2015

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IDCases 2 (2015) 97–98

Contents lists available at ScienceDirect

IDCases

journal homepage: www.elsevier.com/locate/idcr

Case Report

Bordetella petrii recovered from chronic pansinusitis in an adult with cystic fibrosis

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ARTICLE INFO

Article history:
Received 1 August 2015
Received in revised form 16 September 2015
Accepted 16 September 2015

Keywords:
Bordetella petrii
Pansinusitis
Adult cystic fibrosis
MALDI-TOF

ABSTRACT

To date *Bordetella petrii* has infrequently been identified within the clinical setting likely due to the asaccharolytic nature of this organism. We present a case of *B. petrii* recovered on two separate events in a patient with adult cystic fibrosis experiencing chronic pansinusitis.

Case report

We present a 41-year old female with a 20 plus year history of nasal obstruction and chronic sinusitis. Her clinical history indicated velopharyneal insufficiency (incomplete closure of the velopharyngeal sphincter between the oropharynx and the nasopharynx), severe gastroparesis, significant gastric reflux and asthma contributed to a confirmed cystic fibrosis mutation, ΔF508 gene. Individuals diagnosed with adult cystic fibrosis frequently experience gastroparesis, asthma and chronic sinusitis [1,2].

Historically, the patient underwent several surgical interventions, multiple rounds of antimicrobials, decongestants, antihistamines, topical and oral steroids without improvement of her diffuse pansinusitis. In an attempt to alleviate her chronic sinusitis, revision endoscopic sinus surgery with septoplasty and a turbinectomy was performed during early 2014 (day 0). A right maxillary sinus tissue specimen was sent for aerobic bacterial culture, which was incubated aerobically only with 5% CO_2 at 35 °C. The specimen Gram-stain showed few white-blood cells and no organisms. Twenty-four hours post-incubation, moderate growth of a tiny Gram-negative colony was noted on trypticase soy agar with 5% sheep blood (Becton, Dickinson and Company, Franklin Lakes, NJ). No other organisms were recovered. By 48 h, growth was noted on the MacConkey agar (Becton, Dickinson and Company, Franklin Lakes, NJ). The isolate was identified by the Bruker Biotyper MALDI-TOF MS system (Bruker Daltonics Inc., Billerica, MA) as *Bordetella petrii* (score 2.13; highly probable species identification). Since the organism had not been validated by this method, the isolate was tested by the Microscan NBPC30 panel for oxidase positive organisms (Siemens Medical Solutions USA, Inc., Malvern, PA) and the Remel RapID NF PLUS System (Thermo Fisher Scientific Remel Products, Lenexa, KS). The NBPC30 panel identified the organism as *Alcaligenes* species (00064326) 79.12%. The RapID system identified the organism as *Alcaligenes xylosoxidans* (210606) Implicit. Both *B. petrii* and *Alcaligenes* species are asachrolytic organisms and part of the *Alcaligenaceae* family [3]. The isolate exhibited the following phenotypic characteristics: non-motile; oxidase, catalase, and nitrate positive; urea negative; malate, tartrate and citrate positive, this phenotype is consistent throughout literature [3–6]. For more stringent confirmation, 16S rRNA sequencing was performed at ARUP laboratories and provided an identification of *B. petrii* (Salt Lake City, UT). No standard antibiotic susceptibility guidelines are defined for this organism; however, antimicrobial susceptibility test (AST) results for the two isolates are shown in Table 1 for epidemiologic strain differentiation.

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http://dx.doi.org/10.1016/j.idcr.2015.09.004

Table 1
Results of antimicrobial susceptibility testing for both isolate one and two.

Antimicrobial agent	Isolate one MIC (μg/mL)	Isolate two MIC (μg/mL)
Ampicillin	>16	>16
Ampicillin/sulbactam	16/8	16/8
Amikacin	≤16	≤16
Amoxicillin/K Clavulanate	≤8/4	≤8/4
Gentamicin	≥8	≤4
Imipenem	≤4	≤4
Levofloxacin	≤2	≤2
Ciprofloxacin	>2	>2
Moxifloxacin	4	4
Gatifloxacin	≤2	≤2
Norfloxacin	>8	>8
Piperacillin/tazobactam	≤16/4	≤16/4
Tetracycline	≤4	≤4
Ticarcillin/K clavulanate	≤16	≤16
Tobramycin	≤4	≤4
Trimethoprim/sulfamethoxazole	≥2/38	≤2/38
Aztreonam	>16	>16
Cefepime	>16	>16
Cefuroxime	>16	>16
Cefazolin	>16	>16
Cephalothin	>16	>16
Cefoxitin	>16	>16
Cefotetan	>32	>32
Cefotaxime	>32	>32
Ceftazidime	≤8	>16
Ceftriaxone	>32	>32
Meropenem	>8	>8
Chloramphenicol	>16	>16
Meropenem	≤4	≤4
Piperacillin	≤16	≤16
Nitrofurantoin	>64	>64

Microscan NBPC30 for oxidase positive Gram-negative bacteria.

The patient was not treated specifically for *B. petrii* as improvement was noted with the standard post-operative antimicrobial regime of various corticosteroids, oral erythromycin (250 mg/mL, four times a day) and oral cefdinir (300 mg, every 12 h for 10 days). Based on the AST profile of the isolate (Table 1), particularly ceftriaxone and cefotaxime with minimal inhibitory concentrations (MICs) >32 mg/mL, one would expect the organism to be resistant to cefdinir, another 3rd generation cephalosporin. Erythromycin was not tested for this isolate but other studies have shown resistance toward 3rd generation cephalosporins and also toward erythromycin [4,7,8]. One study indicated that piperacillin-tazobactam is the only effective treatment for *B. petrii* [7].

At outpatient follow-up (29 days post-procedure), she underwent endoscopy with collection of a second sinus culture via flocked swab. The direct Gram-stain of the sinus specimen showed few white-blood cells and no organisms. Again, moderate growth of *B. petrii* (MALDI-TOF score 2.00; secure genus identification, probable species identification) occurred, indicating that the initial post-operative antimicrobial therapy did not eradicate *B. petrii*. There was very light growth of normal respiratory flora.

Discussion

There are nine different *Bordetella* species of these *B. petrii* is the only species that does not exhibit a human host tissue tropism [4,6]. This species was first identified in 2001 after isolation from an anaerobic bioreactor enriched with river sediment [6]. Clinically, *B. petrii* has rarely been isolated from clinical specimens and has not been well described as a pathogen. This is likely due to the asacchrolytic nature of the organism in addition to the *B. petrii* not being contained in most automated identification system libraries. There has been a limited number of case reports with *B. petrii* defined as the etiologic agent [4,5,7–10]. *B. petrii* has been implicated as the causative agent in cases of mandibular osteomyelitis, chronic suppurative mastoiditis, chronic pulmonary obstructive disease and persistent bronchiectasis [4,8–10]. Importantly, it has been previously isolated from in cystic fibrosis patients [5,7].

Because it is uncommon, or likely misidentified, accurate identification of *B. petrii* represents a challenge for traditional automated identification systems. These biochemical or enzymatic systems are only marginally effective, due to the lack of a distinct biochemical carbohydrate profile as well as limited or uncurated databases. Not only was *B. petrii* mis-identified by MicroScan (NBPC30) and rapID panels in the two described occasions for this patient, but it was also misidentified in other reported cases [10]. Studies show that *Bordetella* species are closely related to *Achromobacter* (*Algaligenes*) species [6,11]. The case patient had two sinus isolates identified three years prior as *Achromobacter* species (90%) by the BD Phoenix NMIC/ID-124 panel (Becton-Dickinson, Sparks, MD). Unfortunately, these isolates are no longer available to determine if they were misidentified. The gold standard method for identification of *B. petrii* is 16S rRNA sequencing [4,8,10]. At that time the patient was treated post-operatively with 1000 mg of cefazolin (MIC > 16 mg/mL), indicating inadequate coverage.

The importance of *B. petrii* as a clinical pathogen has not been well established; however, it has been described in cystic fibrosis patients [1,2,5,7]. *B. petrii* has been demonstrated to persist despite treatment in patients, as was potentially noted with her previous isolates of *Achromobacter* species [7,10]. By using the MALDI-TOF methodology the clinical laboratory can achieve not only quicker but more accurate organism identifications. More accurate identification can lead to more appropriate treatment and provide insight into the true clinical prevalence of organisms like *B. petrii*, which have been shown to be resilient colonizers especially within cystic fibrosis patients [7,10].

Acknowledgements

No conflicts of interest. No grant funding was utilized for this publication.

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