



## Case report

*Acinetobacter radioresistens* infection with bacteremia and pneumonia

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## ABSTRACT

*Acinetobacter* species are non-fermentative Gram-negative coccobacilli that are ubiquitous in the environment. The archetype pathogen within the genus is *Acinetobacter baumannii*, however, other species have the potential to cause human infection, especially in the hospital setting. We describe a patient with infection due to *Acinetobacter radioresistens*, a rare agent of human disease, which is often misidentified using biochemical methods. *Acinetobacter radioresistens* is the source of the Class D OXA-23 carbapenemase that can confer carbapenem resistance in *A. baumannii*. Therefore, accurate identification of *A. radioresistens* is important for clinical management and to potentially prevent the spread of carbapenem resistance.

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## Introduction

*Acinetobacter* species are strictly aerobic, oxidase-negative, Gram-negative coccobacilli [1]. Members of the genus, in particular *Acinetobacter baumannii*, have gained increasing attention due to their role in nosocomial infections (particularly for patients in intensive care units), and their ability to readily develop pan-drug resistance and cause healthcare-associated infection outbreaks [2,3]. Although more than 30 species belong to the genus, the most frequently isolated species clinically is *Acinetobacter baumannii* (accounting for >90% of *Acinetobacter* species isolates) [1,4]. To our knowledge, there are only three reports in the literature describing the isolation of *Acinetobacter radioresistens* from human clinical specimens (PubMed [<https://www.ncbi.nlm.nih.gov/pubmed/>]; search terms “*Acinetobacter*”, “*radioresistens*”, “case”, and “report”) (Table 1). Herein, we present a case of *A. radioresistens* pneumonia and bacteremia and review the previously described cases.

## Presentation of case

An 87-year-old woman with adenocarcinoma of the lung presented with a two-day history of worsening dyspnea, cough,

nausea and vomiting. Her history was significant for multiple right-sided video-assisted thoracoscopic pleurodeses and active treatment with erlotinib, an inhibitor of epidermal growth factor receptor tyrosine kinase. On physical examination she was afebrile, but markedly tachypneic to 40 breaths/min, hypoxic to 80% saturation on room air, and hypotensive to 86/41 mmHg. She had decreased breath sounds in her right lung with egophony. Her laboratory evaluation was significant for a leukocytosis of  $11.3 \times 10^3/\mu\text{L}$  (71% neutrophils, 17% bands) and acute kidney injury with creatinine levels of 1.84 mg/dL. Chest radiograph revealed total opacification of the right hemithorax. A non-contrast computed tomography scan of the chest showed a consolidated right lung with a small right pleural effusion. The patient was admitted to the medical intensive care unit for post-obstructive pneumonia. She required intubation and initiation of vasopressors. Empiric treatment with intravenous vancomycin (750 mg dosed by level), piperacillin-tazobactam (4.5 g every 12 h), and azithromycin (500 mg daily) was administered upon presentation.

Gram stain of a positive blood culture (broth from the aerobic bottle of one set) collected upon admission showed Gram-negative rods, while microscopic evaluation of tracheal aspirate, bronchial wash and bronchoalveolar specimens revealed varying amounts of white blood cells, Gram-negative rods or Gram-positive cocci. Therapy was subsequently changed to intravenous meropenem (500 mg every 8 h). All blood culture and respiratory tract isolates were identified as *A. radioresistens* by matrix-assisted laser desorption/ionization-time of flight mass spectrometry ([MALDI-TOF MS] MALDI Biotyper CA system, Bruker Daltonics, Billerica, MA, USA). The identification was confirmed by sequencing of the 16S rRNA gene of the blood culture isolate (99.6% identity to the *A.*

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**Table 1**  
*Acinetobacter radioresistens* clinical case descriptions.

Case	Age (years)	Sex	Comorbid Conditions	Source	Treatment	Outcome
Visca et al. [9]	32	F	HIV (CD4 cell count 309/mm <sup>3</sup> ; viral load, <80 copies/mL)	Blood	Ciprofloxacin 400 mg twice a day for 14 days	Survived
Savov et al. [10]	85	M	COPD CHF (NYHA functional class III-IV)	Tracheobronchial	Ceftriaxone 2 × 1 g and Gentamicin 80 mg	Died <sup>a</sup>
Brady et al. [11]	53	F	Li-Fraumeni syndrome	Blood	Ampicillin-Sulbactam <sup>b</sup>	Survived
	60	M	Chronic foot ulcer, DM, ESRD/HD	Blood	Cefepime <sup>b</sup>	Survived
Our Patient	87	F	Adenocarcinoma of lung	Blood; Tracheal; Bronchial	Ampicillin-Sulbactam 3 g every 6 hours	Died

Abbreviations: CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; ESRD/HD, end-stage renal disease/hemodialysis; F, female; M, male; NYHA, New York Heart Association.

<sup>a</sup> Unclear if *A. radioresistens* was the etiologic agent of infection.

<sup>b</sup> Dosing information not provided.

*radioresistens* type strain NBRC 102413). Antibiotic susceptibility testing (AST) of blood and respiratory tract cultures using the Clinical and Laboratory Standards Institute breakpoints for *Acinetobacter* species demonstrated susceptibility to all antibiotics tested (ampicillin-sulbactam, cefepime, ceftazidime, ceftriaxone, gentamicin, levofloxacin, meropenem, piperacillin-tazobactam, tobramycin and trimethoprim-sulfamethoxazole) [5]. The patient was treated with a fourteen-day course of intravenous ampicillin-sulbactam (3 g every 6 h).

The patient initially showed some improvement with reduced fever and vasopressor requirements. However, her respiratory status remained critical. Her family made the decision to withdraw life support and provide comfort care. The patient subsequently expired.

## Discussion

The identification of *Acinetobacter* to the species level remains a challenge using biochemical-based methods [1,6]. Molecular tools including mass spectrometry or DNA sequencing may be required for unambiguous discrimination between species [7,8]. The impact of *Acinetobacter* species is increasingly recognized in both health-care-associated and community-acquired infections, however, the majority of these cases are attributed to *A. baumannii*. The prevalence and pathogenicity of *A. radioresistens* is largely unknown. Prior to our case only three reports (documenting four independent cases) describing recovery of *A. radioresistens* from clinical specimens have been reported in the literature (Table 1).

Two of the reported cases demonstrate the difficulty in identifying *A. radioresistens* using standard microbiologic testing. In the case authored by Visca et al., Gram-positive diplococci were reported from positive blood cultures [9]. Bacterial identification was initially performed using the Sceptor Gram-positive Breakpoint/ID panel (Becton, Dickinson and Company [BD], Franklin Lakes, NJ, USA). Ultimately, the isolate was identified as *A. radioresistens* using 16S rRNA gene sequencing. Based on the DNA sequencing result, biochemical identification was repeated using Sceptor Gram-negative Breakpoint/ID (BD) and API 20NE (bioMérieux, Durham, NC, USA) panels, resulting in misidentification of the organism as *Acinetobacter lwoffii*. In the case described by Savov et al., Gram-negative bacilli recovered from a tracheobronchial culture were identified as *A. baumannii* complex using biochemicals (VITEK 2, bioMérieux) [10]. The isolate was later identified by sequencing of the *rpoB* and 16S rRNA genes as *A. radioresistens*. However, the authors suggest *A. radioresistens* was unlikely the etiological agent of pneumonia since a subsequent tracheobronchial culture taken a day later was devoid of *Acinetobacter* species. Lastly, Brady et al. reported two cases of bacteremia due to Gram-negative bacilli [11]. In both cases, the Verigene Gram-Negative Blood Culture Test (Luminex Corporation, Austin, TX, USA) identified the organisms as “*Acinetobacter* species, OXA detected” directly from positive blood culture broths. The

isolates were ultimately identified as *A. radioresistens* using MALDI-TOF MS (VITEK MS, bioMérieux).

In our patient Gram-positive cocci in pairs were observed in Gram stains of tracheal aspirate, bronchoalveolar lavage and bronchial wash specimens, but subsequently only *A. radioresistens* was isolated in culture. *Acinetobacter* isolates may retain crystal violet and resist decolorization [1,12], which can lead to misinterpretation of the organism as Gram-positive cocci. This feature was seen in our case and that reported by Visca et al. Given the importance of Gram stain in guiding initial management decisions the proclivity of this genus to retain crystal violet is problematic. Clinical microbiologists and physicians should maintain a high suspicion for *Acinetobacter* species when Gram-positive cocci are observed in Gram stains of clinical specimens, yet only Gram-negative organisms are recovered in culture.

*Acinetobacter radioresistens* was first isolated from cotton that had undergone a sterilization process by gamma-radiation resulting in the proposal of *radioresistens* as the specific epithet [13,14]. In addition to its resistance to radiation, it is able to survive desiccation, hydrogen peroxide, and ultraviolet irradiation [15]. These characteristics likely enable its survival in the hospital environment. Indeed, *A. radioresistens* is readily isolated from human skin and within the hospital environment itself [16,17], thus, potentiating the possibility of infection.

The potential for misidentification of *A. radioresistens* using biochemical-based methods raises the question of the true epidemiology of this organism. It is possible that some of the previously reported infections due to *Acinetobacter* species were, in fact, due to *A. radioresistens*. Importantly, *A. radioresistens* is the source of the *bla*<sub>OXA-23</sub> gene, a class D carbapenemase, which can confer carbapenem resistance in *A. baumannii* [11,18]. Our isolate was susceptible to all β-lactams, including carbapenems (carbapenem susceptibility was also noted for the previously described isolates), suggestive of poor expression of the *bla*<sub>OXA-23</sub> gene in *A. radioresistens* [9–11,18]. Thus, *A. radioresistens* could serve as a silent reservoir for carbapenem resistance in hospitalized patients and medical center environments further highlighting the need to accurately identify and contain this organism.

## Conclusion

Our case identifies *A. radioresistens* as a cause of bacteremia and severe pulmonary infection where identification was achieved using MALDI-TOF MS. To our knowledge, this is only the fourth report describing the recovery of this organism from human clinical specimens. It also highlights the important role of MALDI-TOF MS in the management of infectious diseases. Therefore, accurate identification platforms, such as MALDI-TOF MS, should facilitate our understanding of the pathogenesis and prevalence of *A. radioresistens* in human infection, which may become increasingly important due to its association with the *bla*<sub>OXA-23</sub> gene.

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