



# *Raoultella planticola* associated with Meckel's diverticulum perforation and peritonitis in a child: Case report and systematic review of the paediatric literature

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## ABSTRACT

*Raoultella planticola* (*R. planticola*) is a Gram-negative, aerobic, rod bacteria found in water and soil that has been on rare occasions associated with clinical infections. However, in recent years, there has been both an increase in the frequency and severity of *R. planticola* infections. We present the first case of Meckel's diverticulum perforation and peritonitis in a child associated with *R. planticola* infection and a systematic review of the paediatric literature. At present, in the paediatric population, *R. planticola* presents good susceptibility to a variety of antibiotics with the exception of ampicillin.

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## Background/objectives

*Raoultella planticola* (*R. planticola*) is an aerobic, non-motile and encapsulated Gram-negative bacilli. It is primarily considered as environmental bacteria and does not typically cause invasive infections in humans [1].

Since the first case of human infection with *R. planticola* was reported in 1984 in a patient with sepsis there has been only occasionally reports of it being a causative organism of infections in humans [1,2]. However, there is growing concern about the emer-

gence of carbapenem resistance in this species [3,4]. A limited number of paediatric cases have been reported in the literature and to our knowledge, there has not been any report of *R. planticola* complicating a Meckel's diverticulum in either the paediatric or adult age groups. Furthermore, we are not aware of any case of *R. planticola* reported in Australia. Therefore, we present the first case of a perforated Meckel's diverticulum associated with a *R. planticola* peritonitis in child. We have also performed a systematic review of the paediatric literature.

## Methods

We report a case of an 8-year old girl which presented with a perforated Meckel's diverticulum associated with *R. planticola* peritonitis. Written informed consent for publication was obtained

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**Table 1**  
Systematic review: confirmed *R. planticola* cases in children.

Reference	Country	Age (years)/ Gender	Diagnosis	Associated conditions	Treatment	Outcome	Antibiotic susceptibility					
AlSaweed et al. [6]	AMC Saudi Arabia	AMK 4/Male	AMP Endocarditis	GEN GERD, hiatal hernia, cleft palate repair, esophageal stricture	SXT CRO/GEN	TZP N/A	S	N/A	R	S	N/A	S
At1c1 et al. [7]	Turkey	0.1/Female (pre-mature)	Bacteraemia/sepsis	Conjunctivitis	TZP	Recovered	S	N/A	R	S	S	S
Bardellini et al. [8]	Italy	16/Male	Oral mucositis	Burkitt's lymphoma	AMIK/CAZ	Recovered	S	S	S	S	S	S
Howell et al. [9]	USA	0.16/Female	UTI	None	CRO/LEX	Recovered	S	S	S	S	S	S
Vassallo et al. [10]	Malta	15/Female	Conjunctivitis	N/A	N/A	N/A	S	N/A	R	S	S	S
Yoon et al. [11]	Japan	16/Male	Cystitis	Bladder neck rhabdomyosarcoma	CTX/SAM	Recovered	S	S	R	S	S	S
Chun et al. [12]	South Korea	18/Male	Neutropenic fever	B cell lymphoblastic lymphoma	FEP/TEC	Recovered	S	S	R	N/A	N/A	S
Gözmen et al. [13]	Turkey	0.9/N/A	Bacteraemia	Gastroenteritis	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nada et al. [14]	Saudi Arabia	1.25/Female	Central venous line exit site infection	Complicated meconium ileus, peritonitis, ileostomy	AMP/GEN/MTZ	Recovered	S	S	R	S	R	S
Österblad et al. [15]	Finland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Present case	Australia	8/Female	Peritonitis	Meckel's diverticulitis/perforation	LEX/MTZ/GEN	Recovered	S	N/A	R	S	S	N/A

N/A not available, AMC amoxicillin-clavulanic acid, AMK amikacin, AMP ampicillin, CAZ ceftazidime, CRO ceftriaxone, CTX cefotaxime, FEP cefepime, GEN gentamicin, GERD gastro-esophageal reflux disease, LEX cephalixin, MTZ metronidazole, SAM ampicillin-sulbactam, SXT trimethoprim-sulfamethoxazole, TEC teicoplanin, TZP piperacillin/tazobactam, UTI urinary tract infection, R resistant, S susceptible.

from the family. We also performed a systematic review of the English literature published between January 1988 and April 2018 according to the PRISMA guidelines. The following scientific databases were screened for relevant articles: PubMed, ScienceDirect, Scopus, Clinical Trials, The Cochrane Library, Database of Abstracts of Reviews of Effectiveness, IngentaConnect, OvidMedline, Turning Research into Practice (TRIP) database. A combination of the search terms were utilised: “*Raoultella planticola*”, “children” and “paediatrics”.

Selected studies included: case reports and retrospective/prospective case-series limited to a paediatric population ( $\leq 18$  years of age). Studies that contained data on both children and adult patients for which no clear distinction was possible were also excluded. A full text copy of each article was obtained for detailed review. References within the included articles were screened to identify additional relevant articles. The full text of the potentially eligible studies was obtained and assessed for eligibility by the two authors.

### Case report

An 8-year old girl presented to the emergency department with a 12-h history of acute and diffuse abdominal pain associated with multiple episodes of non-bilious vomiting. Her previous medical history was unremarkable. Documented clinical observations included a heart rate of 119bpm, a respiratory rate of 24bpm, and a temperature of 37.5 °C. Abdominal examination revealed a generalised tenderness with localised peritonitis in the right iliac fossa. Her full blood count analysis revealed a white cell count of  $24.0 \times 10^9/L$  (neutrophils  $21.88 \times 10^9/L$ , lymphocytes  $1.14 \times 10^9/L$ ) and a c-reactive protein of 14 mg/L. The urea, creatinine and electrolytes were all within normal range. A diagnosis of potential appendicitis was made, and the child therefore underwent a diagnostic laparoscopy. At surgery, turbid fluid was found in the peritoneal cavity with a macroscopically normal appendix. However, a perforated Meckel's diverticulum was identified at

40 cm from the ileocecal valve which was adherent to adjacent loops of intestine. This segment of ileum was exteriorized via the umbilical port incision with the perforated Meckel's being resected, and an end-to-end anastomosis was performed. Microbiological culture from the peritoneal fluid grew *R. planticola* resistant to amoxicillin. Her post-operative recovery was uncomplicated, and she was discharged after completing a 5 days course of intravenous antibiotic therapy. Oral trimethoprim-sulfamethoxazole therapy was then continued for further 5 days. The patient has remained asymptomatic and well at 6-month follow-up.

### Systematic review of the literature

A total of 418 abstracts were identified from the literature search. Of these 10 contained data on *R. planticola* infection in children and were therefore included in the final review together with our patient (Table 1). There were no recorded deaths. Most authors reported susceptibility to several antibiotics except for ampicillin. Associated medical conditions were present in 70% (7/10) patients.

### Discussion

This is the first documented case of *R. planticola* associated with a Meckel's diverticulum perforation and peritonitis in a child. Furthermore, to the best of our knowledge, it is the first documented case of *R. planticola* in child in Australia. *R. planticola* is a rare cause of clinical infection in adults and especially in children; however, it is estimated that up to 20% of the general population are colonized with *Raoultella species* [1].

In recent years, *R. planticola* has been recognized as an increasingly important pathogen having been associated with a variety of life-threatening infections such as; pancreatitis, peritonitis, septicaemia, necrotising fasciitis and frequently urinary tract infections in adults [1,5].

In our systematic review, we found 10 cases of different clinically relevant infections with *R. planticola* in the paediatric

population (Table 1). The majority (70%) of these patients had associated conditions and therefore potentially more vulnerable to opportunistic infection secondary to an altered immunity. Boattini et al. in their large series, documented a higher infection rate in immunocompromised patients, especially if affected by an underlying oncological diagnosis [5].

The mortality rate has been reported as high as 15.6%, especially in cases of polymicrobial infection [5]. However, no deaths have been reported in the paediatric population. This is likely related to the fact the bacterium is susceptible to a variety of different classes of antibiotics. Our systematic review has confirmed that *R. planticola* may be resistant to aminopenicillins in children, as previously reported in adults [3–5]. Therefore, with also the known similarities with *Klebsiella* spp., *Raoultella* spp. have the potential for multi-drug resistance and unnecessary use of broad-spectrum antibiotics should be avoided. We did not identify any cases of antibiotic resistance to amoxicillin-clavulanic acid. Therefore, we propose that in children, this could be the treatment of choice in uncomplicated cases. This is also recommended as there are readily available formulations of this antibiotic and it is easily tolerated using the oral formulation in children. However, due to the current limited evidence, it is difficult to make definitive recommendations, especially regarding the duration of the treatment.

In conclusion, we identified a small number of cases of *R. planticola* infection in children and no mortality. At present, in children, *R. planticola* presents good sensitivity to a variety of antibiotics, with the exception of ampicillin. It is also mainly diagnosed in children with co-morbidities in contrast to our case. Further studies are required to explain the mechanism of infections induced by *R. planticola*, its virulence and the actual role it plays in human infections, particularly in children.

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#### Competing interests

None declared.

#### Ethical approval

Not required.

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