Original Article

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Frequency of Isolation and Antibiotic Resistance Patterns of Bacterial Isolates from Wound Infections, National Cancer Institute, Wad-Medani, Sudan, 2021

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ABSTRACT

Background: Disturbance of skin integrity (wound) provides a suitable environment for the growth and multiplication of bacteria. The emerging occurrence and spread of multidrug-resistant microbial pathogens present a significant challenge in providing effective health care and is, therefore, a worldwide medical issue.

Aim: The current study reports on the occurrence of possible pathogens associated with wound infections at National Cancer Institute, Wad Madani, Sudan.

Methodology: This was a cross-sectional descriptive, hospital-based study including 100 patients with wounds suspected to be infected. Suspicion was dependent on the inability of wounds to heal properly. A structured questionnaire was given to the subjects to acquire demographic information (age, gender, marital status) and the history of antibiotics administration. Wound swabs were collected and processed according to standard procedure and isolated bacteria were tested for their antimicrobial susceptibilities through the disc diffusion technique according to the CLSI guidelines.

Results: Morphological identification revealed that the percentage of gram-positive cocci among the isolates was: S. Aureus (66%), and Streptococci (34%). On the other hand, gram-negative bacilli included the following: E coli (48.1%), Proteus vulgaris (19%), Proteus mirabilis (14%), Klebsiella species (9%), Pseudomonas species (5%) and other bacterial species (4%). Most bacterial isolates exhibited a high rate of resistance to cephalosporin generations (Cefixime (69%), Cefuroxime (49%), Cefotaxime (32%), Ceftriaxone (29%), Cefepime (20%)). The majority of bacterial isolates were sensitive to Meropenem (resistance rate 3%). The antibiogram results of the other antibiotics were as follows: Ciprofloxacin (18%), Gentamicin (16%).

Conclusion: S. Aureus was the most prevalent bacteria among the isolates with a percentage of 66%. The highest rate of resistance was observed among cephalosporin generations, mainly Cefixime and Cefuroxime with resistance rate of 69% and 49%, respectively.

Keywords: Antibiotic Resistance, Wounds Infection, National Cancer Institute, Cephalosporins.

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INTRODUCTION

Disturbance of skin integrity (wound) provides a suitable environment for the growth and multiplication of bacteria. According to,[1] organisms responsible for causing wound infections were ranked as follows: Staphylococcus aureus (including MRSA methicillin-resistant Staphylococcus aureus), Pseudomonas aeruginosa and members of the Enterobacteriaceae family, such as Escherichia coli, Proteus Vulgaris, and Klebsiella spp. Wound infections remain one of the most common causes of morbidity due to nosocomial infections.[2] The emerging occurrence and spread of multidrug-resistant microbial pathogens present a significant challenge in providing effective health care and is, therefore, a worldwide medical issue. Extensive use of antimicrobial agents in the treatment of commonly isolated pathogens results in their increased resistance to these drugs. In many healthcare facilities, the physician and surgeons prescribed antimicrobial agents that cover gram-positive bacteria,[3] despite the fact that several studies have revealed the predominance of gram-negative over gram-positive bacteria as causative agents of wound infections. This contradiction directly results in treatment failure, increased hospitalization time and decreased health outcome.[4] Further, chemotherapy (cancer treatment) has a bad impact on the immune system.[5] Both cancerous and normal cells in many organs can be affected.[6] The dose of drug needed to achieve adequate tumor cell kill often causes toxicity in normal tissues. Moreover, infection is the most common cause of morbidity and mortality in patients under antineoplastic chemotherapy.[7] Microbiological culture and sensitivity play a vital role in the diagnosis of wound infections and assist in the therapeutic decision-making regarding suitable antimicrobial agent.[8] To successfully identify, treat and prevent infections, a comprehensive understanding of risk factors that predispose to infection and of commonly encountered pathogens is necessary. Moreover, the average cost of a surgical wound infection has proven difficult to estimate and varies depending on the type of surgical procedure.[9] There are scattered data regarding bacterial isolates and the status of wound infection incidences in chemotherapeutic patients in Wad Madani. The current study reports on the occurrence of possible pathogens associated with wound infections at the National Cancer Institute. Wad Madani, Sudan.

Surgical site infections (SSIs) remain one of the most common causes of morbidity in surgical patients, despite advances in surgical practice and antibiotic prophylaxis. The average cost of a surgical wound infection has proven difficult to estimate and varies depending on the type of surgical procedure. Despite improvements in the care of cancer patients over the past several years, infectious complications remain a significant cause of morbidity and mortality.

MATERIALS AND METHODS

Study setting and population

The cross-sectional descriptive, hospital-based study ran for 8 months from February to October 2018. The study was conducted

at National Cancer Institute, University of Gezira, Wad Madani, Sudan. Wad Madani is the capital of the state of Gezira, and lies on the western bank of the Blue Nile River, about 85 Km from Khartoum, the capital of Sudan. National Cancer Institute is one of the most important oncology centers in Africa. In addition to its important role as a research center, the institute also provides valuable services in the diagnosis and treatment of a variety of cancers. The National Cancer Institute receives patients with multiple types of cancers (breast, prostate, colon, lymphomas and others). The wounds in cancer patients may be due previous surgery or as a consequence of cancer radiotherapy. All patients with wounds suspected to be infected were included in the study. Suspicion was dependent on the inability of wounds to heal properly. The selection of participants was dependent on their voluntary consent. Minor and children were selected to participate after agreement of their parents.

Data collection and Processing

A structured questionnaire was given to the study subjects for demographic information (age, gender, marital status) and the history of antibiotics administration. Wound swabs were collected and the samples were transported to the microbiology laboratory within one hour of collection in order to prevent drying.[10] Swabs were immediately inoculated on chocolate agar and blood agar. Incubation was done aerobically at 37C° for 24 hours. Bacterial isolates were identified based on colonial characteristics, Gram staining and biochemical tests.[11] All isolated bacteria were tested for their antimicrobial susceptibilities by the disc diffusion technique according to the CLSI guidelines.[12] The following antibiotic discs were used: Meropenem, Cefixime, Cefuroxime, Cefotaxime, Ceftriaxone, Cefepime, Ciprofloxacin, Gentamicin; these discs were manufactured by Bioanalysis Co. Italy. Data obtained from this study was analyzed by simple table frequency using the Excel software program (percentage, mean, SD).

RESULTS

The analysis of the demographic data of the study subjects revealed that 67% of the subjects were female and 33% were male (Fig. 1). 73% came from rural areas and 27% lived in urban areas. Their distribution across age groups was as follows: 5-16 years, 17%, 17-59 years, 45% and above 60 years, 38% (Fig. 2). The prescription pattern of antibiotics in the hospital was as follows: Ceftriaxone (32%) followed by Cefuroxime (23%), Cefixime (15%), Gentamicin (10%), Cefepime (6%), Ciprofloxacin (5%), Cefotaxime (4%) and Meropenem (2%). Out of a total of 100 samples, 72 (72%) were positive by culture, of which 30 (41.6%) were gram-positive cocci. and 42 (58.4%) were gram-negative bacilli. Out of the 72 positive culture samples, 5 samples showed polymicrobial growth. Morphological identification revealed that the percentage of gram-positive cocci among the isolates was: S. Aureus (66%) and Streptococci (34%). On the other hand, gram-negative bacilli included the following: E coli (48.1%),

Proteus Vulgaris (19%), Proteus Mirabilis (14%), Klebsiella species (9%), Pseudomonas species (5%) and other bacterial species (4%) (Fig. 3). The antibiogram was evaluated against the isolated bacteria; most bacterial isolates exhibited a high rate of resistance to cephalosporin generations (Cefixime (69%), Cefuroxime (49%), Cefotaxime (32%), Ceftriaxone (29%), Cefepime (20%)). The majority of bacterial isolates were sensitive to Meropenem (resistance rate 3 %). The antibiogram results of the other antibiotics were as follows: Ciprofloxacin (18%), Gentamicin (16%) (Fig. 4). S. Aureus was the most prevalent bacteria among the isolates with a percentage of 66%, and the highest rate of resistance was observed among cephalosporin generations, mainly Cefixime and Cefuroxime, with resistance rates of 69% and 49%, respectively.

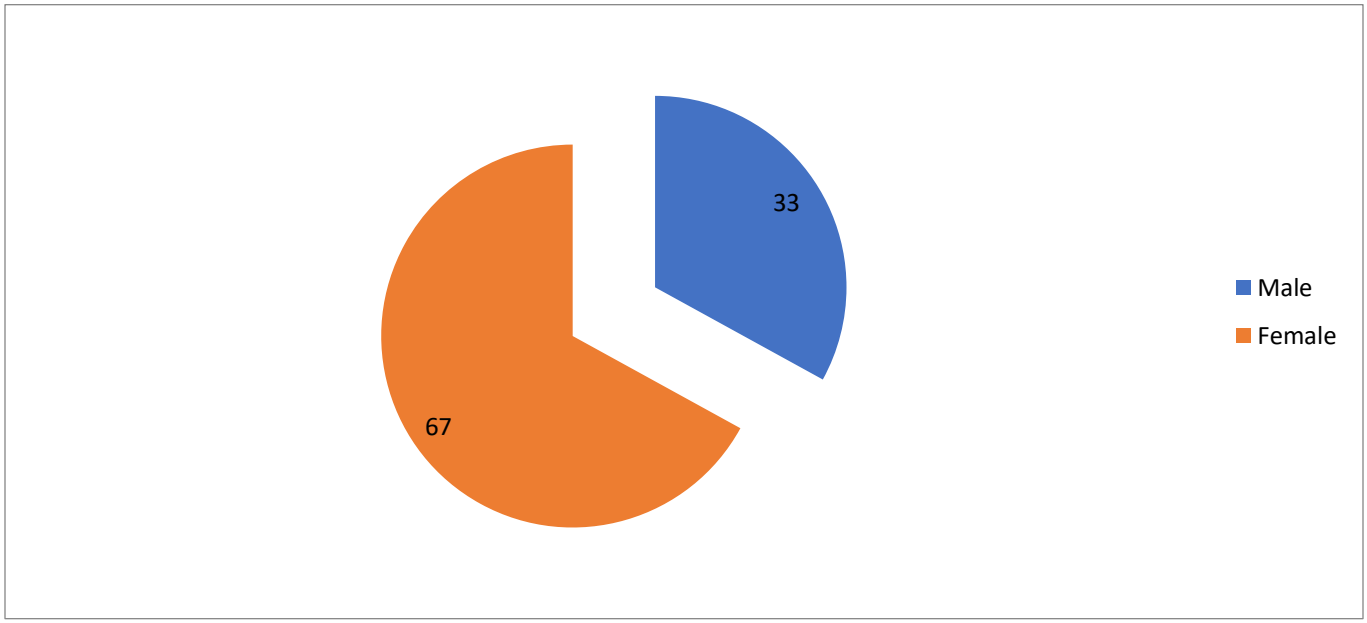

Figure 1: Gender of the study participants.

Figure 2: Age groups of the study participants.

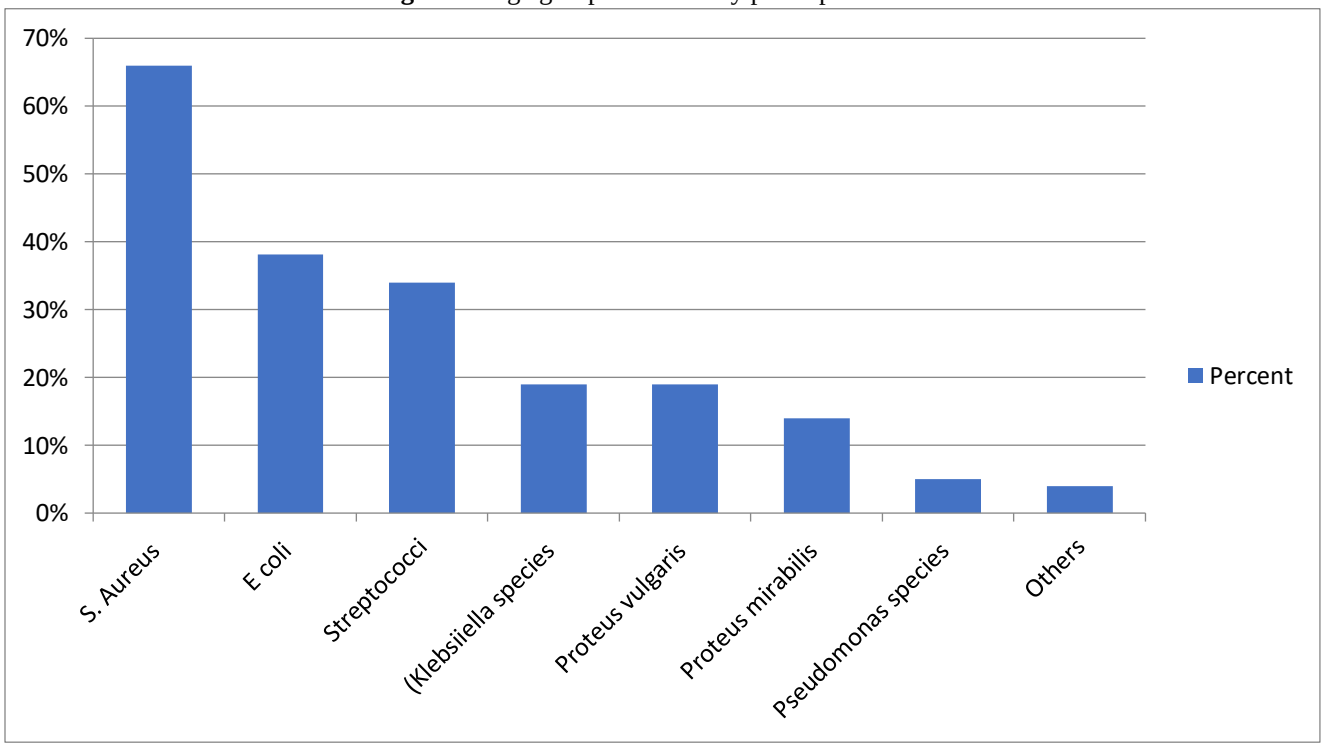

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Figure 3: Distribution of bacterial species among the positive cultured samples

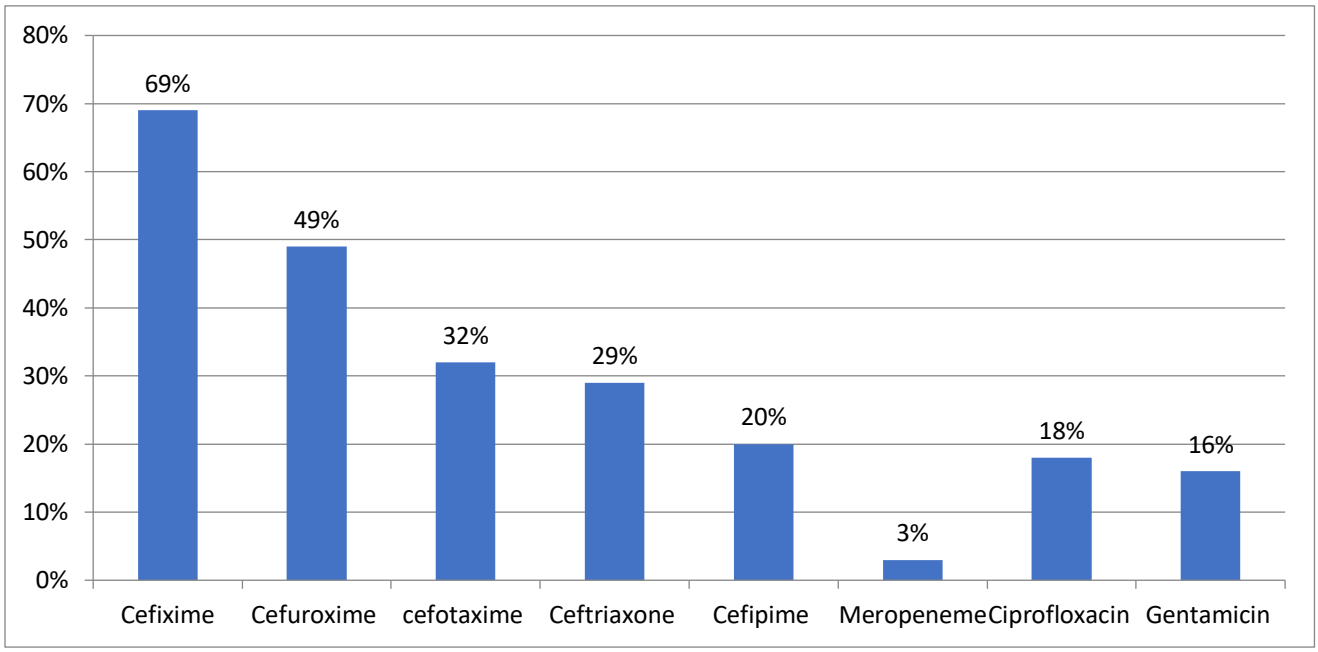

Figure 4: Resistance rate of the different antimicrobial agent used against the isolated bacterial species.

DISCUSSION

Bacterial contamination of wounds is a serious problem in hospitals, especially in cancer patients due to their weakened immune system. This study aimed to determine the occurrence of possible pathogens associated with wound infections and their antimicrobial resistance patterns at National Cancer Institute, Sudan, Wad Madani. Results of the current study showed a high incidence rate of wound infections among patients admitted to the National Cancer Institute (72 %). A similar result was obtained by[13] who conducted a study to find the various organisms that cause wound infection in India; they found an incidence rate of 75.8%. These results may be explained by the negative impact of chemotherapy on the immune system, in addition to the extensive usage of antimicrobial agents in the treatment of commonly isolated pathogens resulting in the emergence of their increased resistance to these drugs. Moreover, prescribing broad-spectrum antibiotics for uncomplicated infections presents as one of the most responsible approaches for emerging resistances. S. aureus was the most common isolate among the study population as indicated by a 66% infection rate, followed by E. coli (38%). S. aureus is the most abundant bacteria found in human skin and can be easily introduced to the body due to the wound. The weakened immune response of patients under chemotherapy facilitates the colonization of the bacteria. Another important factor is the possibility of airborne transmission of the bacteria on the skin of the people present in the operating theatre or by direct contact via hands or equipment. It was observed that infection-control measures may not be adequately adopted. Similar observation was reported elsewhere.[14] The coexistence of S. aureus

with other gram-negative isolates was also reported, where S. aureus and P. aeruginosa were found to be the dominant ones.[15,16] The results of the study revealed that most bacterial isolates exhibited a high rate of resistance to cephalosporin generations (Cefixime (69%), Cefuroxime (49%), Cefotaxime (32%), Ceftriaxone (29%), Cefepime (20%)). These findings are congruent with the results in a study conducted by Ali (2013) in Soba University Hospital, Khartoum, Sudan; it was found that the resistant rates for ceftriaxone and ceftazidime ranged from 56% to 79%.[17] In addition, in a new study conducted in three countries, Sudan, Egypt and Saudi Arabia, the ratios of the multidrug-resistant strains for Egypt, Saudi Arabia and Sudan were 74.4%, 90.1% and 97.5%, respectively.[18] In addition to the geographical location, the behavior of Sudanese and Egyptian citizens toward antibiotic usage is almost similar, which may explain the similarity of results obtained from Sudan and Egypt.

In the last years, cephalosporins were used for self-medication in Sudan. This led to an increase in the misuse of the drug, which in turn, increased the resistance rates of Cephalosporins. These results reflect the magnitude of the issue of antibiotic resistance, which becomes a global problem that is exaggerated in Sudan due to many factors, including the lack of governmental control on drugs, reduced awareness in people about antibiotic prescription, and the socio-economic status of the majority of the population that may make them unable to complete the recommended dose of the drug.

Comprehensive multidisciplinary programs including clinicians, microbiologist and pharmacists are needed to increase the public awareness about antibiotic usage, provide the suitable diagnostic approaches for infectious diseases and create approved guidelines for antibiotic prescription.

Conflict of interest

None to declare.

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