Three cases of Chronic Suppurative Otitis Media (CSOM) caused by *Kerstersia gyiorum* and a review of the literature

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SUMMARY

New identification techniques such as gene sequencing and mass spectrometry have increased the incidence of novel agents such as *Kerstersia gyiorum*. As a new member of the Alcaligenaceae family, *K. gyiorum* was isolated from wounds, respiratory tract, urine specimens and most frequently from chronic suppurative otitis media (CSOM). We isolated three *K. gyiorum* strains from three CSOM cases over a one-year period. The strains were analyzed by mass spectrometry and identified by Bruker Biotyper 3.1 (Bruker Daltonics, USA). The cases were young patients without chronic diseases and immunodeficiencies. Two strains were resistant to ciprofloxacin.

Keywords: *Kerstersia gyiorum*, Alcaligenaceae, MALDI-TOF MS, chronic suppurative otitis media, ciprofloxacin.

INTRODUCTION

Kerstersia gyiorum is a new member of Alcaligenaceae family. It is a rare human pathogen with an increased incidence especially in patients with chronic suppurative otitis media (CSOM). We wanted to draw attention to this novel bacteria detected in three CSOM patients over a one-year period. Furthermore, we wanted to evaluate the cases in the light of the literature.

CASE REPORTS

Written consents of all three patients were obtained for case report publication.

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Case 1: A 21-year-old female patient admitted to otorhinolaringology clinic of Dicle University Hospital with complaints of left ear discharge and hearing loss for 8 years**.** She neither smoked nor used alcohol**.** She did not have any history of systemic diseases. She reported having used intermittent medical treatments including various ear drops and antimicrobials. The physical examination revealed perforated tympanic membrane and cholesteatoma tissue in the epitympanic region of the left ear.

A swab of patient's ear drainage was taken for microbiological examination. Gram staining of the sample revealed Gram-negative rods and polymorphonuclear leucocytes. After an aerobic incubation at 37 °C for 20 hours, grayish-white broad colonies on blood agar and lactose negative colonies on eosin methylene blue agar (EMB) were observed.

The isolate was analyzed by Matrix-Assisted Laser Desorption Ionization-Time of Flight (MAL-

DI-TOF) mass spectrometry (MS) (Figure 1). It was identified up to species level as Kerstersia gyiorum by MALDI Biotyper 3.1 software (Bruker Daltonics, U.S.A) with an identification score of 2,24. Biochemical tests of the isolate revealed catalase positivity and oxidase negativity.

Susceptibility testing was performed by Phoenix 100 (Becton Dickinson, U.S.A) automated system. The bacterium was resistant to gentamicin, ceftazidime and ciprofloxacin, while susceptible to amikacin, imipenem, meropenem and piperacillin-tazobactam according to European Committee on Antimicrobial Susceptibility Testing (EUCAST) non-species-related breakpoints [1]. The patient was discharged after mastoidectomy and tympanoplasty. Ciprofloxacin ear drops and intramuscular ceftriaxone (2 g/day) treatment was started prior to culture and continued for two weeks. The patient's ear discharge stopped in the second week.

Case 2: The second case was a 21-year-old male with purulent right ear discharge since his childhood. He was admitted to the hospital ten months after the first patient. The patient was a smoker (7 packs year). He had no systemic disorder or nasal deformity.

The aerobic culture of ear discharge revealed *K. gyiorum* which was identified by Maldi Biotyper with a score of 2,43. The isolate was susceptible to ceftazidime, ceftriaxone, cefotaxime, cefepime, amikacin and ciprofloxacin; while resistant to gentamicin and trimethoprim-sulfamethoxazole. The patient underwent mastoidectomy and was discharged from the hospital with a medical therapy of intramusculer ceftriaxone 2 g/day and ciprofloxacin ear drops. His ear drainage stopped in the second week.

Case 3: A 27-year-old male patient with some hearing loss and bilateral ear drainage over the years. He was admitted to the hospital three months after the second case. He did not have any history of smoking, alcohol or systemic diseases. Physical examination revealed nasal deformity and large central perforation of tympanic membranes. The patient underwent tympanoplasty. The cholesteatoma and granulation of the right middle ear were removed and the abscess material was sent for culture. The culture grew two different Gram-negative microorganisms; *Morganella morganii* and *K. gyiorum*. Both isolates were identified by Maldi Biotyper with high identification scores (>2.3). On Phoenix 100 susceptibility testing, *K. gyiorum* was resistant to gentamicin, ciprofloxacin and trimethoprim-sulfamethoxazole, while *M. morganii* was resistant to ampicillin, amoxicillin/clavulanate, trimethoprim-sulfamethoxazole, gentamicin and ciprofloxacin. Both isolates were susceptible to ceftazidime, ceftriaxone, cefepime, cefotaxime, amikacin and meropenem. The patient was discharged from the hospital with a medical therapy of ceftriaxone 2 g/day. When his ear discharge continued after two weeks, the patient was prescribed moxifloxacin 800 mg/day and ciproflox-

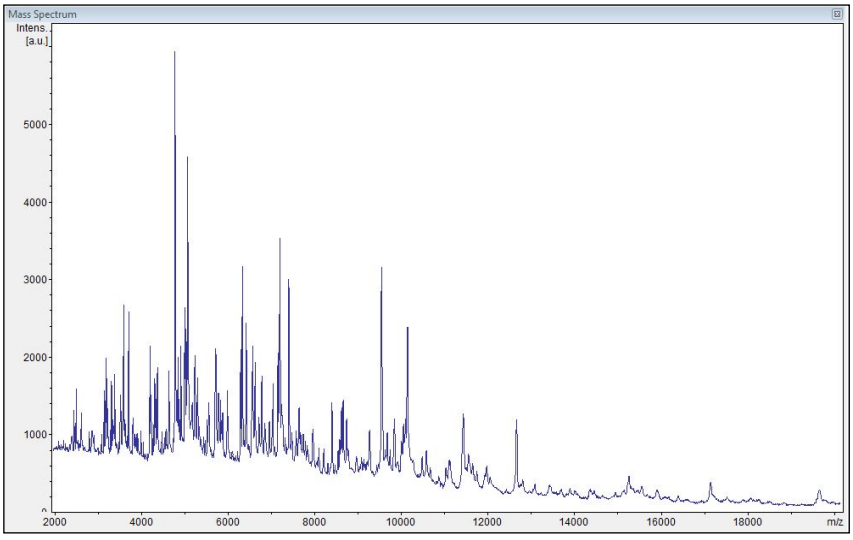

Figure 1 - Mass spectrometry image of *K. gyiorum*.

acin ear drops. His ear discharge stopped in the fifth week after surgery.

DISCUSSION

CSOM is the persistent middle ear inflammation with ear discharge through perforated tympanic membrane. It causes hearing disability and also leads to severe intracranial infections. *Pseudomonas aeruginosa* and *Staphylococcus aureus* are the most frequently isolated microorganisms in CSOM. Gram-negative rods (*Proteus spp*, *Klebsiella spp*), anaerobes (*Bacterioides spp*. and *Fusobacterium spp*.) and fungi (*Aspergillus spp*, *Candida spp*.) were also reported as CSOM agents [2].

K. gyiorum is a new member of Alcaligenaceae family which was first described by Coenye et al., in a whole-cell protein analysis study of nine human clinical isolates. Since many of these strains were isolated from lower extremity wounds, the species was named "gyiorum", meaning "from the limbs" [3]. Subsequent reported cases included wound, wound-related bacteremia, lower respiratory tract infection, urinary tract infection (Table 1), and CSOM [4, 9-15] (Table 2). The mean ages of CSOM and non-CSOM patients were 32.42±17.15 and 62±12.36, respectively. Of CSOM cases; one patient had diabetes mellitus (DM), hypertension, renal and heart failure, while the others had no additional diseases [4,10-15]. All non-CSOM patiens had comorbidies such as morbid obesity, lower extremity cellulitis, respiratory and renal failure, uncontrolled schizophrenia, osteomyelitis, DM, bladder cancer and nephrostomy [4-9]. Our cases consisted of young CSOM patients (21-27 years) with no additional disease. *Morganella morganii*, *Proteus vulgaris*, *P. aeruginosa* and *Stenotrophomonas maltophilia* were the coexisting bacteria isolated from non-CSOM patients [4, 5, 8]. The coexisting bacteria of the CSOM cases were *S. aureus*, *P. aeruginosa*, *Escherichia coli, Proteus mirabi*lis and *Corynebacterium amycolatum* [4, 11, 12, 14]. *M. morganii* was the coexisting bacteria in our third case, while in the other two cases, only *K. gyiorum* was isolated. Our second case and two of previous reported cases [4, 11] were smokers. Further studies are needed to determine the role of smoking in the pathogenesis of CSOM caused by *K. gyiorum*.

Commercial identification systems such as BD Phoenix and Vitek 2 fail to identify *K. gyiorum* because the bacteria is not found in their databases [10]. New technologies such as mass spectrometry (MS) and 16S rRNA gene sequencing have contributed to the identification of such rare bacteria [4]. MS results were found to be consistent with 16 SrNA gene sequences in identifying *K. gyiorum* [4, 5, 12, 13]. A publication of two CSOM cases in Tanzania stated that only MALDI-TOF MS was used to identify *K. gyiorum* [11]. We also used MS for identification. All isolates of our cases were identified up to species level with excellent scores (>2). The biochemical properties and colony morphologies of the isolates were also compatible with *K. gyiorum*.

Table 1 - *K. gyiorum* cases other than chronic suppurative otitis media.

Age/ Gender	*Infection site*	*Identification*	*Ciprofloxacin MIC*	*Co-existing bacteria*	*Comorbidity*
54/F	Lower leg wound	MALDI-TOF MS, 16S rRNA G.s.	2 µg/ml	*Morganella morganii*	Morbid obesity, lower extremity cellulitis [4]
63/F	Lower respiratory tract	MALDI-TOF MS, 16S rRNA G.s.	2 µg/ml	*P. aeruginosa*, *Stenotrophomonas maltophilia*	Chronic respiratory and renal failure [5]
69/F	Wound related bacteremia	16S rRNA G.s.	>2 µg/ml	None	Uncontrolled schizophrenia [6]
57/F	Wound	Draft genome sequencing	Unspecified	Unspecified	DM, Osteomyelitis [7]
82/M	Uninary tract	16S rRNA G.s.	Levofloxacin 1 µg/ml	*Proteus vulgaris*	Bladder cancer, nephrostomy [8]
47/M	Wound	MALDI-TOF MS, 16S rRNA G.s.	2 µg/ml	None	Chronic osteomyelitis [9]

MIC: Minimal Inhibitory Concentration, F: Female, M: Male, G.s.: Gene sequencing,
MALDI-TOF MS: Matrix-Assisted Laser Desorption Ionization–Time of Flight Mass Spectrometry.

Table 2 - Chronic suppurative otitis media (CSOM) cases of *K. Gyiorum*.

Age/ Gender	*Identified by*	*Ciprofloxacin MIC*	*Coexisting bacteria*	*Comorbidity*
21/F	MALDI-TOF MS	>2 µg/ml	None	None (Case 1)
22/M	MALDI-TOF MS	0.5 µg/ml	None	Smoker (Case 2)
27/ M	MALDI-TOF MS	>2 µg/ml	*Morganella morganii*	None (Case 3)
55/ M	MALDI-TOF MS, 16S rRNA G.s.	32 µg/ml	*Corynebacterium amycolatum*	Alcohol user, smoker [4]
16/ M	16S rRNA G.s..	1 µg/ml	None	None [10]
53/ M	MALDI-TOF MS	1 µg/ml	*Proteus mirabilis*	Alcohol user, smoker [11]
33/ M	MALDI-TOF MS	1 µg/ml	*S.aureus, E. coli*	None [11]
25/ M	MALDI-TOF MS, 16S rRNA G.s.	>2 µg/ml	*P. aeruginosa*	None [12]
30/ F	MALDI-TOF MS, 16S rRNA G.s.	>2 µg/ml	None	None [13]
88/ M	MALDI-TOF MS, 16S rRNA G.s.	>2 µg/ml	*S.aureus*	DM, HT, renal and heart failure [14]
51/ F	MALDI-TOF MS, 16S rRNA G.s.	>2 µg/ml	None	None [15]

MIC: Minimal Inhibitory Concentration, F: Female, M: Male, DM: Diabetes Mellitus,
HT: Hypertension, S.: Staphylococcus, P.: Pseudomonas, E.: Escherichia,
MALDI-TOF MS: Matrix-Assisted Laser Desorption Ionization-Time of Flight Mass Spectrometry, G.s.: Gene sequencing.

There is no standard antimicrobial treatment protocol for CSOM. Antiseptic or antibacterial ear drops, systemic antibiotics and tympanomastoidectomy are the treatment choices in CSOM [2]. The isolates of our first and third case were resistant to ciprofloxacin such as reported previous cases [4, 12-15]. All three patients underwent surgical treatment and received medical treatment of intramuscular ceftriaxone. Ciprofloxacin ear drops were prescribed additionally in case 1 and case 2. Although the isolate of the first case was resistant to ciprofloxacin, ear discharges of both patients stopped in the second week. The patients were operated and received both systemic and topical antibiotic therapy. With the help of ear drops, higher antibiotic concentrations than the MIC level were achieved at the site of infection. All these factors contributed to the proper treatment of patients. In the third case, which both *M. morganii* and *K. gyiorum* were isolated, ear drainage didn't stop after two weeks of ceftriaxone treatment. Although the strains were resistant to ciprofloxacin, the patient's ear drainage stopped after systemic moxifloxacin treatment supplemented with ciprofloxacin ear drops. Antimicrobial ear drops may play a role in effective treatment by providing high antibiotic concentrations in the infectious area.

Consequently, *K. gyiorum* should be considered as a causative agent of CSOM whether the patients have comorbidities or not. The usage of MALDI-TOF MS for bacterial identification in microbiology laboratories will contribute to rapid and accurate identification of such novel agents.

Conflict of interest

The authors declare that there's no conflict of interest regarding the publication of this article.

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