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In vitro Activity of Some Antimicrobial Agents against *Staphylococcus aureus* and Methicillin-Resistant *Staphylococcus aureus* in Khartoum, Sudan

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Abstract: *Staphylococcus aureus* is a causative agent of many types of diseases throughout the world. Patients hospitalized for long period of time usually are predisposed to infection by methicillin resistant *S. aureus* (MRSA). The objectives of the present study were to evaluate the efficacy of some antimicrobial agents against *S. aureus* and MRSA and to select the most effective antibiotic. Clinical specimens were collected from patients with wounds and/or urinary tract infections. The specimens were proceeded for isolation of the pathogens. Identification was done by conventional methods. Antimicrobial sensitivity test was carried out using modified Kirby-Bauer Disc Diffusion Technique in accordance with National Committee on Clinical Laboratory Standards (NCCLS). Of 163 *S. aureus* recovered, 15 (9.2%) isolates were MRSA. The most effective antimicrobial agent against both *S. aureus* and MRSA was vancomycin (99%). The activity of the rest antimicrobial agents was cephalexin, 92%, methicillin, 90%, cloxacillin 33%, penicillin 14% and amoxicillin 10%. It is concluded that vancomycin may be an alternative antibiotic for patients with wound and/or urinary tract infections caused by *S. aureus* or MRSA.

Key words: Antimicrobial sensitivity test, *S. aureus*, MRSA, vancomycin, Sudan

INTRODUCTION

Staphylococcus aureus is a causative agent of many types of diseases throughout the world. Patients hospitalized for long periods of time usually are predisposed to infection by methicillin resistant *S. aureus* (MRSA). The prevalence of antibiotic-resistant organisms within hospitals and the severity of infections caused by these organisms have highlighted the need for more vigilant infection control practices to reduce transmission as well as the need for new antimicrobial agents for treatment of these infections (Pillar *et al.*, 2008). Despite the development and introduction of several antimicrobial agents, MRSA infections remain an important cause of concern for the general public and physicians alike (Neela *et al.*, 2008).

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Patients may be at more risk if they undergo frequent or intensive use of antibiotics (Tacconelli *et al.*, 2008). Infection of MRSA can develop in an open wound such as bedsore or when there is a tube, such as urinary catheter that enters the body. Symptoms in serious cases include fever, lethargy and headache. The MRSA can cause urinary tract infection, pneumonia, toxic shock syndrome and even death. In Sudan the drug of choice for MRSA infection is vancomycin. However, many traditional antimicrobial agents have also been used to treat MRSA infections.

Despite the importance of MRSA infections, very little research has been carried out to evaluate the efficacy of antibiotics traditionally used to treat *S. aureus* and MRSA infections in Sudanese patients.

MATERIALS AND METHODS

This study was conducted during the period March 2005 to November 2008. Samples were collected from patients with wound and/or urinary tract infections. The samples were collected from three leading hospitals as follows: 82 (61 wound swabs and 21 urine) samples from Khartoum Teaching Hospital, 91 (77 wound swabs and 14 urine) samples from Khartoum North Teaching Hospital and 75 (60 wound swabs and 15 urine) samples from Omdurman Teaching Hospital. Nutrient agar, blood agar, mannitol salt agar and Muller-Hinton agar were prepared according to manufacturer instructions (MAST Diagnostic, England), then used for isolation. Standard bacteriological methods were used for identification of MRSA according to Barrow and Felltham (2003).

Antibiotics susceptibility test was done for all isolates of *S. aureus*, using modified Kribry-Bauer gel diffusion method. Antibiotic discs were obtained from Oxoid Ltd Co., England including, penicillin (10 µg), amoxicillin (25 µg), cephalexin (30 µg), vancomycin (30 µg), cloxacillin (5 µg) and methicillin (25 µg).

The zones inhibition were interpreted according to the critical diameters given in the most recent NCCLS documents, showing the test organism as susceptible, intermediate or resistant (National Committee for Clinical Laboratory Standards, 1997; WHO, 1997).

RESULTS AND DISCUSSION

During the course of this study, 248 clinical specimens were collected from patients suffering from wound infection or urinary tract infection in three hospitals (Omdurman, Khartoum and Khartoum North Teaching Hospitals). The distribution of subjects according to site of collection is shown in Table 1. The total number of specimens showed significant growth ($>10^5$ for urine and abundant growth for wounds) was 215 (87%). Of these 163 were identified as *S. aureus*. Colonial morphology, Gram's stain and biochemical test of *S. aureus* isolates were found to be similar to those described by Murray and his colleagues (Murray *et al.*, 2007). Activity of methicillin against *S. aureus* revealed that 90.2% were sensitive, 1.6% were intermediate and 9.2% were resistant (Table 2). Of the 163 *S. aureus* isolates, 2 (1%) isolates were resistant to all used antimicrobial agents, 6 (4%) were susceptible to all used antibiotics and 7 strains were susceptible to vancomycin, only (Table 3). Detection of MRSA was carried out according to Mackie and McCarteny (1996). In this study, MRSA was found to be 9.2%. This result is relatively high compared to that of Cooper and Ochola in Australia that showed the prevalence of MRSA ranged from 27.5 to 39.8 per 10,000 so that the average was 33.6 (0.3%) (Cooper and Ochola, 2003). The prevalence of MRSA in the present study is different from CDC survey in 1987, that showed an increased of MRSA prevalence from 22.8 to 56.2%.

Table 1: Distribution of specimens (n = 248) according to hospitals

Hospital	No. of specimens	Percentage
Khartoum	82	33
Khartoum North	91	37
Omdurman	75	30
Total	248	100

Table 2: Susceptibility of isolates to methicillin

Activity of methicillin	Frequency	Percentage
Sensitive	147	90
Intermediate	1	1
Resistant	15	9
Total	163	100

Table 3: The overall activity of antimicrobial agents used

S. aureus strains	Number of isolates	Percentage
[a]MDR strains	2	1
[b]MDS strains	6	4
SR-SV strains	7	4
Total	163	100

[a]MDR: Multidrug- resistant strains (Resistant to all the antimicrobials used in this study), MDS: Multidrug-susceptible strains (susceptible to all the antimicrobials used in this study), SR-SV: Semi-resistant strains susceptible to vancomycin only

Antimicrobial susceptibility tests of the 163 isolates to 6 antimicrobial agents including penicillin, amoxicillin, cloxacillin, cephalexin, methicillin and vancomycin were vancomycin 99%, cephalexin 90%, cloxacillin 63%, cephalexin 33%, penicillin 14% and amoxicillin 10%. These results are consistent with those obtained by Tambekar *et al.* (2009).

The study concluded that amoxacillin, cloxacillin and penicillin are ineffective against MRSA, while cephalexin is highly potent on *S. aureus*. Vancomycin is the most effective drug against *S. aureus* only. The two resistant strains were present among the study isolates. *S. aureus* is becoming increasingly resistant to available antimicrobial agents as indicated by the appearance of vancomycin-resistant *S. aureus*. The study has shown that infections caused by methicillin-resistant *S. aureus* may be associated with morbidity, mortality and high costs. Exposure to antibiotics is a major risk factor for antibiotic resistance among patients.

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