

Rhodococcus Bacteremia in an Immunocompetent Patient

Case Presentation

A 35-year-old man was admitted to the emergency department with a 6-week history of low-grade fever, dizziness, and ringing in his ears. After having a previous diagnosis of middle ear infection, the patient was treated with amoxicillin without improvement. At admission, the ringing in his ears had worsened, and the patient had fainting episodes and nausea. He denied cough or shortness of breath, and his medical history did not suggest he was immunocompromised.

On admission, his temperature was 100.2°F (37.9°C). He appeared ill and was sweating. Physical examination findings were normal. The patient's blood chemistry constituent levels and CBC were within reference ranges. Chest radiographs, magnetic resonance imaging, and computed tomography scans of the head revealed no abnormalities.

Two sets of blood samples were collected for culture on the Bactec 9120 Continuous Monitoring System (BD Biosciences, Franklin Lakes, NJ). Following 3 days' incubation, 1 sample was positive with pleomorphic gram-positive bacilli; the positive bottle was subcultured to blood and chocolate agar plates. Orange-pigmented colonies appeared after a 2-day incubation at 35°C with 5% CO₂ (Fig 1). A Gram stain of the colonies showed pleomorphic gram-positive bacilli (Fig 2). A modified acid-fast stain was positive, and a presumptive identification of *Rhodococcus* species was made (Fig 3). The patient was treated with azithromycin and discharged with symptomatic improvement. Although the source of the infection was never proved, it was thought clinically to be the middle or inner ear.

ABSTRACT *Rhodococcus* species are uncommon opportunistic pathogens in humans; they are most commonly isolated from immunocompromised patients presenting with severe cavitating pulmonary infections. We present a case of *Rhodococcus* bacteremia in an immunocompetent patient. Although *Rhodococcus* species have distinctive colony morphology and Gram stain characteristics, they may be under-recognized or misinterpreted as normal flora in the clinical microbiology laboratory. Presumptive identification of these organisms is important to ensure appropriate empiric antimicrobial therapy.

Clinical Background

Rhodococcus species are aerobic actinomycetes of the family Nocardiaceae, members of which are characterized by gram positivity and branching filamentous growth. *Rhodococcus* species cause significant pulmonary disease in animals especially horses. Most commonly isolated from soil,

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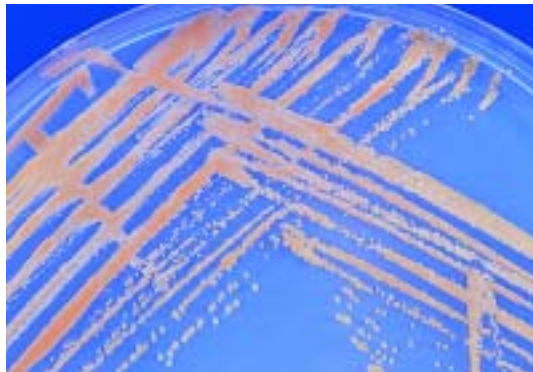


Fig 1. *Rhodococcus* species following several days of growth on Mueller-Hinton agar. Note the characteristic salmon pigmentation. The organism was isolated from 1 of 2 blood cultures obtained from an immunocompetent patient with a 6-week history of low-grade fever, dizziness, and ringing in his ears.

Fig 2. Gram-stained smear of a colony (shown in Fig 1) shows gram-positive and pleomorphic morphology of *Rhodococcus* species (oil immersion, original magnification $\times 1000$).

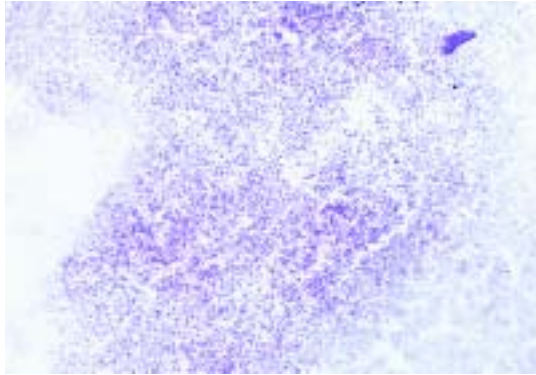
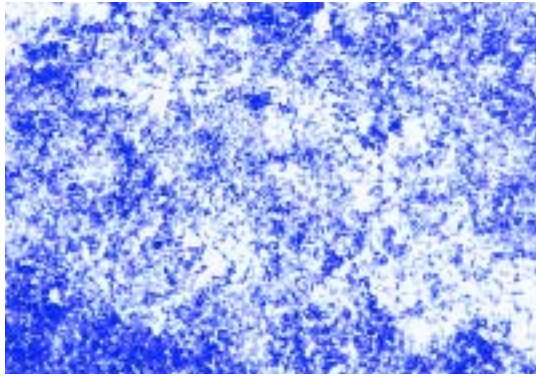


Fig 3. Modified acid-fast stained smear of same organism (Oil immersion, original magnification $\times 1,000$).

these opportunistic pathogens have also been isolated from animal dung and marine sediments. Human infection with *Rhodococcus* species, though rare, is becoming more recognized.¹ Although most infections have occurred in immunocompromised patients, especially those with AIDS, the organism has been isolated in immunocompetent persons as well.²

A patient with a *Rhodococcus* infection most commonly has a high fever and granulomatous pneumonia, which eventually cavitates and spreads.³ Bacteremia commonly ensues in immunocompromised patients, in whom the mortality rate exceeds 50% and multiple relapses occur.⁴ *Rhodococcus* involvement in the vertebrae,⁵ brain,⁶ and bowel⁷ of immunocompromised patients has been reported. People are thought to acquire *Rhodococcus* by inhalation; in 20% to 30% of cases, infection is associated with exposure to animals.¹ As facultative intracellular bacteria, *Rhodococcus* species may persist and replicate within macrophages. This accounts for the frequent relapses that occur even with antimicrobial treatment.

Rhodococcus isolates are generally susceptible to erythromycin, chloramphenicol, vancomycin, and the aminoglycosides. They are frequently resistant to penicillin and cephalosporin antibiotics.⁸ Because penicillins and cephalosporins are often used to treat lower respiratory tract infections, it is important to correctly identify *Rhodococcus* to minimize the time that the patient may be treated with ineffective drugs. Correct identification thus hastens the proper therapy and reduces the duration of illness and length of stay in the hospital.

Role of the Laboratory

Rhodococcus species are diverse in their morphology, biochemistry, and ability to cause disease. Not particularly fastidious, they grow on most routine bacteriologic and fungal media. However, they can be difficult to isolate, and their colonies are often hidden by contaminant overgrowth. Although slow growing, *Rhodococcus* do not require the long incubation periods characteristic of other Nocardiae. Recovery of organisms can be improved by using, along with routine media, selective media such as brain-heart infusion agar with chloramphenicol and cycloheximide, or Columbia agar with colistin and nalidixic acid. Incubation at 30°C also increases recovery. Although *Rhodococcus* colonies tend to be small, discrete, and smooth surfaced, they occasionally may be mucoid and coalescent with a variable but distinct orange to salmon pigmentation after 5 to 7 days of growth. Incubating for several weeks enhances recovery. Microscopically, the organisms are gram-positive filaments that fragment into cocci and bacilli. Gram-stain morphology is often pleomorphic and diphtheroid-like, which although helping to distinguish *Rhodococcus* from staphylococci and bacilli, can cause confusion with coryneform bacteria and misinterpretation as normal flora.

Rhodococcus species can be differentiated from other aerobic actinomycetes by their partial acid-fastness arising from the mycolic acid in their cell wall. *Nocardia*, *Gordona*, and *Tsukamurella* species share this characteristic. Although the organisms react negatively with Ziehl-Neelsen and Kinyoun acid-fast stains, they react positively with acid-fast stains modified with a weak decolorizer. The absence of modified acid-fast positivity does not, however, exclude *Rhodococcus* species because acid-fastness also depends on the age of the colonies and the growth media.

Biochemical Characteristics of Aerobic Actinomycetes¹

Organism	Hydrolysis of					Nitrate Reduction	Urease
	Casein	Hypoxanthine	Tyrosine	Xanthine	Gelatin		
<i>Rhodococcus equi</i>	-	-	-	-	-	+/-	+
<i>Rhodococcus</i> species	-	-	-/+	-	+	+/-	+/-
<i>Gordona</i> species	-	-	-	-	-	+	+
<i>Tsukamurella</i> species	-	+	-	+	+	-	+
<i>Streptomyces somaliensis</i>	+	+	+	+	+	-	-
<i>Streptomyces anulatus</i>	+	+	+	+/-	-	-	+/-
<i>Oerskovia turbata</i>	+	-	-	-	+	+	-/+
<i>Oerskovia xanthineolytica</i>	+	+	-	+	+	+	-/+
<i>Actinomadura</i> species	+	+	+	-	+	+	-
<i>Nocardiosis</i> species	+	+	+	+/-	+	+/-	+/-

Reference

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Rhodococcus can be differentiated from *Nocardia* by growing the organism on tap water agar (Bacto agar [Difco, Detroit] added to 100 mL tap water and sterilized prior to pouring plate); *Rhodococcus* grows minimally (if at all), and *Nocardia* grows freely.⁹ Although other biochemical tests help to distinguish *Rhodococcus* from other organisms, differentiation from other aerobic actinomycetes can be difficult. *Rhodococcus* species typically react positively in catalase, nitrate reduction, and urea hydrolysis tests and negatively with oxidase, gelatin hydrolysis, and carbohydrate reduction. They are nonmotile. Their inability to ferment carbohydrate is important in distinguishing them from *Corynebacteria*.

When *Rhodococcus* is presumptively identified, the species involved may also be identified, though the procedure is beyond the scope of many clinical microbiology laboratories. *Rhodococcus equi* is the organism most commonly associated with human disease. Reliable serologic tests for *Rhodococcus* are not available for clinical use.⁹

Conclusion

As opportunistic pathogens, *Rhodococcus* species most frequently cause cavitary lung infections in immunosuppressed patients. Extrapulmonary disease and infections in immunocompetent patients have also occurred. The clinical onset may be insidious and resemble that of other mycobacterial, fungal, and actinomycotic infections. *Rhodococcus* species should be considered when

the distinctive pigmentation of colonies and pleomorphic Gram stain morphology are encountered. Presumptive identification often suffices for empiric treatment with antimicrobial agents; it can markedly improve the overall course and treatment of infected patients, as well as shorten the patient's length of stay.¹

References

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