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Major Article

Bacteriuria is not associated with surgical site infection in patients undergoing cardiovascular surgery

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Background: Despite absence of evidence, in practice, asymptomatic bacteriuria is perceived as a risk factor for surgical site infection (SSI) among patients with cardiac surgery. We aimed to identify whether an association exists between the preoperative presence of asymptomatic bacteriuria or urinary tract infection and SSI in patients undergoing cardiovascular surgery.

Methods: This is an analytical study with a retrospective cohort of patients undergoing coronary revascularization or valve replacement surgery. We identified cases of bacteriuria, urinary tract infection, and cardiovascular SSI and adjusted the results according to exposure to antibiotics and known risk factors for SSI using a multivariate logistic regression analysis.

Results: A total of 840 patients were included in the study, of whom 33 (3.9%) had asymptomatic bacteriuria and 13 (1.5%) had urinary tract infections. The incidence of SSI was 9.5% (80 patients), with 2.3% of cases having mediastinitis. In the multivariate analysis, asymptomatic bacteriuria (relative risk, 0.83; 95% confidence interval, 0.26-2.56; $P = .74$) and urinary tract infection (relative risk, 2.54; 95% confidence interval, 0.60-10.69; $P = .20$) were not risk factors for SSI. Traditional risk factors were found to increase the risk of SSI.

Conclusions: The presence of bacteriuria is not a risk factor for presenting SSI in cardiovascular surgery. Screening with urinalysis or urine culture would not be recommended for patients undergoing cardiac surgery.

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Surgical site infection (SSI) has a reported incidence of 1%-10% in cardiovascular surgery.¹ SSIs result in a significant increase in health care costs, longer hospital stays, increased use of antimicrobial agents,² and an elevated risk of mortality for patients, with rates as high as 25% in cases of deep or organ/space (mediastinitis) SSI.³ Surgical teams have developed preventive strategies focused

on the prophylactic use of antibiotics; presurgical preparation; and the management of risk factors related to the surgery, surgical environment, and patient.⁴ Patient-related SSI risk factors that have been identified, including female gender, advanced age, obesity, diabetes mellitus, chronic obstructive pulmonary disease, renal disease, atherosclerotic disease, and connective tissue diseases.⁵⁻⁷ Risk factors related to the procedure (eg, prolonged surgery, reintervention due to bleeding, and transfusion of blood products) and to postsurgical care have also been identified.

Asymptomatic bacteriuria and urinary tract infection (UTI) have a high prevalence in certain populations, such as in patients with diabetes and in patients receiving renal replacement therapy.⁸ These infections are also frequently identified in the preoperative assessment of patients who are scheduled to undergo a cardiovascular surgical procedure. Retrospective studies have found no consistent relationship between urinalysis results for inflammatory markers or bacteriuria and SSI in cardiovascular, vascular, or orthopedic

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surgical procedures.⁹ However, because clinicians and cardiovascular surgery groups perceive bacteriuria as deleterious, diagnosis of this condition is currently pursued in clinical practice using laboratory tests, such as Gram staining of the urine and urine cultures, for patients who are scheduled to undergo cardiovascular procedures. Patients in whom bacteriuria is found generally receive antimicrobial management, which results in a longer hospital stay, greater exposure to antibiotics, an increased risk of infectious complications, and increased costs for hospital services.^{10,11}

Our objective was to identify whether an association exists between the presence of bacteriuria or UTI in the preoperative context and SSI of the mediastinum (ie, superficial, deep, or organ/space) or donor vessel in patients undergoing cardiovascular surgery at a referral center in Colombia. Additionally, the roles of known risk factors for SSI, exposure to antibiotics before the procedure, and any phenotypic relationships between the pathogens found in urine cultures and infection cultures from the surgical site were evaluated.

MATERIALS AND METHODS

Setting

The Clínica Universitaria Colombia (Colombia University Clinic), which is located in the city of Bogotá, is a quaternary clinic belonging to the Organización Sanitas Internacional (Sanitas International Organization), which has approximately 1,500,000 members in the city. This clinic is a reference center for cardiovascular surgery, and an average of 350 elective or emergency procedures are performed there annually. These procedures include coronary revascularization; valve replacement; and Bentall, maze, and other procedures, corresponding to approximately 60% of the cardiovascular procedures performed by affiliates of the organization. On average, an SSI rate of between 7% and 11% has been recorded for cardiovascular surgery.

Patients and study design

An analytical study was designed to assess a retrospective cohort of patients who underwent cardiovascular surgery at the Colombia University Clinic. In 2008, an SSI surveillance program was established, which included the identification of all patients undergoing cardiovascular surgery, follow-up during their hospital stay, and telephone call follow-up 30 days after discharge to identify patients with SSI. Because the clinic is a referral center for patients insured by the Sanitas International Organization, all subsequent hospitalizations were performed at the Colombia University Clinic. In cases of hospitalization at another institution in the network, the patient was referred to the Colombia University Clinic, or the audit system sent information regarding suspected infections associated with health care, including SSI. Antibiotic prophylaxis was routinely performed with cefazolin in 2011 but was changed to cefuroxime in 2012, with the duration of prophylaxis extended to 48 hours.

We reviewed the medical records, surveillance system database records, and microbiology database records of patients who underwent cardiovascular surgery between March 2011 and April 2015. Patients older than age 18 years who underwent myocardial revascularization or valve replacement surgery were included. Patients who underwent other cardiovascular procedures and patients with incomplete data in their medical history or a lack of follow-up at 1 month postprocedure were excluded. Patients with active infection in any organ or tract other than the urinary tract were also excluded.

In the selected patients, the known risk factors for the development of pre-, intra-, and postoperative cardiovascular SSI were

evaluated, including exposure to antibiotics before the procedure. In the case of coronary revascularization surgery, the risk of SSI was calculated using the Friedman scoring system,⁷ with scores ranging from 0-3 based on the presence of diabetes mellitus and body mass index. For all procedures, the Society of Thoracic Surgeons scale score for both preoperative and postoperative cardiovascular surgery was documented.⁶ All cases of asymptomatic bacteriuria and UTI before surgery were identified based on urine cultures. Similarly, all cases of cardiovascular SSI in the mediastinum or donor vessel recorded in the database of the institutional cardiovascular surgery group according to the criteria of the Centers for Disease Control and Prevention¹² were identified based on the available culture results and the resistance profiles of the involved microorganisms.

Definitions

Bacteriuria was defined as a urine culture isolate of a group of bacteria present at a density of 10^5 CFU/mL in a urine sample collected using sterile technique from a patient without symptoms or signs of UTI.⁸ The cases of UTI before the procedure were defined by a diagnosis in the medical records and by UTI-like symptoms, such as dysuria, urinary urgency, suprapubic pain, fever, and costovertebral pain, and cases of lower or upper UTI (with positive urine cultures) were distinguished. Prior antibiotic use and therapy duration were recorded for all patients.

For SSI in the mediastinum or donor vessel bed, we used the Centers for Disease Control and Prevention criteria¹² to identify the relevant cases in the database of the cardiovascular surgery group, and we reviewed the medical records to differentiate SSIs into the following groups: superficial, deep, or organ/space infection of the mediastinum and superficial or deep donor vessel infection. The SSI cases required description of several of the following characteristics: purulent discharge observed at and/or collected from the surgical wound; local symptoms of infection (hypersensitivity, local edema, erythema, heat, or dehiscence); symptoms of systemic infection, such as fever or sepsis; antibiotic treatment; and a positive secretion culture in cases in which washing and sampling were performed.

The reported resistance profiles are based on the β -lactamases identified in the gram-negative bacteria or the patterns of antibiotic resistance of these bacteria based on the antibiogram. Penicillinases are enzymes that are characterized by having specificity for penicillin, whereas broad-spectrum β -lactamases are responsible for resistance to both penicillins and first-generation cephalosporins. Extended-spectrum β -lactamases (ESBLs) hydrolyze third-generation cephalosporins with an oxime side chain, such as ceftriaxone and ceftazidime, as well as monobactam aztreonam. AmpC-type β -lactamases also hydrolyze extended-spectrum cephalosporins, such as cephamycins and oxyimino β -lactams. Carbapenemases are active against extended-spectrum cephalosporins and carbapenems. Methicillin resistance in gram-positive cocci involves resistance to most β -lactams. Multidrug resistance refers to resistance against more than 2 different pharmacologic groups.^{13,14}

Statistical analysis

For the statistical analysis, the association between having a UTI or asymptomatic bacteriuria and having an SSI was measured using a risk ratio (RR). The sample size was estimated by taking into account the 95% confidence interval (CI) and 80% power, and the RR was used to detect 2-to-1 exposed-unexposed ratios of 1:1 and an 87% proportion of nonexposed positives. The total number of patients to be included was 770. The RR was adjusted for risk factors using a logistic regression model of association with the selection

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