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Original Article

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Bacteriological Profiles with Antibiotic Susceptibility Pattern in Different Clinical Specimens of Specialized Neuroscience Hospital of Bangladesh

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Abstract

Background: Throughout the world multi-drug resistant hospital acquired infections (HAI) are one of the leading causes of deaths and morbidity amongst hospitalized patients. **Objective:** The aim of study was to identify prevalence and variations of predominant microorganisms and their drug sensitivity and resistance pattern in a tertiary care public hospital, Dhaka, Bangladesh. **Methodology:** The study was conducted in Intensive Care Unit (ICU), High Dependency Unit (HDU), Post-operative ward and general wards of a tertiary care publicNeuro- hospital in Dhaka during 1st January, 2017 to 31st December, 2018. Patients admitted in any of the four units (ICU, HDU, Post-operative and general wards) of the hospital who were clinically suspected of having acquired any infection after 48 hours of admission to the ICUs were included. Depending on the clinical suspicion laboratory samples were collected from the patients. Samples were subjected to the testing and antibiotic sensitivity. **Results:** A total number of total 1672 samples from these patients yielded clinically relevant microorganisms. Of these samples, 273 were respiratory specimens were tracheal aspirate; 537 were urine; 377 were blood; 396 were cerebrospinal fluids; and 82 were other clinical samples. More than two-third samples were growth negative (71.4%) and only one-thirdsamples (28.6%) were growth positive. Maximum growth negative in blood samples and about half of samples of urine and tracheal aspirates were growth negative. About 80% were Gram-negative bacteria like *Escherichia coli*, *Pseudomonas* spp., *Klebsiella* whereas gram-positive organisms were about 20%. Most of the pathogens were Multi-drug resistance. **Conclusion:** Among HAIs Multidrug-resistant Gram-negative bacteria are the main challenge. Regular updating resistance of microbial are needed to develop antibiotic guideline to combat these infections and reduce morbidity and mortality. *[Journal of National Institute of Neurosciences Bangladesh, July 2020;6(2): 82-86]*

Keywords: Antibiotic Susceptibility; Hospital acquired infection (HAI), Multi-drug resistant (MDR)

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Introduction

A "hospital acquired infection (HAI)"-has been defined by WHO as: "an infection acquired in hospital by a patient who was admitted for a reason other than that infection," or as "an infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission[1]. Such infections have also been called "nosocomial infections" and sometimes- "hospital associated infection"[2]. Healthcare-associated infections

(HAI) are regarded as the most common adverse events in health care service delivery. Evidence indicates HAIs lead to prolonged hospital stay, long-term disability, increased antimicrobial resistance, additional financial burden, and even avoidable deaths[3]. The Study on the Efficiency of Nosocomial Infection Control (SENIC) project demonstrated the importance of surveillance to reduce HAI rates, with data indicating 32% of HAIs could be prevented if all hospitals conducted effective infection surveillance and control programs[4].

The majority of international and national studies estimate the burden of HAIs through two methods: point-prevalence surveys and self-report for targeted infections. The US National Healthcare Safety Network (NHSN), German national nosocomial infections surveillance system (KISS), and the International Nosocomial Infection Control Consortium (INICC) reported targeted HAI data, such as: device-associated infections rates[5-7]. In Bangladesh, there are few study conducted in this field. A study done by Zhang et al[8] showed that respiratory tract infection (43.80%) accounted for the most substantial proportion of HAIs, followed by bloodstream infections (15.74%), and urinary tract infection (12.69%) . Another study by Cai et al[9] showed that the most common HAIs were unspecified clinical sepsis (25.5%) and pneumonia (24.8%). Staphylococcus aureus (12.9%) and Pseudomonas aeruginosa (11.5%) are the most common pathogens implicated in HAIs. A study on post caesarean wound infection in Dhaka Medical College Hospital showed that 35.3% of caesarean patients developed hospital acquired infection[10]. A study on 299 admitted patients of Dhaka Medical College Hospital 34(11.37%) were found affected by HAI. Surgical wound infection was the most prevalent (44.1%) among the various types of HAI followed by urinary tract infection (26.5%) and skin and soft tissue infection (14.7%)[11]. Another study showed prevalence of HAI was 10.3%. Intensive care units were the most affected wards (34.5%). Urinary tract infection was the most common infected site (35%). Microbiological documentation was available in 61% of HAI. Staphylococcus was the organism most commonly isolated (18.7%)[12].

The types of HAI and microbials vary from country to country, region to region, hospital to hospital even ward to ward. Almost forty percent of all hospital-acquired infections are urinary tract infection, 80% of them are associated with the use of indwelling catheter. Surgical wound infections are covering 5-15% of HAI depending on the type of operation and patient's physical status[13-15]. In a past few years it has been determined that Gram-negative bacteria become the predominant pathogen of HAIs and carbapenem resistance among these pathogens doubled in all hospitals of Bangladesh. Therefore, monitoring ICU pathogens and documenting their antimicrobial resistance are essential to ensure the prompt organization of measures related to preventive, control and therapeutic actions.

Methodology

This study was conducted in National Institute of Neurosciences & Hospital, Dhaka, Bangladesh. This hospital has a total of 300 patient beds, 12 of which are in the ICUs, 8 beds HDUs, 9 beds are post-operative wards. It had been focused on organisms isolated from general wards, post-operative wards, and ICU and HDU patients between 1st January 2017 to 31st December 2018. This database was produced by active, prospective, and patient-based surveillance studies that were performed throughout the investigation period. The data were obtained from microbiological laboratory department. Antimicrobial resistance determinants were selected as extended-spectrum beta-lactamase (ESBL) production and carbapenem resistance for *Escherichia coli* and *Klebsiella pneumoniae*, carbapenem resistance for *Acinetobacter* species and *Pseudomonas aeruginosa* strains, methicillin resistance for *Staphylococci*, and vancomycin resistance for *Enterococcus* species.

Microbiological Analyses: The clinical samples including blood, urine, cerebrospinal fluid, sputum, wound swabs, pus, catheter, and tracheal aspirate, obtained from the ICU patients, were inoculated in blood agar, eosin-methylene blue agar, chocolate agar, and Sabouraud dextrose agar media (Oxoid Ltd., Hampshire, UK) and incubated at 35^{o}C for 24 to 48 hours. The growing organisms were identified using classical bacteriologic methods and automatized identification systems (Vitek II, BioMerieux, Marcy I'Etoile, France; BD Phoenix, Becton Dickinson and Company, New Jersey, USA). We evaluated the antimicrobial susceptibility of the strains using the disc diffusion method and analyzed the results according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI)[16]. The ESBL production of Enterobacteriaceae was investigated using the double-disc synergy test; the carbapenem resistance of Gram-negative bacteria was investigated using imipenem disc susceptibility, the methicillin resistance of *staphylococci* was studied using cefoxitin disc susceptibility test, and the vancomycin resistance of *Enterococcus* spp. was investigated using vancomycin disc susceptibility test according to the CLSI criteria[16].

Statistical Analysis: The collected data were expressed as numbers (n) and percentages (%). Changes in the frequencies of the pathogens and in their antimicrobial resistance as a function of time were calculated as medians with 25% - 75% ratios, and we compared the results using the Mann-Whitney U test in IBM SPSS Version-16 Statistical software (IBM Corporation, New York, USA).

Results

In total, 1672 samples from these patients yielded clinically relevant microorganisms. Of these samples, 273 were respiratory specimens were tracheal aspirate; 537 were urine; 377 were blood; 396 were cerebrospinal fluids; and 82 were other clinical samples. More than two third samples were growth negative (71.4%) and only 28.6% samples were growth positive (Figure I).

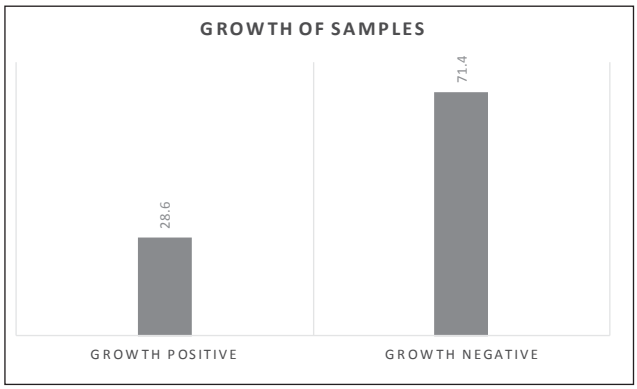


Figure I: Overall Growth status

Maximum growth negative in blood samples and about half of samples of urine and tracheal aspirates were growth negative (Figure II).

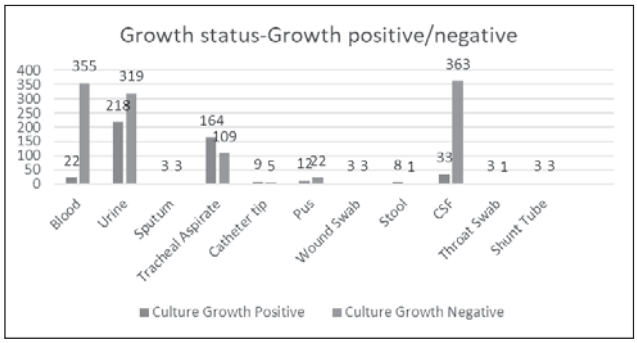
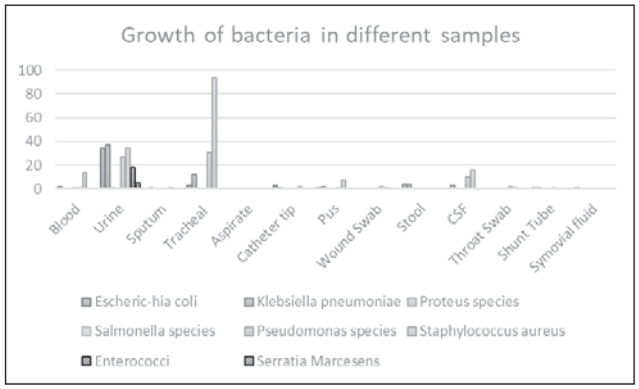


Figure II: Growth status of different specimen

Gram-negative bacteria like Escherichia coli, Pseudomonas spp., Klebsiella species were about 80% and all are almost equally distributed whereas gram-positive organisms like staphylococcus aureus was about 20% (Figure-III).



III: Distribution of microorganisms in different samples

Most of the pathogens were Multidrug resistance (Figure IV).

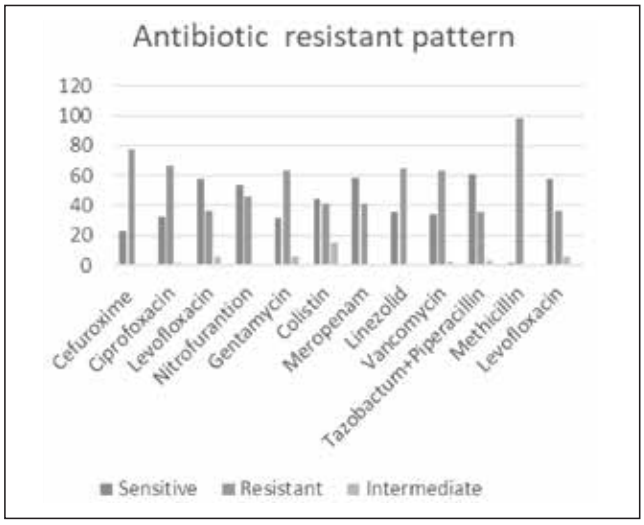


Figure IV: Microbial Sensitivity/Resistant Pattern

Discussion

Healthcare-associated infections (HAIs) are the most frequent health problem related to healthcare delivery worldwide. It is reported that respiratory tract infection (43.80%) accounted for the most substantial proportion of HAIs, followed by bloodstream infections (15.74%), and urinary tract infection (12.69%)[17]. Increasing and differentiating antimicrobial resistance are confusing for clinicians for selecting the most appropriate treatment options. However, early initiation of effective treatment is the key determinant for better outcomes from HAIs. Therefore, investigating the pathogen profiles and monitoring their antimicrobial susceptibility are valuable for many clinical departments for successful management of these patients. In this study, we observed that a significant fraction (about 80%) of our pathogens were Gram-negative bacteria especially in urine samples that

is similar to study done by Kumamoto et al[18]. In contrast, *S. aureus* was found as the leading pathogen in tracheal aspirates which is similar to study done by Jakribettu et al[19]. We think that these Gram-positive bacteria might have been associated with the poor practice of chlorhexidine-based hand disinfectants in our hospital.

Current studies have demonstrated that multidrug-resistant Gram-negative bacteria have been a growing concern for patients in ICUs due to their significant effect on patient mortality. In a multicenter point-prevalence study conducted in Turkey, researchers reported that Gram-negative bacteria constituted nearly 75% of all ICU pathogens. Furthermore, more than half of *Acinetobacter* spp. and *P. aeruginosa* strains were found as multidrug-resistant or extensively drug-resistant[20-23]. In this study, we observed that the frequency of *S. aureus*, one of the major nosocomial pathogens in tracheal aspirates This result might be one of the most significant outputs of this study, with a high concordance of the results from the current literature[24-26].The most worrisome outcome of this study is the pathogens are resistant to most of the antibiotics like Meropenam, tazobactum/ piperacillin and colistin are the last group of antimicrobials have more than 50% resistance against multidrug-resistant Gram-negative organisms that is similar to these studies[27-29].

All of the above-mentioned data indicate that the implemented infection control practices and applied antimicrobial use policies in our hospital have provided some benefits on the frequencies Gram-positive bacteria, and some carbapenem-susceptible Gram-negative bacteria. However, it seems that they have failed to limit the spread of carbapenem-resistant Gram-negative pathogens and s. aureus in our settings. In another study performed in a Turkish tertiary care hospital, the authors reported that the frequencies of top three Gram-negative pathogens including *P. aeruginosa*, *A. baumannii*, and *E. coli* significantly reduced following the reconstruction of the ICUs for acclimatization and staff education[30]. Therefore, in addition to enforced infection control measures, providing adequate space and improving the ventilation systems in ICUs can provide positive benefits in combating hospital pathogens. It should be underline that lacking data belonging to two significant anaerobic HAI pathogens including *Bacteroides* spp. and *Clostridium difficile* may be the most important limitation of this study. Furthermore, as a second limitation, this study was performed in a single center neuro-based hospital rather than a general hospital, nationwide or multicenter surveillance. However, we think that this study is one of the most important investigations from Bangladesh in the last one year as the data were collected by the microbiology department of the hospital.

Conclusion

This present work reveals that multidrug-resistant Gram-negative bacteria are one of the predominant pathogens in urine which may be due to catheterization. On the other hand, in endotracheal aspirate culture Staphylococcus aureus is the main causative agents that are very alarming.

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