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Major Article

Epidemiology of device-associated infections in an intensive care unit of a teaching hospital in Nepal: A prospective surveillance study from a developing country

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Catheter-associated urinary tract infection

Background: Device-associated health care-acquired infections (DA-HAIs) in intensive care unit patients are a major cause of morbidity, mortality, and increased health care costs.

Methods: A prospective, structured clinicomicrobiological surveillance was carried out for 3 common DA-HAIs: ventilator-associated pneumonia (VAP), central line-associated bloodstream infection (CLABSI), and catheter-associated urinary tract infection (CAUTI) present in the patients of an intensive care unit of a teaching hospital in Nepal. DA-HAIs were identified using the Centers for Disease Control and Prevention definitions, and their rates were expressed as number of DA-HAIs per 1,000 device-days.

Results: Overall incidence rate of DA-HAIs was 27.3 per 1,000 patient-days occurring in 37.1% of patients. The device utilization ratio for mechanical ventilation, central line catheter, and urinary catheter was 0.83, 0.63, and 0.78, respectively. The rates of VAP, CLABSI, and CAUTI were 21.40, 8.64, and 5.11 per 1,000 device-days, respectively. *Acinetobacter* spp (32.7%), *Klebsiella* spp (23.6%), *Burkholderia cepacia* complex (12.7%), and *Escherichia coli* (10.9%) were the common bacterial pathogens. Most of the bacterial isolates associated with DA-HAIs were found to be multidrug-resistant.

Conclusions: Incidence of DA-HAIs in the study intensive care unit was high compared with that of developed countries. Formulation and implementation of standard infection control protocols, active surveillance of DA-HAIs, and antimicrobial stewardship are urgently needed in our country.

Health care-associated infection (HAI) continues to be the most common adverse event affecting severely ill patients residing in intensive care units (ICUs) around the globe.[1,2] The extremely vulnerable nature of these patients, multiple procedures, use of invasive devices, prolonged use of antimicrobial regimens, and multidrug-resistant organisms are making ICUs epicenters of infection.[3] Device-associated hospital-acquired infections (DA-HAIs) are primary threats to the safety of patients in ICUs that are responsible for increased patient morbidity and mortality.[4] Consequently, they are associated with prolonged hospital stay, long-term disabilities, increased drug resistance, and additional financial burden to families.[5,6] Ventilator-associated pneumonia (VAP), central line-associated bloodstream infection (CLABSI), and catheter-associated urinary tract infection (CAUTI) are the common device-associated infections in ICUs.[2,6] In fact, many of these DA-HAIs could

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Conflicts of interest: None to report.

NPP, SPA, and BPR conceived the design of study; reviewed the literature; and performed necessary interventions, including laboratory investigations. NPP, SPA, HPK, JPS, and SD developed the standardized surveillance form and identified the cases. NPP prepared the manuscript with the help of SPA, SKM, BPR, and BMP. All authors contributed toward data analysis, drafting, and revising the manuscript, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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be prevented through an effective surveillance program that defines the extent, etiology, and nature of such infections, which is an initial step toward reducing the threat of infection in vulnerable, hospitalized patients.[7,8]

There are well-established programs for the surveillance and control of HAIs in the developed world, an integral feature of their national infection control programs.[6] However, it has been observed that there are scanty published guidelines on infection control and DA-HAIs using standardized international case definitions available from the Indian subcontinent.[9] A few studies that intended to retrieve the relevant information on ICU-related DA-HAIs reported extremely important results, showing that both the incidence and mortality are high compared with the values reported from developed countries.[10,11] The International Nosocomial Infection Control Consortium (INICC), a worldwide network of ICUs in developing countries, revealed 3- to 5-fold higher rates of DA-HAIs in the ICUs of developing countries compared with those of the United States.[12] However, there is no such national program for surveillance of HAIs in our country, Nepal. Therefore, in view of the relevance of international studies and also inadequate information about ICU-related infections available from Nepal, it became crucial for us to know the burden and spectrum of DA-HAIs in the mixed medical-surgical ICU of our major tertiary care teaching hospital in Nepal.

METHODS

Design and setting of study

This prospective study was conducted among patients admitted to the ICU of Tribhuvan University Teaching Hospital, a tertiary care referral center in Kathmandu, Nepal, with 700 patient beds. The duration of study was 15 months (January 2014-March 2015). The study ICU is a fully equipped 11-bed adult medical-surgical unit with annual turnover of 600 patients. This research was approved by the institutional review board of Institute of Medicine, Kathmandu, Nepal. Letter of approval (Ref No: 129(6-11-E)/2070/71) was obtained after submitting and presenting the proposal to the committee.

Clinical specimen and data

The first sample (urine, blood, and tracheal aspirate) collected from every patient admitted to the ICU was sent for bacteriologic culture to keep a baseline record to exclude infection at the time of admission into the ICU and to get the true picture of infection rate. Information was collected from all study patients regarding age, gender, origin of admission, provisional diagnosis, duration of ICU stay, antibiotics taken (empirical and rational), patient exposure and duration (eg, surgery within 1 month and presence of a urinary catheter, mechanical ventilation, or central venous catheter), and outcome. Information regarding total leukocyte count, temperature, chest radiograph result, oxygenation level, Acute Physiology and Chronic Health Evaluation II score, and clinical pulmonary infection score were also documented in a previously designed clinical profile form.

Diagnosis of infections in our ICU

The presence of and criteria for infection were assessed daily on the ward round by a critical care physician responsible for the patients' care. Clinical infection and sepsis were defined as the presence of more than 1 of 4 clinical criteria, consisting of body temperature >38°C or <36°C, heart rate >90 beats per minute, respiratory rate >20 breaths per minute, hyperventilation, and neutrophilia or neutropenia with >10% immature neutrophils as well as local signs of infection. The patients included into the study were prospectively followed until discharge from the ICU or death. Microbiology samples from areas such as peripheral venous blood, central venous catheter, urine, endotracheal secretions, bronchoalveolar lavage, pus, and any other suspected infection focus were always obtained when a new infection was suspected during the ICU stay. All the clinical specimens were processed in the clinical bacteriology laboratory according to the standard microbiologic methods. Identification of the significant bacterial isolates associated with the infectious process was done according to the guidelines of American Society of Microbiology.[13] Multidrug-resistant bacterial isolates were recognized as the isolates not susceptible to at least 1 agent from 3 different antimicrobial categories of first-line drugs.[14]

DA-HAI case definitions

The diagnosis of infection was based on the criteria required for the definition of the Centers for Disease Control and Prevention (CDC) with some modifications.[15] The infections were considered health care acquired if they developed after 3 calendar days of admission to the ICU, and if there was no evidence that infection was present or incubating at the time of admission. To simplify the operational steps, only the first episode of DA-HAI was considered.

VAP

Pneumonia was considered as associated to ventilation when a chest radiograph showed new or progressive infiltrates, consolidation, or cavitations in a patient on mechanical ventilation for more than 48 hours or within 48 hours after removal of mechanical ventilation. Clinically defined pneumonia was diagnosed based on the presence of fever, altered leukocyte count, and at least 2 of the following pulmonary criteria: new onset of purulent sputum or change in character of sputum; new onset or worsening cough, dyspnea, or tachypnea; and worsening alveolar gaseous exchange. VAP was confirmed in patients with only 1 of the pulmonary criteria in the presence of positive quantitative culture of bronchoalveolar lavage fluid with 10^4 CFU/mL and endotracheal aspirate with threshold of 10^6 CFU/mL.[15]

CLABSI

CLABSI was considered when a patient with a central line in place (or in the 48 hours after line removal) developed purulence on the catheter insertion site and/or a recognized pathogen (>10^3 CFU/mL) cultured from central venous catheter culture and peripheral blood cultures that was not related to an infection at another site, or had at least 1 of the following signs or symptoms: fever >38°C; chills; hypotension; and a common skin contaminant that was cultured from 2 or more blood cultures drawn on separate occasions when signs, symptoms, and positive laboratory results were not related to an infection at another site.[15]

CAUTI

CAUTI was defined when a patient meet the criteria of symptomatic urinary tract infection after placement of a urinary catheter at the time of specimen collection or during the 48 hours after catheter removal, along with at least 1 of the following signs or symptoms with no other recognized cause: fever (>38°C), suprapubic tenderness, costovertebral angle pain or tenderness, dysuria, and urgency or frequency. In addition to the aforementioned clinical criteria, diagnosis of CAUTI required laboratory confirmation with a positive urine culture of 10^5 CFU/mL with no more than 2 species of microorganisms or a positive urinalysis (demonstrated by either pyuria or microorganisms viewed on Gram stain of unspun urine) and a