Letters to the Editor


Virginiamycin has been widely utilized in agriculture for nearly 3 decades but was removed from growth promotion and therapeutic use in the European Union in 1998 (1), generally in response to concerns about evolving resistance that might compromise streptogramin (quinupristin-dalfopristin) therapies in humans. Recent events affecting the future of streptomycins in human infection treatment include (i) Food and Drug Administration release of linezolid as an alternative agent for vancomycin-resistant Enterococcus faecium therapy, (ii) emerging resistances to streptogramins among human E. faecium strains, and (iii) elevated rates of adverse events compromising the wide clinical application of this class. Also, the discovery of vat(D)- and vat(E)-encoded streptogramin acetyltransferases associated with streptogramin resistance has been documented in enterococcal isolates of animal or poultry origin (4–6, 8; G. Werner and W. Witte, Letter, Antimicrob Agents Chemother. 43:1813–1814, 1999). Each of these latter reports describes the “possible” transfer of these organisms to the human gastrointestinal tract flora and subsequent direct causal effects of streptogramin-resistant organism infections or passage of the genetic resistance determinants to the human microbial flora (1).

Several publications have indicated that a reservoir of streptogramin resistance genes exists in poultry, in meat production environments, and on retail meat products, each associated with the consumption of virginiamycin (1, 2, 5–7, 8). The most recent report by Simjee and colleagues (5) further suggests the presence of a “potential public health hazard” in the form of a vat(E) reservoir among the intrinsically streptogramin-resistant Enterococcus faecalis strains isolated in 5 of 16 retail poultry samples from the Washington, D.C., area. To assess the level of this hazard, isolates of E. faecalis from unique human episodes of bloodstream infection (BSI; 159 strains from 32 different medical centers in North America, including the mid-Atlantic states) in the SENTRY Antimicrobial Surveillance Program were screened for vat(D) and vat(E) (4, 8; Werner and Witte, letter). Also, 10 BSI strains of E. faecium were tested for which the quinupristin-dalfopristin MICs were elevated. Eight of the E. faecium strains were from North America (streptogramin MIC range, 2 to 8 μg/ml), and two isolates were from BSI episodes in European patients (streptogramin MICs, 4 and >8 μg/ml).

The 169 strains were tested by reference broth microdilution susceptibility methods against 27 antimicrobial agents (TREK Diagnostics, Cleveland, Ohio) according to procedures described by the National Committee for Clinical Laboratory Standards (3). However, only the results for eight drugs are reported here (Table 1). The enterococcal identification was confirmed by the Vitek System (bioMérieux, Hazelwood, Mo.). Determination of the streptogramin resistance genes was accomplished after genomic DNA extraction from broth cultures with a QIAamp DNA mini kit (QIAGEN, Inc.). vat(E) primers were prepared with the following primer sequences (6): vatE forward, 5′-ACT ATA CCT GAC GCA AAT GC-3′; vatE reverse, 5′-GTT TCA AAT CTT GGT CCG-3′. PCRs were performed with puReTaqReady-To-Go PCR beads (American Biosciences, Inc., Piscataway, N.J.) in accordance with a protocol described by Werner and Witte (letter). The testing for vat(D) utilized the methods of Werner et al. (8). Following amplification, the PCR products were separated by electrophoresis with 2% agarose gel and visualized on a Gel Doc 2000 imaging system.

Table 1 summarizes the antimicrobial susceptibility pattern for the 159 screened bloodstream isolates of E. faecalis. All strains were susceptible to ampicillin, but 2.5 to 5.0% were resistant to the two glycopeptides (teicoplanin and/or vancomycin). All vat(D) tests were negative (data not shown). vat(E) was not detected in any of the North American E. faecalis or E. faecium strains (167 bacteremia isolates) tested by the same procedures utilized by Simjee et al. (5). These results from

---

**Table 1.** Antimicrobial activities of seven selected agents tested against 159 BSI strains of *E. faecalis* for which the quinupristin-dalfopristin MICs were ≥4 μg/ml (SENTRY Program, 2002, North America)

<table>
<thead>
<tr>
<th>Antimicrobial agent</th>
<th>MIC (μg/ml)</th>
<th>% by category&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Range</th>
<th>50% of strains</th>
<th>90% of strains</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>≤2</td>
<td>≤2</td>
<td>≤2–8</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>&gt;8</td>
<td>&gt;8</td>
<td>0.12–&gt;8</td>
<td>0.0</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>≥0.12</td>
<td>0.25</td>
<td>0.12–&gt;8</td>
<td>0.0</td>
<td>97.5</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>2</td>
<td>2</td>
<td>1–16</td>
<td>0.0</td>
<td>95.0</td>
</tr>
<tr>
<td>Gentamicin (HL)&lt;b&gt;</td>
<td>≤500</td>
<td>1,000</td>
<td>≤500–&gt;1,000</td>
<td>0.0</td>
<td>49.1&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Streptomycin (HL)&lt;b&gt;</td>
<td>≥1,000</td>
<td>2,000</td>
<td>≥1,000–&gt;2,000</td>
<td>0.0</td>
<td>53.5&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> According to the susceptibility criteria of the NCCLS (4).

<sup>b</sup> HL, high-level screen for resistance.

<sup>c</sup> Percent susceptible indicates the proportion of strains for which there is likely to be synergy when the drug is used with an active β-lactam or glycopeptide (3).
invasive human infection isolates stand in marked contrast to the rates of vat(E) documented in E. faecalis from the small sample of retail poultry (31.3%) (5) and to the level of quinupristin-dalfopristin resistance (51 to 78%) reported in E. faecium from the poultry production environments on the eastern seaboard (2). Also, the findings of a non-vat(D) or -vat(E) mechanism of resistance in E. faecium stands in contrast to the occurrence rates published by Werner et al. (8) for Europe (Germany), where 32 (89%) of 36 isolates from hospitalized patients have a detectable acetyltransferase gene.

To address the possible public health risks of an endemic vat(E) reservoir in animal strains of E. faecalis (5), surveillance programs must be alert to document initial occurrences of these strains producing human infections or to the transfer of vat(E) to species (E. faecium) likely to receive human quinupristin-dalfopristin regimens. This investigation, stimulated by the results published by the U.S. Food and Drug Administration Center for Veterinary Medicine (5), suggests that a large comprehensive sample of contemporary (2002) human enterococcal bacteremia isolates does not harbor vat(E). Furthermore, BSI isolates of E. faecium (eight strains from North America) for which the quinupristin-dalfopristin MICs indicate nonsusceptibility were free of vat(D) and vat(E) as a cause of the documented resistance (3). Since other investigators have noted a high prevalence of virginiamycin-resistant strains in E. faecium of poultry origin in the United States (2, 5, 7), we must conclude that these strains remain extremely rare as the causative agent of invasive human enterococcal infection.

REFERENCES

Ronald N. Jones
Tufts University School of Medicine
Boston, MA 02111

Lalitagauri M. Deshpande
The JONES Group/JMI Laboratories, Inc.
345 Beaver Creek Centre, Suite A
North Liberty, IA 52317

* Phone: (319) 665-3370
Fax: (319) 665-3371
E-mail: ronald-jones@jmilabs.com