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A Retrospective Case Series Study of *Alcaligenes faecalis* Pneumonia

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Abstract

Background: The potentially developing human pathogen *Alcaligenes faecalis* is a Gram-negative, nonfermenting bacterium. Treatment of *A. faecalis* infections is frequently difficult due to increased resistance to many antibiotics, such as β-lactam antibiotics, aminoglycosides, and quinolones. In the literature, *A. faecalis* pneumonia has never been documented in a case series study. Here, we provide a case series study of patients with *A. faecalis* pneumonia.

Objectives: The aim of this study was to elucidate the clinical characteristics, management strategies, and outcomes of *A. faecalis* pneumonia patients.

Methods: Patients with *A. faecalis* pneumonia between January 2014 and December 2019 were included in a retrospective investigation. We examined the clinical outcomes of patients with *A. faecalis* pneumonia, together with the risk factors for pneumonia, prior intravenous antibiotic use within 90 days, respiratory secretion culture results, antibiotic sensitivity test results, and other variables.

Results: Observations revealed eight patients with *A. faecalis* pneumonia, including six males and two females. The mean age of patients was 70 years. These eight patients shared risk factors for pneumonia. Six patients were discharged, and two patients died as a result of *A. faecalis* pneumonia. Two patients with pneumonia caused by extensively drug-resistant *A. faecalis* were identified.

Conclusions: Rare cases of *A. faecalis* pneumonia have been documented in the literature. Recently, *A. faecalis* has developed extensive drug resistance. To treat pneumonia caused by *A. faecalis* with substantial antibiotic resistance, either polymyxin B or tigecycline is needed. The clinical outcome is typically satisfactory when *A. faecalis* pneumonia patients receive appropriate antibiotic therapy, but cases of fatal pneumonia have been documented in the literature.

Keywords: *Alcaligenes faecalis*,Pneumonia, Extensively Drug-Resistant

1. Background

Alcaligenaceae, which are included in the order *Burkholderiales*, are a family of bacteria. *Alcaligenes faecalis* is a Gram-negative, obligate, nonfermenting aerobe that is motile with peritrichous flagella and a non-pigmented rod (1). *Alcaligenes faecalis* has been linked to a variety of human clinical infections. Sixty-two *A. faecalis* infections were sporadically reported in the medical literature before 1997 (2). Meningitis and bacteremia were the most frequently reported cases, and the majority of these infections were reported in newborns and infants. Most patients were treated with sulfonamides. In 1960, Doxiadis reported 33 cases of bacteremia in newborns, which was the largest case series of *A. faecalis* bacteremia. *Alcaligenes faecalis* is resistant to sulfonamides, and *A. faecalis* bacteraemia caused 20 fatalities (3).

There were 127 sporadically reported cases of *A. faecalis* infection in the literature after 1997 (2). In Angola, Fillipe documented 20 cases of chronic otitis media (4). These instances of *A. faecalis* chronic otitis media were associated with the locals' use of bird feces as a traditional therapy to avoid ear discharge. The cases reported in the literature after 1997 (excluding the 20 cases of chronic otitis media in Angola) indicate that urinary tract infections, skin and soft tissue infections, and pulmonary infections were the most common locations of *A. faecalis* infection (2). Here, we report a case series of patients with *A. faecalis* pneumonia.

2. Objectives

The aim of this study was to elucidate the clinical characteristics, management strategies, and outcomes of *A. faecalis* pneumonia patients.

3. Methods

We retrospectively analyzed all patients who were hospitalized at Dalin Tzu Chi Hospital between January 2014 and December 2019 with pneumonia caused by *A. faecalis*. The trial was open to any adult patient who met all the requirements and had a confirmed radiological and clinical diagnosis of pneumonia. The criteria used to define pneumonia were as follows: (1) chest radiography showing a new or developing infiltrate (s); (2) fever (defined as an oral temperature greater than 38 °C); and (3) purulent sputum or a change in the properties of sputum; (4) a new or worsening cough; (5) dyspnoea or tachypnea; (6) audible results, such as rales and/or signs of lung consolidation, upon pulmonary examination; (7) a peripheral white blood cell count of more than 10,000 cells/mm^3.

Patients were diagnosed with pneumonia when they had clinical symptoms and signs of pneumonia, and their chest radiography revealed new pulmonary infiltration. Bronchial lavage fluid or respiratory secretions were obtained for culturing. Through the use of the VITEK II system and ASTGN87 cards (BioMérieux, Marcy-l'Étoile, France) with the Clinical and Laboratory Standards Institute interpretation criteria M100 - 25th, bacterial cultures of respiratory secretions and tests for antibiotic resistance were conducted. As soon as respiratory secretions were obtained, they were cultured on colistin-nalidixic acid agar, blood agar, chocolate agar, and Eosin Methylene Blue Agar. The transfer tube and matching suspension tube were placed in the adjacent slot along with one GN identification card (automated identification of 135 taxa of the most significant fermenting and nonfermenting Gram-negative bacilli) and another card of VITEK II AST-N322 (for susceptibility testing of aerobic Gram-negative bacilli against specific antimicrobials).

The results of every test were evaluated using the raw data and compared to thresholds. We procured patient data and medical records through the use of a microbiology laboratory reporting system. The data collected encompassed a spectrum of aspects, including demographics, clinical symptoms, and signs, imaging findings, risk factors for pneumonia, previous intravenous antibiotic use within 90 days, pulmonary secretion culture results, antibiotic sensitivity test results, and, ultimately, clinical outcomes. The definition of extensively drug-resistant/pan-drug-resistant cites the study of Maggiorakos et al. (5).

4. Results

4.1. Case Report

An 82-year-old male patient has been hospitalized at Dalin Tzu Chi Hospital five times due to pneumonia since December 2017. He received a tracheostomy on December 20, 2017. He experienced productive cough and dyspnoea on February 16, 2019. He visited our emergency room for help. His chest radiograph showed a chronic fibrotic lesion over both lungs with waving of both diaphragms and alveolar opacity over the left upper lung. At the time of pneumonia diagnosis, he was admitted to our ward for further management. His sputum culture on February 17, 2019, revealed *A. faecalis* growth. We thought that *A. faecalis* was a contaminating bacterium.

The patient was treated with cefpirome (1.0 gram) intravenously every 12 hours. His condition improved gradually. He suffered from fever again on February 23, 2019, and his chest radiograph showed alveolar opacity in the left lung. His sputum culture on February 24, 2019, revealed the presence of *A. faecalis*, *Pseudomonas aeruginosa*, and *Escherichia coli*. We intravenously administered cefoperazone-sulbactam (2.0 grams) for 12 hours to the patient. After seven days of intravenous cefoperazone-sulbactam therapy, he experienced fever improvement in the ward. Unfortunately, he suffered from choking, fever, and dyspnoea on March 1, 2019. His chest radiograph on March 1, 2019, revealed progressive increasing alveolar opacity over the left lung. His sputum culture showed *A. faecalis* growth.

We determined that *A. faecalis* was a pathogen, not a contaminating bacterium. *A. faecalis* is only sensitive to tigecycline and resistant to many antibiotics, such as anti-pseudomonas penicillin, cephalosporins, carbapenems, quinolones, and aminoglycosides. Therefore, we prescribed 50 milligrams of intravenous tigecycline every 12 hours. After treatment, the severity of *A. faecalis* pneumonia was well controlled. His chest radiograph on March 18, 2019, revealed a resolution of the left lung alveolar opacity. He was discharged on

Table1. Whole Complete Course of Patient's Hospitalization

Hospital Day	Temporal Temperature (°C)	WBC Count	CRP mg/dL	Sputum Culture	Antibiotics	Comment
1	36.8 - 37.4	7200	0.99		Cefpirome	Admisson
2	36.5 - 38.0			*Alcaligenes faecalis*	Cefpirome	Fever
3	36.0 - 38.3			*Alcaligenes faecalis*	Cefpirome	Fever
4	36.1 - 37.0				Cefpirome	
5	36.2 - 37.0				Cefpirome	
6	36.0 - 37.1				Cefpirome	
7	36.0 - 37.2				Cefpirome	
8	37.2 - 38.5	10260	6.09	*Alcaligenes facealis*	CPZ-sulbactam	Fever
9	36.1 - 37.8			*Pseudomonas aeruginosa and Escherichia coli*	CPZ-sulbactam	
10	36.0 - 36.8				CPZ-sulbactam	
11	36.1 - 36.9				CPZ-sulbactam	
12	36.3 - 36.9				CPZ-sulbactam	
13	36.0- 37.0				CPZ-sulbactam	
14	36.4 - 38.8				CPZ-sulbactam	Fever
15	36.0 - 38.8				CPZ-sulbactam	Fever
16	36.8 - 38.5	11830	10.2	*Alcaligenes faecalis*	Tigecycline	Fever
17	36.8 - 38.6				Tigecycline	Fever
18	36.3 - 38.3				Tigecycline	Fever
19	36.7 - 38.1				Tigecycline	Fever
20	36.6 - 37.8				Tigecycline	Fever
21	36.0 - 37.1				Tigecycline	
22	36.0 - 36.9				Tigecycline	
23	36.0 - 36.2				Tigecycline	
24	36.0 - 36.9				Tigecycline	
25	36.0 - 36.0				Tigecycline	
26	36.0 - 36.6				Tigecycline	
27	36.0 - 36.8				Tigecycline	
28	36.1 - 36.9				Tigecycline	
29	36.0 - 36.6				Tigecycline	
30	36.0 - 36.1				Tigecycline	
31	36.0 - 36.3				Tigecycline	Discharge

March 18, 2019. Table 1 shows the complete course of the patient's hospitalization.

4.2. Case Series

All patients who were hospitalized with *A. faecalis* pneumonia at Dalin Tzu Chi Hospital from January 2014 to December 2019 were retrospectively analyzed. Eight patients with *A. faecalis* pneumonia were diagnosed, including six males and two females. The age distribution ranged from 51 to 83 years. The mean age was 70.0 years. The following patient conditions increased their likelihood of pneumonia: Four bedridden patients with cognitive impairments, three with underlying cancers, and one with end-stage renal disease. Seven patients had a history of prior intravenous antibiotic use within 90 days. Sputum cultures from six patients revealed polymicrobial infections. Antibiotic sensitivity tests revealed the emergence of extensively drug-resistant *A. faecalis* in 2018. A patient with stage IV adenocarcinoma of the lung receiving chemotherapy did not receive adequate intravenous antibiotic therapy and died due to *A. faecalis* pneumonia. Another patient with stage IIIA squamous cell carcinoma of the lung receiving sequential radiotherapy and chemotherapy received adequate intravenous antibiotic therapy but still died due to *A. faecalis* pneumonia. After receiving sufficient intravenous antibiotic medication, six patients were released with perfect health. The bacteriology and clinical outcomes of the eight patients are displayed in Table 2 (2).

Table 2. Bacteriology and Clinical Outcome in Eight Cases of *Alcaligenes faecalis* Pneumonia [a]

Variables	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case7	Case8
Year	2014	2014	2015	2018	2019	2019	2019	2019
Prior intravenous antibiotic use within 90 days	No	ETP FEP VAN	LVX	CAZ LVX DOR VAN	CAZ AMK IPM TEC CIP	TZP MEM CAZ TEC AMK	CRO SAM	TZP MEM CAZ VAN LVX AMK
Antibiotics therapy	CXM	CRO	FEP	TGC	TGC	MEM	CAZ	CAZ
Outcome	Cure	Cure	Dead	Cure	Cure	Cure	Dead	Cure
Results of antibiotics sensitivity test of *Alcaligenes faecalis*								
GEN	S	S	R	R	R	R	S	NIL
AMK	S	S	R	R	R	R	S	NIL
CAZ	S	S	R	R	R	S	S	NIL
FEP	S	S	R	R	R	R	S	NIL
SAM	S	S	R	R	R	R	S	NIL
TZP	S	S	R	R	R	S	R	NIL
CIP	S	S	R	R	R	R	R	NIL
IPM	S	S	S	R	R	S	S	NIL
MEM	S	S	S	R	R	S	S	NIL
TGC	NA	NA	NA	S	S	NA	NA	NIL
Mixed infection pathogens								
Proteus vulgaris	V							
MSSA							V	
Pseudomonas aeruginosa						V		V
Providencia stuartii		V						
Brukholderia cepacia			V					

[a] Obtained the appropriate permissions for re-use table from the BMC infectious diseases.

5. Discussion

In 1983, Gray et al. reported a pathogenetic change in the trachea of turkey infected with *A. faecalis* (6). The pathogenesis of *A. faecalis* pneumonia in humans is unknown. No authors have explored this issue or reported the findings in the literature. Very few case reports of *A. faecalis* pneumonia exist. In 2006, Leesik et al. reported on microbial pathogens in adults with community-acquired pneumonia, including two cases of community-acquired pneumonia caused by *A. faecalis* (7). Ergul et al. reported two cases of *A. faecalis* ventilator-associated pneumonia in a pediatric intensive care unit in 2017 (8). However, these two articles included no description of the clinical information about *A. faecalis* pneumonia patients. Agarwal et al. reported a 32-year-old male patient who had hemorrhagic fever caused by dengue in 2017. His chest radiograph revealed alveolar opacities in both lungs (9).

Using bronchoalveolar lavage fluid culture, *A. faecalis* was isolated. The results of the antibiotic sensitivity test indicated sensitivity to tigecycline and colistin and resistance to carbapenems, quinolones, aminoglycosides, cephalosporins, monobactam, minocycline, and ureidopenicillins. This patient later succumbed to his illness (9). According to a 2018 study by Junejo et al., a 73-year-old man had bilateral alveolar opacities on his chest radiograph. Culture and sensitivity analysis revealed that the sputum-isolated *A. faecalis* strain was resistant to anti-*Pseudomonas* penicillins, carbapenems, aminoglycosides, and quinolones. After receiving polymyxin B treatment, the patient's hemodynamic stability improved (10). Al-Zakhari et al. reported the death of a 66-year-old male patient in 2020. The patient suffered from cavitary pneumonia caused by pan-drug-resistant *A. faecalis*. The patient died despite aggressive antibiotic treatment (linezolid and polymyxin B) (11). Patients 4 and 5 had extensively drug-resistant *A. faecalis* pneumonia in this study, and the results for antibiotic sensitivity were the same as those in Agarwal and Junejo's reports (9, 10).

In Bizet's study, *A. faecalis* containing a β-lactamase was discovered (1). In Pereira's study, a strain of *A.*

faecalis resistant to expanded-spectrum beta-lactamase cephalosporins was identified in the urine of a patient (12). Agarwal et al. reported a case of a patient with extensively drug-resistant *A. faecalis* pneumonia (9). Hasan et al. reported a patient with pan-drug-resistant *A. faecalis* bacteraemia who received double-dose tigecycline and had a successful treatment outcome (13). In 2018, a strain of extensively drug-resistant *A. faecalis* susceptible to only tigecycline was isolated in our hospital.

Among our two patients with extensively drug-resistant *A. faecalis* pneumonia, both had a history of prior intravenous antibiotic use within 90 days, which may be a risk factor for extensive drug-resistant *A. faecalis* infection. Of the seven patients with *A. faecalis* pneumonia reported in the literature and our eight patients, four died (26.7%). The other eleven patients received adequate intravenous antibiotic therapy and recovered. The pathogenicity of *A. faecalis* is minimal. Patients with *A. faecalis* infection usually have a good prognosis with appropriate intravenous antibiotic therapy. We emphasize the fact that life-threatening *A. faecalis* infections have been reported.

5.1. Conclusions

Recently, extensively drug-resistant *A. faecalis* strains have emerged. The use of polymyxin B or tigecycline is necessary for patients with extensively drug-resistant *A. faecalis* pneumonia. Patients with *A. faecalis* pneumonia usually have a good prognosis after receiving appropriate intravenous antibiotic therapy. However, fatal cases of pneumonia have been reported in the literature.

Footnotes

Authors' Contribution: Chienhsiu Huang, made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

Conflict of Interests Statement: The authors declared no conflict of inetersts.

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after its publication. The data are not publicly available due to the data are not publicly available due to privacy or ethical restrictions.

Ethical Approval: The project was approved by the Buddhist Dalin Tzu Chi General Hospital Research Ethics Committee (Approved IRB No. B10802024).

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Informed Consent: Case reported patient: The patient and his legally authorized representative provided written informed consent for this case report to be published in a medical journal.

References

1. Bizet J, Bizet C. Strains of Alcaligenes faecalis from clinical material. *J Infect*. 1997;**35**(2):167-9. [PubMed ID: 9354352]. https://doi.org/10.1016/s0163-4453(97)91710-2.
2. Huang C. Extensively drug-resistant Alcaligenes faecalis infection. *BMC Infect Dis*. 2020;**20**(1):833. [PubMed ID: 33176714]. [PubMed Central ID: PMC7659064]. https://doi.org/10.1186/s12879-020-05557-8.
3. Doxiadis SA, Pavlatou M, Chryssostomidou O. Bacillus faecalis alcaligenes septicemia in the newborn. *J Pediatr*. 1960;**56**:648-54. [PubMed ID: 13817922]. https://doi.org/10.1016/s0022-3476(60)80339-3.
4. Filipe M, Reimer A, Matuschek E, Paul M, Pelkonen T, Riesbeck K. Fluoroquinolone-resistant Alcaligenes faecalis related to chronic suppurative Otitis media, Angola. *Emerg Infect Dis*. 2017;**23**(10):1740-2. [PubMed ID: 28930018]. [PubMed Central ID: PMC5621561]. https://doi.org/10.3201/eid2310.170268.
5. Magiorakos AP, Srinivasan A, Carey RB, Carmeli Y, Falagas ME, Giske CG, et al. Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. *Clin Microbiol Infect*. 2012;**18**(3):268-81. [PubMed ID: 21793988]. https://doi.org/10.1111/j.1469-0691.2011.03570.x.
6. Gray JG, Roberts JF, Dillman RC, Simmons DG. Pathogenesis of change in the upper respiratory tracts of turkeys experimentally infected with an Alcaligenes faecalis isolate. *Infect Immun*. 1983;**42**(1):350-5. [PubMed ID: 6618668]. [PubMed Central ID: PMC264564]. https://doi.org/10.1128/iai.42.1.350-355.1983.
7. Leesik H, Ani U, Juhani A, Altraja A. Microbial pathogens of adult community-acquired pneumonia in Southern Estonia. *Med (Kaunas)*. 2006;**42**(5):384-94. [PubMed ID: 16778466].
8. Ergul AB, Cetin S, Altintop YA, Bozdemir SE, Ozcan A, Altug U, et al. Evaluation of microorganisms causing ventilator-associated pneumonia in a pediatric intensive care unit. *Eurasian J Med*. 2017;**49**(2):87-91. [PubMed ID: 28638248]. [PubMed Central ID: PMC5469850]. https://doi.org/10.5152/eurasianjmed.2017.16262.
9. Agarwal A, Sharma S, Bhargava V, Bhargava V, Agarwal M, Airun M. First reported case of Alcaligenes faecalis isolated from bronchoalveolar lavage in a patient with dengue hemorrhagic fever. *J Assoc Chest Physicians*. 2017;**5**(1):51. https://doi.org/10.4103/2320-8775.177512.

10. Junejo SZ, Tuli S, Trandafirescu T. A rare case of pneumonia caused by Alcaligenes faecalis bacteria. *Bacterial Infect Case Rep*. American Thoracic Society; 2018. A3602 p.
11. Al-Zakhari R, Suhail M, Ataallah B, Aljammali S, Grigos A. Rare but fatal case of cavitary pneumonia caused by Alcaligenes faecalis. *Cureus*. 2020. https://doi.org/10.7759/cureus.8934.
12. Pereira M, Perilli M, Mantengoli E, Luzzaro F, Toniolo A, Rossolini GM, et al. PER-1 extended-spectrum beta-lactamase production in an Alcaligenes faecalis clinical isolate resistant to expanded-spectrum cephalosporins and monobactams from a hospital in Northern Italy. *Microb Drug Resist*. 2000;**6**(1):85-90. [PubMed ID: 10868812]. https://doi.org/10.1089/mdr.2000.6.85.
13. Hasan MJ, Nizhu LN, Rabbani R. Bloodstream infection with pandrug-resistant Alcaligenes faecalis treated with double-dose of tigecycline. *ID Cases*. 2019;**18**. e00600. [PubMed ID: 31367521]. [PubMed Central ID: PMC6656691]. https://doi.org/10.1016/j.idcr.2019.e00600.