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CASE REPORT

RETRACTED ARTICLE: A Case Report of *Moraxella catarrhalis* Infection After Lumbar Spinal Fixation and Fusion

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Abstract: *Moraxella catarrhalis* (MC) is an aerobic Gram-negative cocci known to cause respiratory tract infections in humans as an opportunistic pathogen, with infections in other body parts being rare. This case involves an elderly female patient with a medical history of hypertension, type 2 diabetes, coronary heart disease, and osteoporosis. Following coronary angiography and lumbar spine surgery prompted by lower back and left lower limb pain, the patient developed persistent purulent discharge from the lumbar spine wound post-surgery, which did not respond to conventional anti-infection therapy, leading to her transfer to our hospital. Upon examination, Direct Radiography (DR) diagram revealed gas accumulation and bone curling in the 4–5 intervertebral space, muscle layer, and fascia layer of the lumbar vertebrae. Subsequent culture of the wound fluid confirmed the presence of MC, resulting in a diagnosis of postoperative lumbar spine infection. Treatment involved antibiotics administration, lesion clearance, spinal exploration, and autologous iliac bone transplantation for fusion, alongside the management of glucose levels and hypertension, anticoagulation therapy, as well as the use of Duhuo Jisheng Decoction to promote blood circulation and eliminate blood stasis. Following this comprehensive treatment approach, the patient achieved a full recovery and was discharged. To the best of our knowledge, this is the first reported case of *Moraxella catarrhalis* infection following lumbar spinal fixation and fusion in Sichuan Province, China. The exact cause of infection in this case remains unclear. However, this case emphasizes the importance of considering the colonization site and infection mechanism of MC beyond the respiratory tract, underscoring the need for vigilance in clinical practice beyond typical infection sites.

Keywords: *Moraxella catarrhalis*, lumbar spinal fixation and fusion, case report

Introduction

Moraxella catarrhalis (MC), also known as *Branhamella catarrhalis*, is an aerobic Gram-negative cocci residing mainly in the human upper respiratory tract. Initially considered a normal flora, MC has been identified as a causative agent of upper respiratory tract infections.[1] Moreover, MC has been associated with various other infections, including acute otitis media, maxillary sinusitis, lower respiratory tract infection, meningitis, endocarditis, urethritis, conjunctivitis, and sepsis.[2] Particularly notable is its propensity to cause Otitis media (OM) in children, ranking as the third most common pathogen related to OM globally and exacerbating chronic obstructive pulmonary disease in the elderly.[3,4]

MC infection is related to age. Infants often have MC colonization in the nasopharynx, while the carrier rate in the upper respiratory tract of healthy adults is 1% to 5%. Research indicates that MC causes approximately 709 million cases of acute OM worldwide each year, with 51% of these patients being under the age of four. Acute OM is considered one of the most common childhood diseases.[5–7] Additionally, the detection rate of MC in patients with chronic lung disease is higher than in healthy adults. MC is the second most common cause of chronic lung disease exacerbation.[8] In winter, MC colonization is more likely to occur based on viral infection.[9] At present, research on MC primarily focuses on its pathogenic genes, virulence mechanisms, and vaccine development.[3,4,10]

With advancements in lumbar surgery techniques and spinal fixation devices, lumbar fusion surgery has become increasingly common. Notably, while this procedure effectively achieves spinal canal decompression and intervertebral stability, it also carries a risk of infection, which can complicate treatment and increase healthcare costs.[11] The incidence

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of postoperative spinal infections varies significantly. For instance, Geromet et al[12] reported infection rates ranging from 0.7% to 11.9% following spinal fixation, whereas Kasliwal et al[13] noted a rate of 20%. These variations may be related to surgical conditions and preventive measures. A retrospective study found an overall infection rate of 1.66% (27/1623) following dynamic pedicle screw fixation. The primary pathogens responsible for infections include *Staphylococcus epidermidis, Staphylococcus aureus, Salmonella, Escherichia coli, Pseudomonas aeruginosa, Enterobacter aerogenes*, and *Acinetobacter baumannii*, etc.[11]

Despite its well-documented association with common diseases, relatively few cases have reported lumbar space infection caused by MC. This paper presents a unique case of MC infection following lumbar spinal fixation and fusion, documenting the first such occurrence in Sichuan, China.

Case Report

The 72-year-old female patient presented with a complex medical history including hypertension and type 2 diabetes spanning a decade, as well as a recent diagnosis of coronary heart disease. Additionally, she had a background of osteoporosis and no known history of infectious diseases or trauma. Notably, the patient had previously undergone coronary angiography three months prior and had recently undergone lumbar spine surgery elsewhere due to complaints of low back pain and left lower limb pain. However, within one month post-surgery, the patient's surgical wound exhibited persistent purulent discharge, prompting her referral to our facility for further evaluation and management.

During the physical examination, a 12 cm long surgical wound on the patient's waist was observed, extending to the fascia layer and there is white flocculent purulent discharge. The patient's vital signs were recorded as follows: Body temperature of 36.1°C, pulse rate of 95 beats/minute, blood pressure 127/68mmHg, and random blood sugar level of 7.7mmol/L. The Direct Radiography (DR) diagram revealed various findings in the patient's lumbar spine when viewed in both anteroposterior and lateral directions. These findings included slight scoliosis, degenerative changes in the vertebral body, pneumatosis in the lumbar 4–5 intervertebral space, and abnormalities in the muscle layer and fascial layer. Additionally, frizzy bone was observed in the imaging (refer to Figure 1), indicating a potential intervertebral space infection.

The patient presented abnormal laboratory results, including a lymphocyte count of 0.67×10^9/L, an eosinophil count of 0.01×10^9/L, and a neutrophil ratio of 75.2%. Additionally, the patient exhibited red blood cell levels of 3.29×10^12/L, a hemoglobin concentration of 100 g/L, a hematocrit level of 31.8%, and a mean hemoglobin concentration of 314 g/L. Further investigations revealed fibrin and fibrinogen degradation products at 6.5μg/mL, D-dimer levels of 2μg/mL, and

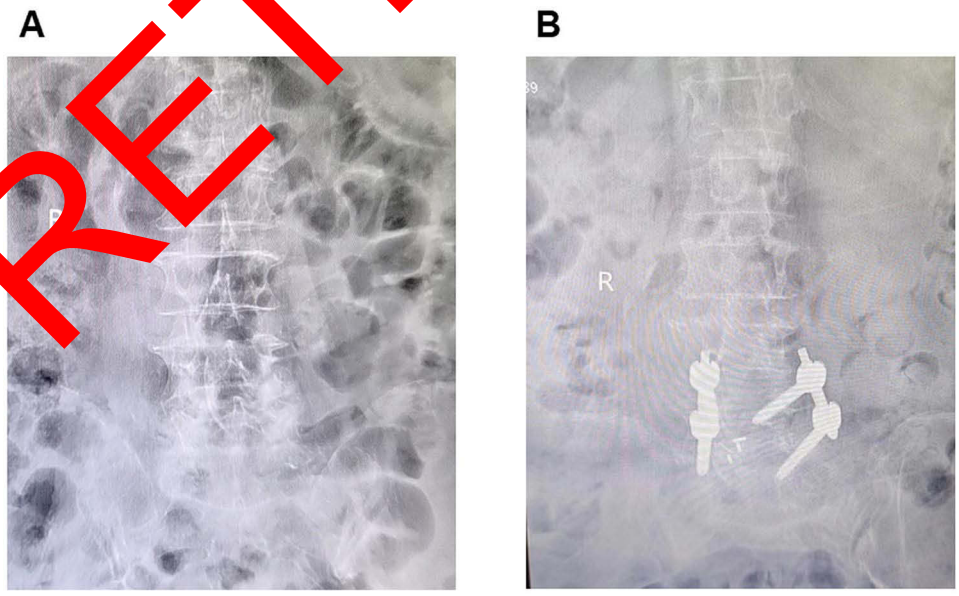

Figure 1 Digital radiography of the patient's lumbar spine. (**A**) Before surgery; (**B**) After surgery. The "R" in the figure represents the right side.

fibrinogen levels of 8.92 g/L. The patient also displayed elevated high-sensitivity C-reactive protein at 122.88 mg/L, total protein at 61.45 g/L, and albumin at 34.2 g/L, with a prealbumin level of 96 mg/L and lipoprotein levels of 477 mg/L. Electrolyte abnormalities included potassium at 3.25 mmol/L and magnesium at 0.72 mmol/L.

The patient's wound pus was collected and promptly sent to the microbiology laboratory for smearing and culturing. Gram staining results indicate the presence of Gram-negative diplococci, which appear in a coffee bean shape. After incubating the sample on a blood agar plate at 35°C for 18–24 hours, grayish-white, non-hemolytic colonies were observed (Figure 2). The colony surface was dry, and an inoculating loop could move the entire colony. Both the Catalase and Oxidase tests yielded positive results. A single colony was selected, and its turbidity was adjusted to 1.8–2.2 McF. The bacteria were identified using the VITEK®2 Compact fully automated microbiological analysis system and its accompanying NH card, revealing the bacteria to be MC.

At the same time, some preserved bacterial strains were sent to the county hospital for identification using the Autof ms1000 automated microbial mass spectrometer, which identified the bacteria as MC. The turbidity of the bacterial solution was adjusted to 2 McF, and the *Moraxella catarrhalis* susceptibility test kit (Biomerieux, turbidimetric method) was used for drug sensitivity testing. The results of the drug sensitivity test are shown in Table 1. The identification and susceptibility testing in our microbiology laboratory follows the procedures and standards set by the National Committee for Clinical Laboratory Standards (NCCLS). We ensure the reliability of test results through weekly quality control. If the weekly quality control exceeds the specified range, we promptly investigate and correct the issue or revert to daily quality control of standard bacterial strains.[14]

To address the patient's conditions effectively, a comprehensive treatment plan was implemented. First, efforts were made to enhance the patient's nutrition intake, and if necessary, daily intravenous infusion of 25 g compound amino acid injection (18AA) (12.5g/250mL). Additionally, potassium chloride sustained-release tablets are taken orally to supplement potassium, with a dosage of one 0.5g tablet three times daily. The patient follows a diabetic diet. If postprandial blood glucose is uncontrolled, subcutaneous injections of Ubile before meals may be necessary, starting at a dose of 0.1 U/kg per meal. If fasting blood glucose is uncontrolled, daily subcutaneous injection of insulin glargine may be required, starting at a dose of 0.1 U/kg. Adjust pre-meal insulin doses based on postprandial and pre-meal blood glucose levels, and adjust long-acting insulin dosage based on fasting blood glucose levels, while preventing hypoglycemia. To regulate blood pressure, the patient was prescribed candesartan medoxomil tablets at 4 mg once daily, metoprolol

Figure 2 Morphology of bacterial colonies.

Table 1 Drug Sensitivity Results

Antibiotic	MIC (ug/mL)	Sensitivity
Ampicillin	=8	R
Amoxicillin/Clavulanic acid	≤4	S
Cefaclor	≤8	S
Cefuroxime	≤4	S
Cefotaxime	≤2	S
Ofloxacin	≤2	S
Tetracycline	≤2	S
Moxifloxacin	<0.0625	S
Chloramphenicol	≤2	S
Rifampicin	≤1	S
Trimethoprim/Sulfamethoxazole	≤0.5	S
Beta Lactamase	Neg	–

Abbreviations: R, resistance; S, sensitive.

succinate extended-release tablets at 23.75 mg once daily, and felodipine extended-release tablets at 5 mg once daily. Additionally, the patient experienced swelling in the left lower limb post-surgery and was prescribed daily oral doses of 75 mg clopidogrel bisulfate and 100 mg enteric-coated aspirin to prevent platelet aggregation. Complementary treatment with traditional Chinese medicine involves the administration of Duhuo Jisheng decoction (Oral, one dose per day), known for its ability to promote blood circulation, dispel blood stasis, and nourish the liver and kidneys.

Antibiotic treatment for MC infection. After undergoing lumbar spine infection focus removal, spinal canal exploration, and autologous skeletal bone graft fusion, the patient's wound secretions were collected for a second microbial culture, yielding negative results. Following one month of active treatment, the patient experienced a significant reduction in waist pain. A review of the lumbar spine MR indicated a shrinkage of the infection focus (Figure 1). The patient was discharged after the laboratory test indicators gradually returned to normal during recovery.

Discussion

Infection after lumbar spinal fixation is a common complication following spinal surgery, with an incidence rate of approximately 9% to 12%. It has significant implications on patient outcomes and overall medical costs, as highlighted by a study conducted by Pull et al. The retrospective analysis of 3174 patients who had undergone spinal surgery revealed that infection after internal fixation surgery can escalate overall medical costs by over four times. The fixation device that is implanted in the lumbar spine post-surgery plays a crucial role in maintaining stability and structural integrity in the long term, typically for 6–12 months. Therefore, great caution should be exercised when considering the removal of the fixation device. Failure to promptly address the infection can lead to a myriad of complications, including chronic pain,[15] internal fixation failure, permanent neurological dysfunction, and even life-threatening consequences such as sepsis and multiple organ failure.[16,17] In recent years, infection after lumbar internal fixation has emerged as a significant complication that spine surgeons must consider due to the advancements and widespread adoption of spinal internal fixation and fusion surgery. Early infections are primarily associated with the patient's overall health, the sterilization of surgical instruments, and the performance of the surgical procedure. Diagnostic tools like laboratory tests and imaging play a crucial role in identifying lumbar space infections. To reduce the risk of infection in patients undergoing spinal fixation surgery and to alleviate their physical, psychological, and familial burdens, medical staff should standardize surgical procedures and actively prevent infections from preoperative, intraoperative, and postoperative perspectives.[11]

In the process of identifying bacterial genera, it is important to distinguish Moraxella catarrhalis (MC) from other Moraxella species. MC is characterized by its cocci shape, often appearing in pairs or kidney-shaped arrangements, and it tests positive for the DNase test. In contrast, other Moraxella species are mostly coccoid rods and test negative for DNase. Research has shown that MC can adhere to and invade hosts through various virulence

mechanisms.[18] The pathogenic mechanisms of MC are primarily associated with components such as the outer membrane, mucins, receptor proteins, complement resistance, and biofilm formation. The outer membrane of MC is composed of phospholipids, glycine, integral outer membrane proteins, and lipoproteins. These macromolecules serve as critical virulence factors in the bacterial pathogenic process, mediating the interaction between MC and host surface receptors expressed by respiratory epithelial cells. MC-produced outer membrane vesicles can mislead the body's immune cells.[19] Infection of bronchial epithelial cells by MC can activate the reduced coenzyme II oxidase/reactive oxygen species/transforming growth factor signaling pathway, leading to the overexpression of MUC5AC, which further induces inflammatory responses and tissue damage.[20] Within the host, MC forms biofilms that not only resist the host's immune defenses but also enhance its ability to compete with commensal bacterial communities. Furthermore, receptor proteins facilitate MC's acquisition of iron necessary for growth, while the evolution of complement evasion mechanisms has enhanced MC's survival capabilities.[19] Additionally, MC can stimulate the body to produce specific antibodies.[10,21] In vitro experiments have shown that MC can evade the oxidative stress response of neutrophils. Moreover, MC is capable of subverting and utilizing the host's innate immune response to enhance its reproduction. It was observed in the experiment that MC also supported the survival of co-infected nontypeable Haemophilus influenzae.[22]

Previous studies have shown that β-lactams, macrolides, tetracyclines, and fluoroquinolones exhibit high sensitivity to MC. However, as the detection rate of MC has increased and the use of antimicrobial agents has expanded, the resistance rate of MC has risen annually. The production of β-lactamase is one of the primary reasons for MC resistance, leading to varying degrees of resistance to β-lactam antibiotics and ampicillin. Clinically, the detection rate of β-lactamase MC in countries such as Japan and China is as high as 95% or more.[23] In a study analyzing various characteristics of high-prevalence MC strains, it was observed that 88.10% carried the ompB1 gene, 98.57% carried the ompE gene, and 71.90% carried the ompCD gene. The resistance rates to cefuroxime, azithromycin, and erythromycin were reported as 43.33%, 28.10%, and 39.05%, respectively.[23] In the treatment of MC infections, it is recommended to primarily use aminoglycoside antibiotics or third-generation cephalosporins. The choice of antibiotics should be based on the patient's condition and the results of susceptibility testing.[19]

The β-lactamase produced by MC can protect bacteria by facilitating the production of other pathogenic enzymes. When co-infected with Streptococcus pneumoniae or Haemophilus influenzae, it may enhance the resistance of other bacteria.[19] Studies have shown that MC can engage in gene transfer with Gram-positive bacteria, occasionally resulting in the emergence of cross-resistance genes.[24] It is noteworthy that the MC isolated from this disease shows sensitivity to various antibiotics and is β-lactamase negative (Table 1), which is more likely related to the bacteria's evolutionary stages.[4] The patient is an elderly woman, suffering from hypertension, type 2 diabetes, osteoporosis and other diseases, and is weak in physique. In this scenario, besides the toxicity mechanism of the causative agent itself, we believe that interactions among the host, endogenous flora, and pathogenic bacteria also contributed to the occurrence of the infection,[25] which may have been the reason for the patient's discharge from the hospital one month after surgery. Currently, infections of the lumbar intervertebral space caused by MC are rare, and their clinical manifestations, preliminary diagnosis, and treatment methods remain unclear. Clinicians need to pay more attention to MC-related infections, broaden the scope of investigation, and conduct more in-depth research into the infection mechanisms of MC.

Conclusion

Lumbar space infection caused by *Moraxella catarrhalis* is a rare disease with unclear clinical manifestations, diagnosis, and treatment patterns. In this case, the keys to eliminating lumbar space infection were microbial culture and antibiotic treatment. The patient was discharged from the hospital after the removal of lumbar spinal infection lesions, spinal canal exploration, autologous skeletal bone grafting and fusion, and treatment of underlying diseases. Clinicians should be vigilant towards infection cases caused by special pathogenic bacteria and perform a comprehensive assessment of patients' symptoms, based on clinical manifestations and relevant examinations.

Abbreviation

MC, *Moraxella catarrhalis*; OM, Otitis media; DR, Direct Radiography; NCCLS, The National Committee for Clinical Laboratory Standards.

Ethics Approval

This case report does not include images or data that could identify patients, so ethical approval from the local ethics committee is not required. We have obtained the patient's written informed consent form.

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Disclosure

No conflict of interest exists in the submission of this manuscript, and the manuscript is approved by all authors for publication.

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