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RESISTANCE AND SUSCEPTIBILITY PATTERNS OF *S. aureus* TO VANCOMICIN AND LINEZOLID

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Abstract

Background: Given the rising complication for treating *S.aureus* infections, information regarding the medical impact of antimicrobial agents remains vital for decision making. Scientific studies investigating patterns of susceptibility of *S.aureus* to first line drugs such as vancomycin and linezolid have divergent views given that some scientists established *S.aureus* to be more susceptible to vancomycin while others established *S.aureus* to be more susceptible to linezolid. This makes it impossible to single out the most effective antibiotic between vancomycin and linezolid. **Aim:** To investigate the resistance and susceptibility pattern of *S.aureus* to vancomycin and linezolid. **Method:** Pus samples from diabetic patients with foot ulcers (DPFUs) were collected for *S. aureus* screening and susceptibility test. **Results:** *S. aureus* isolated from DPFUs at Vihiga County Referral Hospital, Kenya had a susceptibility rate of 36% and 60% to vancomycin and linezolid respectively. **Recommendations:** Linezolid having the highest susceptibility rate should be used as the first line antibiotic for treating bacterial infections which appear to be resistant to most of the commonly used antibiotics.

Keywords: *S.aureus*, Susceptibility, Vancomycin, linezolid

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1.0 Introduction

Given the rising complication for treating *S.aureus* infections, information regarding the medical impact of antimicrobial agents remains vital for decision making (Caffrey *et al.*, 2010). Vancomycin, a glycopeptide and linezolid an oxazolidinone being the first line antibiotic agents have turn out to be the typical remedy to which other antibiotics are likened (Watkins *et al.*, 2012). Vancomycin though established as a regimen of choice for *S. aureus* treatment, occurrence of *S. aureus* strains with reduced vancomycin susceptibilities led to the discovery of linezolid (Kishore *et al.*, 2014). Linezolid discovered in 1990s was approved in 2000 as the first line antibiotic for treatment of Gram positive infections including *S.aureus* (Ehsan *et al.*, 2014). The medical value of vancomycin and linezolid is endangered by the development of resistant strains of *S.aureus* (Swoboda *et al.*, 2005).

Scientific studies investigating patterns of susceptibility of *S.aureus* to first line drugs such as vancomycin and linezolid have divergent views given that some scientists established *S.aureus* to be more susceptible to vancomycin while others established *S.aureus* to be more susceptible to linezolid. Whereas Kishore *et al.* (2014) argued that they have similar in vitro susceptibility; Wunderink *et al.* (2012) concluded that the treatment of *S.aureus* was significantly higher with linezolid than with vancomycin. This makes it impossible to single out the most effective antibiotic between vancomycin and linezolid in treatment of *S.aureus* isolated from diabetic foot ulcers thus justifying the study.

2.0 Literature Review

Vancomycin and linezolid are the first line drugs used in management of resistant strains of *S. aureus*. Wunderink *et al.* (2012) assessed efficacy of linezolid. Although they concluded that the susceptibility of *S. aureus* was greater with linezolid in comparison to vancomycin. Similarly, in their study Olivares *et al.* (2011) on the efficacy of vancomycin, ciprofloxacin, daptomycin and linezolid, it was established that there was low susceptibility to vancomycin in comparison to Linezolid.

Kishore *et al.* (2014) compared the activity of linezolid and vancomycin against *S. aureus* in order to help in formulating a better treatment. They concluded that linezolid and vancomycin had similar levels of susceptibility for *S. aureus*. On the other hand, Ehsan *et al.* (2014) determined the efficacy of vancomycin and linezolid to Staphylococci and found linezolid to be more active than vancomycin.

Various studies on investigating resistance and susceptibility patterns of *S.aureus* to vancomycin and linezolid have been conducted. However, there are mixed results given that some scientists established *S. aureus* to be more susceptible to vancomycin while others established *S. aureus* to be more susceptible to linezolid. This makes the resistance and susceptibility patterns of *S.aureus* to vancomycin and linezolid uncertain.

3.0 Methods and Materials

A hospital based cross- sectional study design involving 225 adult diabetic patients with DFUs at Vihiga County Referral Hospital, Vihiga County, Kenya was employed.

3.2 Data Collection and Analysis

Questionnaires were used to gather information on socio-demographic features of the participants and a laboratory form to investigate *S.aureus* susceptibility. Descriptive statistics involving frequency distribution tables were used to present antimicrobial susceptibility pattern of *S. aureus* infection.

3.3 Laboratory Techniques

Pus specimens from foot ulcers of diabetic patients were swabbed aseptically for *S. aureus* screening. The wound was cleaned with sterile saline and the swab moistened with sterile saline water before swabbing the wound. The specimens were inoculated on to Blood Agar (BA) plates incubated at 37°C for 24 - 48 hours. Gram staining was done and the isolated colonies were further tested for the production of free coagulase enzyme using the tube coagulase test; all the confirmed *S. aureus* strains were subsequently tested for antimicrobial susceptibility based on the Kirby-Bauer disk diffusion method using antimicrobial discs (vancomycin and linezolid). Diameter of zones of inhibition was measured using a transparent plastic ruler. Any growth around the disc was considered resistant, measured zones of inhibition were compared with that of Clinical and Laboratory Standards Institute.

4.0 Research Findings

4.1 Demographic Properties

4.1.1 Age

Findings in Table 4.1 indicate that majority of DPFUs were aged above 60 years at approximately 44%.

Table 4.1: Age

Years	Frequency	Percent (%)
18-30	17	11
31-34	34	22
35-60	37	24
Over 60	68	44
Total	156	100

4.1.2 Gender

Table 4.2 results indicated that 51% and 49 % of diabetic patients with foot ulcers were male and female respectively. Thus women are more exposed to *S.aureus* colonization in relation to their male counterparts.

Table 4.2. Gender

Gender	Frequency	Percentage (%)
Male	80	51
Female	76	49
Total	156	100

4.1.3 Education

Results in Table 4.3 indicated that most of the diabetic patients with foot ulcers had low level of education i.e. 66% had up to primary school education.

Table 4.3: Education

Level	Frequency	Percent (%)
None	08	6
Primary	94	60
Secondary	41	26
College/University	13	8
Total	156	100

4.1.4 *S. aureus* Colonization.

Following cultures, isolation and identification of pus swab of 156 specimens as in Table 4.4 it emerged that 94 of the pus swab were Gram positive and coagulase positive. This implied that 60% of the DPFUs were colonized by *S. aureus*.

Table 4.4: S. aureus Colonization

Result	Frequency	Percent (%)
Positive for <i>S. aureus</i>	94	60
Negative for <i>S. aureus</i>	62	40
Total	156	100

4.1.5 Susceptibility of S. aureus to vancomycin and linezolid

Table 4.4 indicated that 36 % of the samples were susceptible to vancomycin while 60% were susceptible to linezolid. Similarly, 64% of the samples were resistant to vancomycin while 40% were resistant to linezolid. Based on gender as indicated in Table 4.4, it is clear that female patients were more resistant to both vancomycin and linezolid at 40% and 33% respectively as opposed to males at 23% and 7% respectively. This implied that *S. aureus* was more susceptible and less resistant to linezolid in comparison to vancomycin.

Table 4.4: Resistance & Susceptibility of S. aureus to vancomycin and linezolid

Characteristic	Vancomycin n=94		Linezolid n=94	
	S	30µg R	S	30µg R
Age				
18-30	-	-	-	-
31-44	12(13%)	0(0%)	12(13%)	0 (0%)
45-60	1(1%)	21(22%)	7(7%)	15 (16%)
Over 60	21(22%)	39(42%)	37(39%)	23 (25%)
Gender				
Male	18(19%)	22 (23%)	33(35%)	7 (7%)
Female	16(17%)	38 (40%)	23(25%)	31 (33%)
Education				
None	0(0%)	7 (7.4%)	0(0.0%)	7 (7%)
Primary	16(17%)	37 (39%)	29(31%)	24 (26%)
Secondary	18(19%)	13 (14%)	23(25%)	7 (7%)
College	0(0%)	3 (3%)	4(4%)	0(0%)
Total (n = 94)	34 (36)	60 (64%)	56 (60%)	38 (40%)

5.0 Conclusions and Recommendations

The research work concludes that linezolid was the most effective antibiotic to treat *S. aureus* with 60% susceptibility rate in comparison to vancomycin at 36%. Therefore, linezolid having the highest susceptibility rate of should be used as the first line antibiotic in treating bacterial pathogens that are resistant to most of the antibiotics. This will make sure that DPFUs having chronic infections get suitable prescription that will decrease infection rate and thus improve the health status.

7.0 Declarations

7.1 Ethics approval and consent to participate

Approval to conduct the study was provided by Ethical Review Committee at Maseno University and permission from Vihiga County Referral Hospital administration. Informed assent was sought from the participants. Free education on diabetes was also provided to the participants with assurance on the confidentiality of their responses given and study results.

7.2 Acknowledgements

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