Respiratory Medicine Case Reports 24 (2018) 135–137

Contents lists available at ScienceDirect

Respiratory Medicine Case Reports

journal homepage: www.elsevier.com/locate/rmcr

Case report

Ventilator associated pneumonia caused by *Raoultella ornithinolytica* in two immunocompetent trauma patients

J.R. Van Cleve[a,*], B.A. Boucher[a], D.V. Smith[a], M.A. Croce[b]

[a] University of Tennessee, College of Pharmacy, USA
[b] University of Tennessee, College of Medicine, Department of Surgery, USA

ARTICLE INFO

Kewords:
Raoultella ornithinolytica
Ventilator-associated pneumonia
Trauma
Antibiotics

ABSTRACT

Infections with *Raoultella ornithinolytica* have recently been reported more frequently in the medical literature. This pathogen has the potential to cause many types of infections, including pneumonia. Here, we report the first two cases of ventilator-associated pneumonia (VAP) in trauma patients caused by *Raoultella ornithinolytica*. Both of these infections were successfully treated with antibiotics based on susceptibilities and the patients were able to be transferred out of the intensive care unit.

1. Introduction

Raoultella ornithinolytica is an encapsulated Gram negative aerobic bacillus bacterium of the Enterobacteriaceae family. This bacterium was formerly known as *Klebsiella ornithinolytica* but was reclassified as *Raoultella* in 2001 based on new genetic approaches [1]. *R. ornithinolytica* previously was thought to rarely cause infection in humans; however, recently it has been reported in the literature as causing many different types of infections including bacteremia, cholangitis, urinary tract infection, pneumonia, skin infections, osteomyelitis, meningitis, cerebral abscess, mediastinitis, pericarditis, conjunctivitis, otitis, among other infections [2,3]. The increase in reporting of *R. ornithinolytica* is likely due to implementation of new identification techniques in the laboratory such as the matrix-assisted laser desorption/ionization-time of flight mass spectrometer (MALDI-TOF MS) as older techniques did not always differentiate between *Klebsiella* spp and *Raoultella* spp [2,4]. In the most comprehensive study to date, Seng et al. reported 112 cases of *R. ornithinolytica* infections over an eleven year period which included both community and hospital-acquired infections from different sources [2]. This study included 20 cases of pneumonia representing 18% of infections. Boattini et al. reported three cases of hospital-acquired and 3 cases of community-acquired pneumonia over a 5 year period [3]. Risk factors for infection include solid cancer, diabetes mellitus, immunodeficiency, post-invasive procedures, and post-urethra trauma [2]. Nevertheless, there have been no cases of ventilator associated pneumonia (VAP) caused by *R. ornithinolytica* in an immunocompetent trauma population. We present two cases of ventilator-associated pneumonia caused by *R. ornithinolytica.*

2. Case 1

A 39 year old male was admitted to the Elvis Presley Memorial Trauma Center due to injuries suffered from being struck as a pedestrian by motor vehicle. The patient was intubated in the field prior to admission. Injuries included subarachnoid hemorrhage, intraventricular hemorrhage, multiple facial fractures, right clavicle fracture, right hemothorax and pneumothorax, multiple rib fractures, Grade 3 liver laceration, bilateral L1 transverse process fracture, right L2-L4 transverse process fractures, and right axillary artery laceration. On hospital day 7, mechanical ventilation was weaned and the patient extubated. On hospital day 10, the patient developed a fever of 39.5 °C, increased respiratory secretions, and right-sided infiltrate seen on chest x-ray. His white blood cell count of 11,900/μL. The patient required re-intubation due to persistent low oxygen saturation. Ventilator associated pneumonia (VAP) was suspected due to the patient being on the ventilator for seven days on admission and the patient underwent bronchoscopy with quantitative bronchoalveolar lavage (BAL) per trauma unit VAP protocol. Broad spectrum antibiotics were started with ceftazidime and vancomycin after the BAL was performed. Quantitative BAL results from the lung were *R. ornithinolytica* 6.5 × 10^6 CFU/mL in the left lower lobe and 9.3 × 10^6 CFU/mL in right lower lobe (susceptibilities in Table 1). *Enterococcus* species also grew in both BALs with 4 × 10^5 CFU/mL in the left lower lobe and 4.5 × 10^4 CFU/mL in the right lower lobe. Antibiotics were changed to piperacillin/tazobactam monotherapy on the fourth day to effectively cover both organisms. Repeat BAL was performed on the eighth day of antibiotics with no significant growth seen in the final results indicating clearance of pneumonia with no other signs or symptoms of infection. The patient

* Corresponding author.
E-mail address: jonathan.vancleve@lovelace.com (J.R. Van Cleve).

https://doi.org/10.1016/j.rmcr.2018.05.006
Received 5 April 2018; Accepted 1 May 2018

Table 1

Antibiotics	MIC (Susceptibility)		
	Patient#1 (RLL BAL)	Patient#1 (LLL BAL)	Patient#2 (LLL)
Amikacin	≤2 (S)	≤2 (S)	≤2 (S)
Ampicillin	≥32 (R)	≥32 (R)	≥32 (R)
Ampicillin/sulbactam	≥32 (R)	16 (I)	≥32 (R)
Aztreonam	S	S	S
Cefazolin	≥64 (R)	≥64 (R)	≥64 (R)
Cefepime	≤1 (S)	≤1 (S)	≤1 (S)
Ceftazidime	≤1 (S)	≤1 (S)	≤1 (S)
Ceftriaxone	≤1 (S)	≤1 (S)	≤1 (S)
Ciprofloxacin	≤0.25 (S)	≤0.25 (S)	≤0.25 (S)
Gentamicin	≤1 (S)	≤1 (S)	≤1 (S)
Imipenem	≤0.25 (S)	≤0.25 (S)	≤0.5 (S)
Piperacillin/tazobactam	S	S	S
Tobramycin	≤1 (S)	≤1 (S)	≤1 (S)
Trimethoprim/ sulfamethoxazole	≤20 (S)	≤20 (S)	≤20 (S)

was treated with a total of twelve days of antibiotics (4 days of ceftazidime and vancomycin, 8 days of piperacillin/tazobactam). The patient continued to improve and was transferred out of the intensive care unit (ICU) on day 24 of hospital stay and was discharged home after a hospital stay of 41 days.

3. Case 2

A 50 year old male was admitted to the trauma intensive care unit (ICU) due to injuries suffered from a motor vehicle crash with multiple fractures. The patient's past medical history included atrial fibrillation, myocardial infarction ten years prior to admission with multiple stents, placement of a pacemaker, and chronic obstructive pulmonary disorder. The patient was intubated on admission with respiratory depression. The mechanical ventilation was unable to be weaned due to pain requirements with multiple rib flail segments from his initial injuries. On day 3, the patient developed a fever of 38.7 °C, purulent sputum, and a chest x-ray that revealed unilateral opaque hemi-thorax on the left. His WBC was normal at 4.3/μL while C-reactive protein (CRP) was 27.9 mg/dL. VAP was suspected and the patient underwent bronchoscopy with quantitative BAL per trauma unit VAP protocol. BAL fluid analysis showed cloudy fluid appearance, WBC 3900/μL, and 99% segmented neutrophils. The result of the quantitative BAL was *R. ornithinolytica* 4 × 10^6 CFU/mL confirming the diagnosis of VAP. The patient was started on broad spectrum antibiotics with ampicillin/sulbactam on the day of bronchoscopy for coverage of early VAP pathogens per the trauma unit's antibiogram. On antibiotic day 2, susceptibilities returned and antibiotics were changed to cefepime due to the resistance to ampicillin/sulbactam as shown in Table 1. A repeat bronchoscopy with quantitative BAL was attempted on day 7 of antibiotics but was unable to be completed due to procedural difficulties. After seven days of treatment with cefepime, the patient was afebrile, WBC was normal, chest x-ray showed improvement, and CRP had decreased to 16.6 mg/dl. The patient was treated for a total of nine days with antibiotics *i.e.*, two days of ampicillin/sulbactam and seven days of cefepime. The patient continued to improve and was transferred out of the ICU on day 18 of hospital stay. The patient was transferred to a skilled nursing facility after a 24 day stay to continue rehabilitation.

4. Discussion

These two cases describe the first reports of *R. ornithinolytica* causing VAP in immunocompetent trauma patients. Newer identification techniques, such as MALDI-TOF MS, have allowed this organism to become recognized as a human pathogen which can cause multiple types of infections as reported in previous studies and cases. Two virulence factors exhibited by this bacterium, the ability to form biofilms and ability to adhere to human tissues, could explain the ability to cause nosocomial infections such as ventilator associated pneumonia [2,5]. A previous study has shown risk of infection from *R. ornithinolytica* with invasive procedures [2]. The two subjects did not have any of the other risk factors for infection including solid cancer, diabetes mellitus, immunodeficiency, and post-urethra trauma.

R. ornithinolytica is naturally resistant to aminopenicillins which was seen in both cases with exhibited resistance to ampicillin/sulbactam [6]. There are documented cases of carbapenemase-producing *R. ornithinolytica*; however, the isolates in our case series did not demonstrate resistance to imipenem [6]. Resistance to cefazolin was expected as many enteric Gram negatives are resistant to first-generation cephalosporins. The isolates in our cases demonstrated susceptibility to 3rd and 4th generation cephalosporins, piperacillin/tazobactam, aminoglycosides, fluoroquinolones and aztreonam. One patient was able to clear the infection with ceftazidime plus vancomycin for four days, then eight days of piperacillin/tazobactam. The other patient received ampicillin/sulbactam for two days, then cefepime for seven days. This organism has not been isolated in any other patients in the ICU recently and both patients presented months apart demonstrating that the two infections were not due cross-contamination and that *R. ornithinolytica* is not part of the unit's microbial flora.

5. Conclusion

R. ornithinolytica is a previously underreported, emerging cause of nosocomial infections. This organism should be treated by healthcare providers as a pathogen with the possibility of drug resistance. In this case series, we report the first two cases of *R. ornithinolytica* VAP in an immunocompetent trauma population that were successfully treated guided by antimicrobial susceptibilities.

Disclosure section

Conflict of Interest Statement

The Authors declare that there is no conflict of interest.

Funding statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethics approval

Ethical approval to report this case was obtained from University of Tennessee Health Sciences Center IRB.

Informed consent

Informed consent for patient information to be published in this article was not obtained because informed consent was waived since this case report was a retrospective chart review study.

Acknowledgements

None.

References

[1] M. Drancourt, C. Bollet, A. Carta, P. Rousselier, Phylogenetic analyses of Klebsiella species delineate Klebsiella and Raoultella gen. nov., with description of Raoultella ornithinolytica comb. nov., Raoultella terrigena comb. nov. and Raoultella planticola comb. nov, Int. J. Syst. Evol. Microbiol. 51 (Pt 3) (2001) 925–932.

[2] P. Seng, B.M. Boushab, F. Romain, et al., Emerging role of Raoultella ornithinolytica in human infections: a series of cases and review of literature, Int. J. Infect. Dis. 45

(2016) 65–71.
[3] M. Boattini, A. Almeida, C. Cardoso, et al., Infections on the rise: Raoultella spp., clinical and microbiological findings from a retrospective study, 2010–2014, Inf. Disp. 48 (1) (2016) 87–91.
[4] E. de Jong, A.S. de Jong, R. Rentenaar, et al., Differentiation of Raoultella ornithinolytica/planticola and Klebsiella oxytoca clinical isolates by matrix-assisted laser desorption/ionization-time of flight mass spectrometry, Diagn. Microbiol. Infect. Dis. 75 (4) (2013) 431–433.
[5] R. Djeribi, W. Bouchloukh, B. Menaa, et al., Characterization of bacterial biofilms formed on urinary catheters, Am. J. Infect. Contr. 40 (9) (2012) 854–859.
[6] B. Zheng, L. Li, J. Zhang, J. Ji, Y. Fang, et al., Emergence of Raoultella ornithinolytica coproducing IMP-4 and KPC-2 carbapenemases in China, Antimicrob. Agents Chemother. 59 (11) (2015) 7086–7089.