INTRODUCTION

Aerococcus viridans, a catalase-negative gram-positive coccus rarely causing bacteremia, was isolated from blood cultures of a 52-yr-old man under the granulocytopenic condition. The isolate showed the typical characteristics of A. viridans, i.e., tetrad arrangements in gram stain, positive pyrrolidonyl aminopeptidase (PYR) and negative leucine aminopeptidase (LAP) reactions, and no growth at 45°C. The isolate was revealed to be highly resistant to penicillin, erythromycin, clindamycin, and ceftriaxone, although most strains of A. viridans isolated from the previously reported patients were susceptible to penicillin and other commonly used antibiotics. Even though A. viridans is rarely associated with human infections, it could be a potential causative agent of bacteremia, especially in immunocompromised patients.

CASE REPORT

A 52-yr-old man was transferred to emergency room of Wonju Christian Hospital, Wonju, from a local hospital on June 2, 1997, due to intracerebral hematoma, subarachnoid and ventricular hemorrhage, and multiple fractures due to traffic accident. On presentation to the emergency room, his mental status was semicomatose. Hematologic findings were: hemoglobin 11.2 g/dL, hematocrit 32.5%, WBC count 11,100/μL (87% neutrophils, 7% monocytes, and 6% lymphocytes), and platelet count 186,000/μL. And no organism was detected from three sets of aerobic and anaerobic blood cultures. On the fourth day of admission, the patient underwent stereotaxic closed drainage of the intracerebral hematoma, and as of January 21, 1998, he subsequently underwent 4 episodes of major operations to correct underlying disorders as follows: internal fixation of leg (July 7, 1997), open reduction of the mandible fracture (September 5, 1997), ventriculo-peritoneal shunt for hydrocephalus (December 16, 1997), and revision of ventriculo-peritoneal shunt (January 21, 1998). Between the admission and the 492th hospital day, the patient’s WBC counts were higher than 5,000/μL, even though he was intermittently treated with antimicrobial agents for pneumonia, urinary tract infection, and wound infection. On the 497th hospital day, mild to moderate fever accompanied with leukopenia (total WBC count; 2,470/μL, differential count; 38% neutrophils, 35% lymphocytes, 10% monocytes, 10% eosinophils, 1% basophils) was noted, and then two days later three sets of blood cultures were performed due to sustained low grade fever and low WBC count (1,640/μL). Blood cultures were done according to our routine proce-
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A. viridans is frequently isolated from two divergent sources: as a common airborne organism in hospital environments and as a marine organism causing a fatal disease in lobster (16). In human, aerococci can be found in a very small number as indigenous inhabitants in the upper respiratory tract and on the skin of normal persons (1). This organism is generally saprophytic and rarely has been encountered as a human pathogen (2, 9, 10). It was first described as a potential human pathogen in 1967 (5). Since then, it has been reported as the causative agent of meningitis (8), endocarditis (9), bacteremia (10), or of other infections such as urinary tract infection, septic arthritis, and wound infection (2).

Although the pathogenicity and virulence of A. viridans have not been well-established, infections due to this organism presumably seem to occur in previously damaged tissues or may be nosocomial in association with a prolonged hospitalization, antibiotic treatment, invasive procedures, presence of foreign bodies, or neutropenic state (2, 3, 7, 10). Kern and Vanek (7) suggested that both granulocytopenia and oral mucositis be the major risk factors for aerococcal bacteremia. Recently, Swanson et al. (10) also described that A. viridans might be a significant pathogen in patients with functional asplenia, in that the organism is encapsulated with an acidic polysaccharide, and the strains with heavier encapsulation are more virulent (17).

**DISCUSSION**

Table 1. Characteristics of A. viridans isolate

| Tests               | A. viridans* | Isolate |
|---------------------|--------------|---------|
| Gram stain          |              |         |
| Relation to oxygen  | Tetrads, pairs | Tetrads, pairs |
| Hemolysis           | Microaerophilic | Microaerophilic |
| Catalase            | Alpha        | Alpha |
| Bile esculin        | V            | +       |
| Growth in 6.5% NaCl | +            | +       |
| Pyrrolidonyl aminopeptidase | + | + |
| Leucine aminopeptidase | -       | -       |
| Growth at 45°C      | -            | -       |
| Arginine ditylhydrolase | -      | -       |
| Hippurate hydrolysis | V          | -       |
| Acid from glucose   | +            | +       |
| lactose             | +            | +       |
| trehalose           | +            | +       |
| sorbose             | -            | -       |
| Voges-Proskauer reaction | -      | -       |

*Adapted from references 2 and 3.

1*, negative or no growth; +, positive or growth; V, variable.

A. viridans (probabilities, 99.6% [bionumber, 4500410] and 99.9% [bionumber, 21630101150], respectively).
Penicillin-resistant *Aerococcus viridans* Bacteremia Associated with Granulocytopenia

Limited are the data in the literature on the antimicrobial susceptibility of *A. viridans*, because this organism has been infrequently associated with human infections, and is usually susceptible to penicillin. In addition, standardized susceptibility testing methods and interpretive criteria are not available for aerococci, although most investigators have used the non-pneumococcal Streptococcus category of the NCCLS.

As revealed by a cluster of sporadic reports, antimicrobial susceptibility patterns of *A. viridans* have been rapidly changed as follows: until the late 1980s, this organism had been reported as susceptible to the most commonly used antibiotics, but recent studies have documented that *A. viridans* has shown resistance not only to penicillin but also to chloramphenicol and the quinolones as well (7, 9, 12, 18). In 1987, Kern and Vanek (7) described that two aerococci isolated from blood cultures were sensitive to penicillin G and piperacillin but resistant to fluoroquinolone and netilmicin given orally for prophylaxis. In 1996, Swanson et al. (10) reported a case of penicillin-resistant *A. viridans* (penicillin MIC, 0.5 μg/mL) bacteremia in a child who was receiving prophylactic penicillin. These observations suggest that drug resistance of *A. viridans* could be induced by selective pressure by prolonged antibiotic use.

Augustine et al. (9) reported a case of endocarditis caused by *A. viridans* with multidrug resistance, i.e., resistance to penicillin, ampicillin, cefotaxime, gentamicin, and intermediate resistant to ciprofloxacin, but they did not discussed on MICs. According to the antimicrobial susceptibility data of 30 aerococcal isolates obtained from Centers for Disease Control and Prevention (12), the MICs for 9 strains were 0.5 μg/mL, with MICs for 5 strains being more than 1 μg/mL; therefore, approximately 46% of aerococci tested were either relatively resistant or resistant to penicillin. Moreover, Christensen et al. (13) recently documented that penicillin resistance should be the peculiar characteristics of *A. viridans* capable of differentiating it from *A. coccos* like organisms.

Since *A. viridans* is usually recognized as susceptible to penicillin, the treatment protocol for aerococcal endocarditis is similar to that for endocarditis caused by penicillin-susceptible streptococci (19). Although penicillin - or multidrug-resistant *A. viridans* strains have been occasionally isolated from clinical specimens as documented by some authors and us, optimal treatment of systemic infections caused by the penicillin-resistant *A. viridans* has not been established yet.

In conclusion, even though *A. viridans* is rarely associated with human infections, it could be a potential causative agent of bacteremia, if *A. viridans* is isolated from the multiple set of blood cultures especially in immunocompromized patients, effective antibiotics on the basis of antibiogram thereof should be administered. Further investigations are needed to establish the optimal treatment for this pathogen.

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