Letters to the Editor

Effect of Linezolid in Comparison with That of Vancomycin on Glycocalyx Production: In Vitro Study

Production of slime is considered one of *Staphylococcus aureus*' critical virulence and colonization factors (4), probably providing a permanent binding to the host cell surface and interfering with local host defense (9, 11). Linezolid, the first oxazolidinone introduced in clinical practice, exhibits excellent activity against *S. aureus* strains, including methicillin-resistant strains, although a linezolid-resistant strain has been recently isolated (8, 10, 12).

Eight strains of methicillin-resistant and -susceptible *S. aureus* were evaluated for slime production in the presence of subinhibitory concentrations (0.25 and 0.5 times the MIC) of linezolid (Pharmacia & Upjohn, Kalamazoo, Mich.) and vancomycin (Sigma, St. Louis, Mo.). A spectrophotometric

method was used to classify bacteria as nonadherent (optical densities [ODs] ≤ 0.146), weakly adherent (ODs > 0.146 but ≤ 0.292), and strongly adherent (ODs > 0.292) (2–4). Slime production was observed by scanning electron microscopy (SEM): after bacterial incubation for 18 h on glass slides with or without subinhibitory concentrations of antibiotics, the slides were removed and processed as described elsewhere (6).

Subinhibitory concentrations of linezolid and vancomycin generally caused a reduction in OD, which corresponds to a change from strongly or weakly adherent to weakly or not adherent (Table 1). Consequently, the percent decrement in OD with respect to the antibiotic-free incubation was about 82 and 62% for linezolid and about 80 and 46% for vancomycin at

FIG. 1. Bacterial slime of staphylococci before treatment with linezolid and vancomycin (A) or after treatment with 0.5 times the MIC of linezolid (B), 0.25 times the MIC of linezolid (C), or 0.5 times the MIC of vancomycin (D).

TABLE 1. Effects of subinhibitory concentrations of linezolid and vancomycin on slime production of *S. aureus* ($n = 8$)

	OD ₃₄₀ (mean $\pm$ SEM)		
	Control	0.5 $\times$ MIC ^a	0.25 $\times$ MIC ^a
Linezolid	0.353 $\pm$ 0.095	0.063 $\pm$ 0.032*	0.136 $\pm$ 0.056*
Vancomycin	0.353 $\pm$ 0.095	0.069 $\pm$ 0.048*	0.191 $\pm$ 0.107

^a*, $P < 0.05$ versus control.

0.5 and 0.25 times the corresponding MIC, respectively. Spectrophotometric results were strongly supported by SEM observations. With respect to controls (Fig. 1A), where microbial cells were coated in an extracellular material, bacteria grown in the presence of linezolid (0.5 and 0.25 times the MIC) and vancomycin (0.5 times the MIC) were more distinctly outlined (Fig. 1B to D). Incubation with vancomycin at 0.25 times the MIC produced slime reduction in four out of eight strains, evidencing a limited ability of vancomycin in impairing slime production at concentrations lower than 0.5 times the MIC, as reported by others (1).

The mechanism by which linezolid affects slime production was not investigated in this study. However, as already reported for antibiotics affecting protein synthesis, it may be hypothesized that the drug suppresses steps of the synthesis of monosaccharides or destroys hexose-containing polysaccharides, once produced, independently of its mode of antibacterial activity (13). The importance of slime production in pathogenesis of several infections and the difficulty in eradicating biofilm-producing bacteria have been widely evidenced by several studies (5, 7, 14). Slime production facilitates bacterial adherence to implanted biomaterial, thus favoring the development of infections characterized by a high rate of morbidity and mortality. *S. aureus* and *S. epidermidis* are among the most frequent pathogens associated with such infections. Therefore, linezolid, with its ability in limiting slime production, should be considered as a valid therapeutic alternative in prophylaxis and treatment of methicillin-resistant staphylococci infections.

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