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CASE REPORT

Emerging pathogen: a case and review of *Raoultella planticola*

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Abstract *Raoultella planticola* has been considered a relatively harmless Gram-negativebacteria, rarely associated with clinical infection. However, in recent years, thefrequency at which severe infection by *R. planticola* and drug-resistant strainsare reported in literature has increased. Here, we present one case of acutecholecystitis caused by *R. planticola*, and review all previously reported casesof the infection in an attempt to identify new trends in biological and clinical features of*R. planticola* infections.

Keywords *Raoultella planticola* · Klebsiella species · Human infection · Drug resistance

Introduction

Although *Raoultella planticola* is generally considered a harmless, environmental Gram-negative bacteria, 17 cases of serious infection have been attributed to the pathogen since it was first reported by Freney et al. in 1984. Of these, three fatalities were reported all of which were associated with drug-resistant strains. Here, we describe a case of *Raoultella planticola* (*R. planticola*) cholecystitis and provide a review of the aforementioned cases of infection by the organism.

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Case

A 49-year-old gentleman with a past medical history of alcohol abuse, compensated alcoholic cirrhosis and diabetes mellitus presented to the hospital for elective alcohol detoxification. In the emergency department, he endorsed vague abdominal pain associated with nausea and vomiting, but otherwise complete review of systems was unremarkable. Additional past medical history included benign prostatic hypertrophy and hyperlipidemia. He had no prior surgeries, no history of smoking or illicit drug use, and no recent travel, ingestions or exposures.

On admission, the patient was tachycardic (110 beats/min), but otherwise afebrile and hemodynamically stable. His abdominal exam was benign. He had no stigmata of chronic liver disease. Routine laboratory evaluation was notable for transaminitis (aspartate aminotransferase 187 U/L, alanine aminotransferase 61 U/L), hyperbilirubinemia (total bilirubin 2.9 mg/dL), elevated alkaline phosphatase (322 U/L), which were all attributed to alcohol abuse, alcoholic hepatitis and cirrhosis. Otherwise, initial testing was unremarkable, including a normal leukocyte count, amylase and lipase.

As a result, he was initiated on a combination of scheduled and symptom-triggered benzodiazepines for alcohol withdrawal. However, his hospital course was notable for new onset fevers, hypotension, leukocytosis, and worsening hyperbilirubinemia. An abdominal ultrasound showed a “distended gallbladder containing sludge and possibly stones. There is a small amount of pericholecystic fluid, which can be associated with acute

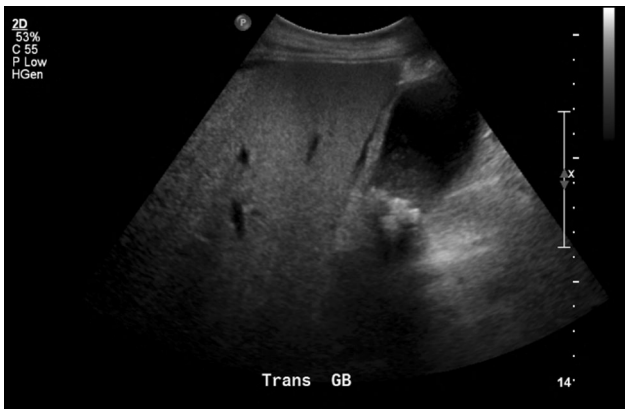

Fig. 1 Abdominal ultrasound showing distended gallbladder and pericholecystic fluid was suggestive of acute cholecystitis

cholecystitis" (Fig. 1). Subsequent HIDA scan demonstrated a "non-visualized gallbladder 4.5 h consistent with cholecystitis".

The patient was transferred to the Medical Intensive Care Unit (MICU) for severe sepsis, where he was initiated on broad-spectrum intravenous antibiotics (vancomycin and piperacillin–tazobactam). Due to his acute decompensation, a surgical consultation deemed him a poor surgical candidate, therefore interventional radiology performed an aspiration of the pericholecystic fluid and placement of a percutaneous cholecystostomy tube. Biliary fluid cultures were positive for *Raoultella planticola* and *Enterococcus*. His antibiotic coverage was eventually changed to tigecycline to cover both organisms after he developed a drug rash to piperacillin–tazobactam. His condition improved, and he was eventually discharged to short-term rehabilitation to complete a 14-day course of antibiotic treatment.

Discussion

R. planticola has rarely been linked to clinical infection. Typically, it is a harmless aquatic, botanic and soil organism. Several studies estimate that between 9 and 18 % of humans are colonized with the bacteria [2, 8, 9]. In our review of the literature, we found 17 cases of serious infections with *R. planticola*. Table 1 provides a summary of these cases including 6 (35 %) patients with bacteremia, 4 (23 %) with GI tract-related infections, 3 (17 %) with skin and soft tissue infections, 3 (17 %) with respiratory tract infections and 1 (6 %) with cystitis; 9 (53 %) of these cases met criteria for nosocomial infection and 6 (35 %) involved immunocompromised hosts. 3 (17 %) patients expired, all of whom had developed bacteremia with a multidrug-resistant strain carrying the carbapenem-resistent gene bla KPC [3, 20].

Interestingly, studies have shown that there are extensive resemblances between *R. planticola* and *Klebsiella* spp. Podschun et al. evaluated the scope of this correspondence between the common virulence factors of these two species and found that the magnitude of resemblance between them is enormous, suggesting that *R. planticola* and *Klebsiella* spp. could behave similarly within their human hosts, respond similarly to antibiotic treatment and evolve similarly in terms of drug resistance [3–7, 19, 20]. Many of the cases demonstrated that, in general, *R. planticola* is sensitive to a wide range of antibiotics. However, like *Klebsiella* spp., *R. planticola* has the ability to acquire antibiotic-resistant plasmid genes resulting in severe and even fatal infections [3, 20].

Based on the cases of clinical infection and the known microbiologic facts about *R. planticola*, we suggest four possible scenarios for *R. planticola*'s natural course of infection:

1) *Trauma* Infection in this group occurs in the community after a traumatic incident in a contaminated environment. Trauma results in localized immune deficiency due to inflammation and tissue hypoxia and inoculates a significant load of *R. planticola* into an anatomically and immunologically injured site leading to overt infection [10–12].
2) *Nosocomial* Infection in this group involves the introduction of the bacteria during an invasive intrahospital procedure either by inoculation of dormant colonizers or via contaminated instruments [1, 13–15]
3) *Immunocompromised* Infection in this group occurs when systemic impairment of the host immune system enables dormant colonizers to become invasive [3, 17, 18, 20].
4) Enteric fever and bacteremia in a Immunocompetent patient [16].

In conclusion, *R. planticola* may be an emerging pathogen capable of causing significant infections in multiple different organ systems in a variety of hosts. Given its similarity to *Klebsiella* spp., it would not be unreasonable to believe that this bacteria may eventually become more broadly a *multidrug resistant* and result in an increasingly heavy burden in terms of morbidity and mortality. In order to be prepared for this possible scenario, *R. planticola* no

Table 1 Summary of the previous case reports

Author	Patient	Clinical diagnosis	Comorbidity	Invasive intra-hospital procedure or traumatic event	Immunocompromised?	Nosocomial vs. community acquired	Treatment
Freney et al.	69/female	Bacteremia	Bacterial endocarditis, MV stenosis	Mitral valve replacement	No	Nosocomial	Cefotaxime, tobramycin
Freney et al. [2]	40/male	Bacteremia	Mitral stenosis, bacterial endocarditis	Mitral valve replacement	No	Nosocomial	Unknown
Freney et al.	57/unknown	Pneumonia	Coronary artery disease		No	Nosocomial	Ceftriaxone
Alves et al.	45/male	Pancreatitis and retroperitoneal abscess	Alcoholism, pneumonia	Exploratory laparotomy	Yes	Nosocomial	Imipenem, amikacin
Castanheira et al.[a]	64/male	Bacteremia	Leukemia	Surgical abscess debridement	Yes	Nosocomial	Doxycycline
Castanheira et al.[a]	83/female	Pneumonia	None	None	No	Community acquired	None
Castanheira et al.	51/male	Bacteremia	MV disease, peripheral vascular disease, hypertension	MV replacement, mechanical ventilation	No	Nosocomial	Gentamicin, amikacin
O'Connell et al.	30/male	Cellulitis	None	Hammer crush injury	No	Community acquired	Benzylpenicillin, flucloxacillin, clindamycin, ciprofloxacin
Wolcott et al.	66/male	Surgical site infection	Coronary artery disease, hypertension, hyperlipidemia	Farming accident, open reduction internal fixation	No	Community acquired	Ertapenem
Yokota et al.	65/male	Ascending cholangitis	Adenocarcinoma of the neck	ERCP, lithotripsy	Yes	Nosocomial	Piperacillin–tazobactam
Hu et al.	59/male	Ascending cholangitis	Pancreatic carcinoma	ERCP	Yes	Nosocomial	Piperacillin–tazobactam
Kim et al.	66/male	Necrotizing fasciitis	Coronary artery disease, diabetes	None	No	Community acquired	Cefotaxime, levofloxacin, tigecycline
Teo et al.	62/female	Acute cholecystitis	Celiac disease, IBD	None	No	Community acquired	Co-amoxiclav
Puerta-Fernandez et al.	63/male	Bacteremia	Pituitary adenoma	None	No	Community acquired	Cefotaxime
Olson et al.	89/male	Cystitis	Coronary artery disease, congestive heart disease, atrial fibrillation, hypertension, chronic kidney disease	None	No	Community acquired	Ciprofloxacin
Tseng et al.[a]	77/male	Pneumonia, septic shock	None	None		Nosocomial	Levofloxacin, meropenem, colistin
Tseng et al.	57/male	Catheter-related bacteremia	Lung cancer, chemotherapy	Catheterization	Yes	Nosocomial	Ceftazidime, levofloxacin, gentamicin

[a] Patient demise

longer should be viewed as a harmless environmental organism, but rather as an invasive organism requiring prompt diagnosis and treatment.

Conflict of interest The authors announce no conflict of interest and that no funding were received.

Ethical statement Shortly after discharge, the patient passed away. Thus, the informed consent was obtained from the patients' first degree relatives.

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