) of hospitals, unless otherwise indicated. Boldface type indicates statistical significance. BSI, bloodstream infection; MRSA, methicillin-resistant *Staphylococcus aureus*; SD, standard deviation.

[a] Multivariate analysis found that vancomycin use for CABG prophylaxis was associated with teaching hospital status (odds ratio [OR], 5.9 [95% confidence interval (CI), 1.0–38.7]) and inversely associated with Southern California location (OR, 0.15 [95% CI, 0.02–0.7]).

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In the multivariable model, routine vancomycin use was independently associated with teaching hospital status (odds ratio [OR], 5.9 [95% confidence interval (CI), 1.0–38.7]) and inversely associated with Southern California location (OR, 0.15 [95% CI, 0.02–0.7]). Hospital MRSA burden was not associated with routine vancomycin use in the multivariable model.

Thirty-three hospitals that use cefazolin for routine prophylaxis changed CABG prophylaxis for individual patients (33 [57%] of 58). Vancomycin monotherapy was used in 18 (55%) of 33 centers, vancomycin and a cephalosporin were used in 15 (45%) of 33 (vancomycin and cefazolin, 14 centers; vancomycin and cefepime, 1 center), and daptomycin was used in 2 (6%) of 33. Hospital characteristics were not associated with vancomycin prophylaxis for individual patients (data not shown).

Preoperative antibiotic prophylaxis is a cornerstone of infection prevention for CABG.[2] Findings from our large sample of cardiac surgery centers demonstrate heterogeneity in clinical practice and systematic deviations from guideline recommendations.

We were surprised to find 21 centers using vancomycin alone, either routinely or in select patients. The use of vancomycin alone is not recommended by IDSA/SHEA or STS guidelines because of the known risk of gram-negative mediastinitis.[3,4]

We identified 29 centers that combine vancomycin with a cephalosporin, either routinely or in select patients. Dual-agent prophylaxis is consistent with STS guidelines but has not been formally studied.[4] Theoretically, dual-agent prophylaxis prevents SSI due to methicillin-susceptible *S. aureus* and gram-negative pathogens from the cephalosporin component and will reduce MRSA SSI by the inclusion of vancomycin.[7,8] Conversely, the dual-agent approach may result in more adverse effects, including emergence of resistance and *Clostridium difficile* infections, without measurable benefit. Formal evaluation of the cost, benefits, and antimicrobial stewardship implications of the dual-agent approach are warranted.

A clinical trial of β-lactam prophylaxis compared with dual-agent prophylaxis is needed. A randomized trial, based on the STS Adult Cardiac Surgery registry, could provide a cost-effective infrastructure for data collection and quicker enrollment than a traditional multicenter trial.[9,10] A randomized registry trial could be adequately powered to capture rare events, such as emergence of resistance after broader prophylactic strategies.[9,10]

Our investigation demonstrates significant variation in clinical practice. The variation may reflect limited clinical data and discrepancies between national guidelines. However, the heterogeneity in practice, particularly monotherapy with vancomycin, raises significant patient safety and healthcare quality concerns.

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Healthcare Worker Perception of Bare Below the Elbows: Readiness for Change?

Patients prefer a clean, well-groomed, and easily identified healthcare provider, and some prefer that their providers wear white coats.[1] White coats are known to become colonized with pathogenic bacteria during the course of care, but it is uncertain whether this translates to higher rates of infection.[2,3,4] One study reported that patients' initial preference for white coats changed once they were educated about microbial contamination of apparel.[5] Uncertainty exists as to how physicians feel regarding how their attire impacts their self-perception and confidence. Few studies of physician preferences and perceptions regarding attire exist.[1,6] We assessed perceptions of the white coat to assess barriers to the adoption of a bare-below-the-elbows (BBE) approach to patient care in the hospital.

At a 900-bed, urban academic medical center where BBE is recommended for inpatient care, an anonymous, institutional review board–approved survey using a Likert scale was distributed to a convenience sample of faculty and resident physicians and medical students at medical and surgical grand rounds over a 2-month period. Data were analyzed using the χ^2 test or Fisher exact test when appropriate. Alpha was set at 0.05, and all tests of significance were 2-tailed. Analyses were conducted using SAS 9.2 for Windows (SAS).

Three hundred surveys were distributed with a response rate of 64%. Incomplete responses to questions account for the differences in denominators in each survey item. Sixty percent of the respondents (112 of 188) were male; 43% of respondents were house staff, 32% were medical students, and the remaining 25% were faculty physicians. Seventy-four percent (134 of 182) stated that they practiced predominantly in the inpatient setting.

Seventy-two percent of respondents (136 of 190) were aware of the BBE recommendation at our hospital, and 1% (2 of 192) stated that religious beliefs prevented them from complying. Forty-two percent of healthcare providers (81 of 191) reported wearing their white coats always or most of the time during inpatient care, with no difference by healthcare worker rank ($P = .76$).

The most common reason for wearing a white coat was storage (overall, 40%; attending physicians, 35%; house staff, 36%; students, 46%; $P = .40$). Sixty-four percent (123 of 192) reported carrying 5 or more items in their white coat on most days (attending physicians, 43%; house staff, 60%,; students, 82%; $P = .001$). Thirty-eight percent (70 of 186) stated that, if hospital-issued scrubs had more carrying capacity, it would decrease white coat use (attending physicians, 19%; house staff, 26%; students, 68%; $P < .001$). Most respondents (160 [86%] of 186) felt that white coat use should not be mandated. Physician perceptions on the use of a white coat are summarized in Table 1.

Other reasons for wearing a white coat were perceived expectation of a colleague or supervisor (34 [22%] of 157), personal style (32 [20%] of 157), perceived patient expectation (21 [13%] of 157), or other reasons (7 [5%] of 157). There were no statistically significant differences in perceptions regarding wearing a white coat based on seniority.

Seventy-four percent (137 of 185) felt that white coats were probable or definite vectors for pathogen transmission to patients. Sixty-six percent (123 of 187) felt that practicing BBE was probably or definitely effective at reducing transmission of pathogens (attending physicians, 65%; residents, 58%; students, 78%; $P = .04$). The majority of respondents reported following a BBE approach (98 [55%] of 179).

Eighty-two percent of respondents (150 of 182) felt that white coats should be laundered at least weekly, whereas only 43% (77 of 181) reported actually doing so. Forty-five percent of attending physicians, 31% of house staff, and 53% of students washed their white coats at least weekly ($P = .03$). Forty percent of all respondents reported washing their white coat monthly, and 17% never wash their white coat.

Neckties were worn infrequently by male health care providers, with medical students reporting the highest frequency of wearing neckties (12 [36%] of 33). Wristwatches were commonly worn by attending physicians (28 [58%] of 48).

Most healthcare workers felt that self-confidence, professionalism, and patient perception were not affected by white coats and that their use should not be mandated. Laundering of white coats was infrequent, and this was concerning. Many healthcare providers, particularly residents and students, felt that white coats have the potential to cross-transmit organisms and that a BBE strategy for inpatient care was an effective way to limit cross-transmission.

Although the majority of respondents reported a BBE approach to patient care, white coats are still used along with

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