Clin. Lab. 2021;67:XXX-XXX


## CASE REPORT

# Bacteremia Caused by Moraxella Osloensis: a Fatal Case of an Immunocompromised Patient and Literature Review

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**SUMMARY**

***Background:*** ***Moraxella osloensis*** **rarely causes infection in humans, and most of the reported cases are not fatal. It is often difficult to identify** ***M. osloensis*** **using conventional biochemical methods.**
***Methods:*** **Here, we report a bacteremia case caused by** ***M. osloensis*** **in a patient with advanced lung cancer who initially presented symptoms of fever.**
***Results:*** **Blood culture revealed growth of a gram-negative bacterium, which was identified as** ***M. osloensis*** **through 16S rRNA gene sequencing and MALDI-TOF analyses. The patient could not recover from sepsis with empirical treatment.**
***Conclusions:*** **As** ***M. osloensis*** **can cause serious infections in immunocompromised patients, its prompt identification is important.**
**(Clin. Lab. 2021;67:xx-xx. DOI: 10.7754/Clin.Lab.2020.200459)**

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**KEY WORDS**

*Moraxella osloensis*, bacteremia, immunocompromised, *Enhydrobacter aerosaccus*, 16S rRNA sequencing, MALTI-TOF

## INTRODUCTION

*Moraxella osloensis* is an aerobic, pleomorphic gram-negative bacterium. It has been isolated from multiple environmental sources, such as sinks, laundry, metals, and hospitals, and it is one of the commensal organisms found in the human respiratory tract. Further, this bacterium is known to rarely cause infection in humans [1,2]. However, there are few bacteremia cases that have been reported to be caused by *M. osloensis.* In this paper, we report a case study of fatal bacteremia caused by *M. osloensis* along with a brief literature review.

## CASE PRESENTATION

A 76-year-old male, who was undergoing chemotherapy for the treatment of end-stage small cell lung cancer (SCLC), was admitted to the Korean medical hospital in

Case Report accepted May 25, 2020

Kyung Hee University Medical Center at Gangdong to receive adjuvant herbal immunotherapy. This patient also suffered from hypertension as indicated in his health report. Transferred to the Department of Oncology, the patient had fever with chills, cough with blood-tinged sputum, and aggravated dyspnea a day earlier. The laboratory testing revealed the following results: white blood cells 9,560/μL (82% neutrophils, 12% lymphocytes, and 6% monocytes), hemoglobin 10.3 g/dL, platelet count 118,000/μL, and C-reactive protein level 4.6 mg/dL. The chest X-ray showed no significant difference compared to the previous chest X-ray performed 6 days ago of a right hilar mass and irregular consolidation with ground glass opacity in both the lower lung fields. On day 2, blood culture analysis was performed and after 1 day of incubation, a gram-negative cocobacillus was isolated. An immediate treatment was initiated with 1 g of meropenem that was administered intravenously every 8 hours. We were not able to identify the bacterium precisely by using the VITEK 2 system (bioMerieux Inc., Hazelwood, MO, USA). The bacterium was found to be oxidase-positive, catalase-positive, and DNase-negative. We further performed molecular identification by polymerase chain reaction amplification followed by sequence analysis of the 16S ribosomal RNA (rRNA) gene to identify the bacteria. Sequencing analysis was performed through the GenBank BLAST search. The isolate was identified as *M. osloensis* with highest similarity (99.18%; 1,452/1,464 bp; accession number LN871835.1). The results were also obtained by using the Bruker Biotyper (Bruker Daltonics, Billerica, MA, USA) and Vitek MS (bioMérieux, Durham, NC, USA) as MALDI-TOF systems. Bruker Biotyper could not identify the strain, and gave a very low score (1.192). However, Vitek MS demonstrated 50% similarity to *M. osloensis* and 50% to *Enhydrobacter aerosaccus*. We did not perform susceptibility tests on this bacterium, as no Clinical & Laboratory Standards Institute (CLSI) guidelines are available so far. The patient was placed on DNR (do-not-resuscitate) order, and died on day 9 as he could not recover from sepsis.

## DISCUSSION

*M. osloensis* is known to be a rare pathogen that causes infection in humans. In the adult population, so far, there are only six case reports of bacteremia caused by *M. osloensis*, to the best of our knowledge (Table 1). The majority of the adult cases of *M. osloensis*-induced bacteremia were found in immunocompromised patients, either with a history of organ transplantation or cancer. In the present case, the patient had lung cancer, was undergoing chemotherapy, and the disease was aggravated.

*M. osloensis* is often misidentified as other species during the identification process. According to a recent report, *M. osloensis* was misidentified as *Comamonas testosteroni* by using an automated system [3]. In the present case, low discrimination results were obtained by using the automated system, and by conducting the additional MALDI-TOF test, *M. osloensis* and *E. aerosaccus* exhibited the same confidence level as 50%. *E. aerosaccus* LMG 21877 was shown to be highly related to *Moraxella osloensis* with almost 100% sequence homology. Kawamura et al. argued that *E. aerosaccus* LMG 21877 strain does not belong to *E. aerosaccus*, as it significantly differs in growth properties, G+C% of DNA, 16S rRNA sequence and other features, but since it was the first strain that was published for the 16S rRNA sequence as *E. aerosaccus*, which would be the primary cause of confusion [4]. Other studies have also reported that *E. aerosaccus* is highly related to the genus Moraxella [5,6]. Bergey's Manual of Systematic Bacteriology 2nd edition also stated that it belongs to the family Moraxellaceae [7]. Conversely, some biochemical reactions of *E. aerosaccus* LMG 21877 have been reported to be different from *M. osloensis*. For instance, *E. aerosaccus* differs from *M. osloensis* in gas vacuolation, in a positive result for nitrate reduction, and negative results for valine arylamidase and cystine arylamidase [4]. Considering these findings, it would be unreasonable to say that the *E. aerosaccus* LMG 21877 strain belongs to *Moraxella* and that it does not belong to *E. aerosaccus*. Therefore, it is important to further investigate the relationship between *M. osloensis* and *E. aerosaccus*. These two microorganisms can have the exact same test results in 16S rRNA sequencing and MALDI-TOF analyses. Therefore, it is necessary to know each feature accurately to differentiate them from each other.

In addition, the antibiotic susceptibility of *M. osloensis* has not been fully studied and there are no guidelines available for its treatment. In most of the previously reported cases, the isolates have been found to be susceptible to penicillins, cephalosporins, aminoglycosides, fluoroquinolones, and carbapenems, but *M. osloensis* strains exhibiting resistance against these antibiotics have also been reported [3,8]. The disease was usually resolved even with the empirical use of antibiotics in the *M. osloensis* bacteremia cases. However, in the present case, it could not be achieved due to the patient's general condition. Therefore, it is important to establish fast and accurate identification and the corresponding antibiotic susceptibility test (AST) criteria. In our case, we could identify the bacterial strain by performing various tests, such as biochemical and molecular identification and MALDI-TOF analyses. For the identification of *M. osloensis*, 16S rRNA sequencing is considered as the gold standard method so far, but there have been cases where MALDI-TOF was successfully implemented in its identification [3,6]. As MALDI-TOF provides the results faster than 16S rRNA sequencing, it has often been used for routine clinical microbiological tests and has replaced conventional biochemical identification methods. Therefore, it can also be a useful tool for efficient identification of *M. osloensis*.

*M. osloensis* is a difficult species to identify because it

**Table 1. Clinical characteristics and identification method of bacteremia caused by Moraxella in adults.**

| References | Age/ gender | Underlying condition | Clinical manifestation | Method for identification: score value | Method that failed identification: misidentified result (score value) | Treatment |
|---|---|---|---|---|---|---|
| Lasser et al. (1978) [9] | 36/F | none | arthritis, bacteremia, urethritis | biochemical | N/A | penicillin |
| Stryker et al. (1982) [10] | 66/M | porcine aortic valve | endocarditis, renal failure | biochemical | N/A | penicillin, oxacillin, tobramycin |
| Buchman et al. (1993) [11] | 71/F | chronic intestinal pseudo-obstruction | bacteremia | biochemical | N/A | vancomycin, gentamycin |
| Sifri et al. (2008) [12] | 60/M | KTP, RCC | ileus | 16S rRNA sequencing: 99% | N/A | ciprofloxacin |
| Sung et al. (2014) [6] | 66/M | AML | maxillary sinusitis | 16S rRNA sequencing: 99.6% [a] MALDI-TOF MS (Bruker): 1.885 | Biochemical (Vitek2 system): M. osloensis (50%) | ampicillin-sulbactam |
| Lee et al. (2017) [3] | N/A | lung cancer | pneumonia with acute respiratory failure | 16Sr RNA sequencing: 100% MALDI-TOF MS (Bruker): 1.848 | Biochemical (Phoenix 100 ID/AST system): C testosterone (N/A) | cefoperazone/ sulbactam |
| Present study | 76/M | lung cancer | bacteremia, pneumonia, colitis | 16Sr RNA sequencing: 99.18% MALDI-TOF MS (Vitek MS): 50% [b] | Biochemical (Vitek2 system): M. catarrhalis (34%) | meropenem |

**a - Second highest similarity to Enhydrobacter aerosaccus with 99.0%.**
**b - Moraxella osloensis was identified with a 50% confidence value for both M. osloensis and E. aerosaccus.**
**Abbreviations: N/A - not available, KTP - kidney transplantation, RCC - renal cell carcinoma, AML - acute myeloid leukemia.**

has not been fully studied and exhibits pleomorphic appearance. As it is also rarely found to cause human infections, it is difficult to suspect *M. osloensis* in the clinical laboratory. We experienced a rare bacteremia case caused by *M. osloensis* in a patient with lung cancer. The causative organism was identified by performing 16S rRNA sequencing and MALDI-TOF analyses. The patient could not recover with the administration of empirical antibiotic therapy. We suggest accurate and prompt identification/AST results are important for *M. osloensis* because it can cause serious infections in immunocompromised patients. As *M. osloensis* is still an unrecognized species in clinical laboratories and uncertainty remains regarding its diagnosis and necessity for treatment, further studies should approach these aspects urgently.

**Declaration of Interest:**
The authors declare that they have no conflict of interest.

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