Mixed Infections of the Paronychium with *Prevotella bivia*

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Introduction

We encountered and treated two cases of *Prevotella bivia* in mixed aerobic/anaerobic paronychia within a period of 1 year. Upon reviewing the literature, we found a dearth of both experimental and anecdotal evidence of this specific bacterial infection, with only one case of *P. bivia* in the hand having been reported [1].

The most prevalent pathogen in acute paronychia is *Staphylococcus aureus*, which is the causative bacterium in 50 to 80% of cases [2–4]. However, anaerobic infections,

especially mixed aerobic/anaerobic infections, are becoming increasingly common [1, 5–7]. Mixed infections, not uncommon in paronychia, provide a fertile environment for the exchange of genetic material, thus increasing both the severity of infection and the chance of developing bacterial resistance [8–10]. Gram-negative anaerobes, which have been proven to induce a pro-inflammatory response, are normally the anaerobes involved in these mixed infections [2, 5, 7, 10, 11].

P. bivia is an anaerobic, non-pigmented, Gram-negative bacillus species which naturally thrives in the human female vaginal tract and occasionally is found in the oral flora [1, 5, 12, 13]. Due to its ability to grow abundantly in the presence of estrogen, *P. bivia* is traditionally implicated in vaginal tract infections such as endometritis and pelvic inflammatory disease [5, 13]. However, *P. bivia* has also been found in rare locations such as the nail bed, chest wall, intervertebral discs, and even the hip and knee joints [5, 10, 14–16]. If left untreated, it may lead to more serious conditions, including necrotizing fasciitis, osteomyelitis, or septic arthritis [12, 17–20].

In recent reports, the general consensus for treating paronychial infections has been broad spectrum antibiotics such as oral amoxicillin/clavulanate or oral clindamycin [2, 11, 21]. These choices are intended to provide broad coverage of both aerobic and anaerobic species, regardless of susceptibility testing. The challenging aspect of mixed infections is that susceptibility testing for anaerobes is not well standardized [22]. Also, some *P. bivia* strains have actually shown resistance to broad spectrum antibiotics such as clindamycin [9]. Thus, confusion still exists over how to treat these infections. The following cases shed

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some light on how the aerobic pathogen may be a new target for treating these mixed infections.

Case Synopses

Case 1

A 17 year old, right-handed, Dominican female reported a history of onychophagia and pain around the nail of the right thumb at a level of 5/10 on the visual analog scale. The patient also endured swelling, redness, and discharge from the radial side of the right thumb for a few days before presentation to the office. Prior to admission for this ailment, the patient did not have any history of injury to the right hand. Physical examination revealed swelling and moderate tenderness of the right thumb and paronychia tissue, mainly along the radial sulcus. Standard anterior-posterior and lateral radiographs of the hand and finger were performed, but nothing abnormal was noted. Neither lymphangitis nor lymphadenopathy was found. Based on these findings, the patient was diagnosed with an acute paronychia infection of the right thumb.

Incision and drainage was performed the following day on an out-patient basis with partial excision of the nail; aerobic and anaerobic pathogenic cultures were taken. The patient was given intra-operative oral cefazolin, per facility protocol, and prescribed a postoperative course of oral ciprofloxacin by the surgeon. It is our feeling that the regimen should have been consistent, but miscommunication caused the difference in treatment. One week postoperatively, the lab report indicated the presence of heavy growth of *S. aureus* and *P. bivia* from the wound. The Gram-stain confirmed this finding, revealing Gram-positive cocci bacteria. The *S. aureus* was found to be methicillin sensitive, and the *P. bivia* was found to be Beta-lactamase positive, but no other susceptibility tests were performed. Due to consistent clinical improvement, the antibiotic course of ciprofloxacin was continued despite lack of sensitivity data for *P. bivia*.

At 1 week postoperatively, the dressing was removed. Although there were no signs or symptoms of infection, the patient was instructed to continue antibiotic therapy, and to perform daily Hibiclens and normal saline soaks at home. At 3 weeks, the patient was still asymptomatic and antibiotic therapy was discontinued. At 5 weeks, the office visit was uneventful and the incision was completely healed. The patient was discharged.

Case 2

A 55 year old Caucasian female presented with complaints of a week's duration of pain and swelling in the left thumb. She was seen by her primary care physician 2 days prior

and was prescribed a course of oral ciprofloxacin at that time. The patient reported an allergy to penicillin. Physical examination revealed visible swelling, mild erythema around the dorsal nail fold, and some discoloration under the nail plate. Standard anterior-posterior and lateral radiographs of the hand and finger revealed normal bony alignment and no signs of bone pathology. No other abnormalities or pathologies were found. She had tenderness about the thumb, most specifically over the dorsal nail fold and nail plate. Based on the above findings, the patient was diagnosed with acute left thumb eponychia, with a possible superimposed felon of the left thumb. The patient was indicated for surgical drainage and partial excision of the fingernail.

Two days after the office visit, the patient was admitted for surgery on an out-patient basis. First, the nail was removed and the space drained, after which the pulp was explored. There was no felon. Aerobic and anaerobic cultures were taken, and the patient's antibiotic regimen was switched to oral clindamycin for added coverage due to fear of resistance to ciprofloxacin. Six days postoperatively, the lab reported that there was moderate growth of *Enterococcus* species and light growth of *Pseudomonas aeruginosa*. Normal saprophytic flora was also present. The *P. aeruginosa* was found to be resistant to ceftazidime, and piperacillin/tazobactam. This organism was found to be sensitive to ciprofloxacin, and the patient was switched back to this antibiotic. Clindamycin was not included in this lab report. Eleven days postoperatively, a second lab report indicated that there was also moderate growth of *P. melaninogenica* and heavy growth of *P. bivia* in the thumbnail bed. In mixed cultures, additional anaerobes were present in small concentrations. Both the *P. bivia* and *P. melaninogenica* were found to be Beta-lactamase positive, but no other susceptibility tests were performed. At this point, the patient's infection was resolved, and no new antibiotics were prescribed or changed; the patient was instructed to finish the oral ciprofloxacin prescription.

The patient was seen at one and three weeks postoperatively. On examination, the incisions appeared well-healed, with no signs of drainage, and the erythema present around the thumb had largely abated. At 3 weeks, ciprofloxacin therapy was discontinued and the patient was instructed to follow-up on an "as needed" basis.

Discussion

Infections of the paronychia are often found in nail biters due to the direct inoculation of mouth flora by sucking or biting, which is thought to be the cause of most pediatric nail infections [2, 5, 18]. A recent study found *P. bivia* to be present in dental plaque [12]. The oral cavity was most likely the source of bacteria in the first case above.

In the last decade, there has been an increased awareness of anaerobic, Gram-negative musculoskeletal infections, including an increased incidence in the hand [1, 4, 7]. In most cases of mixed infections, anaerobes outnumbered aerobes in the various sites observed [18]. It has been noted that combination aerobic and anaerobic infections may create a synergistic effect: the presence of aerobes in unison with *P. bivia* is known to elevate the pathogenicity of the *Prevotella* strain, allowing it to become the dominant strain eventually [5, 12, 14]. Mikamo et al. found that when *P. bivia* was the sole bacterium at the wound site, no infection developed; however, when there was another bacterial strain present in addition to *P. bivia*, there was a 100% infection rate [13]. The patients in both of our cases showed a dual infection; therefore we surmise that this may have led to the clinical infections presented. The only other reported case of *P. bivia* in the hand, which resulted in osteomyelitis and digital amputation, also presented with a dual infection [1].

Like its precise mechanism of pathogenicity, there is no consensus for the optimal antibiotic treatment of *P. bivia* infections [5, 22]. Anaerobes are naturally resistant to both aminoglycosides and older fluoroquinolones [9]. In addition, most *P. bivia* strains are β -lactamase positive. Several studies have suggested that clindamycin, amoxicillin/clavulanate, metronidazole, and imipenem are all effective against *P. bivia* [1, 5]. Most practitioners also recommend that paronychia of any kind be treated with oral amoxicillin/clavulanate or oral clindamycin, regardless of the causative bacteria [2, 11, 22]. In the absence of culture results, clindamycin is an especially safe empiric choice due to its additional effectiveness against methicillin-resistant *Staphylococcus aureus* (MRSA), which has also seen a rise in incidence in the hand [16, 23, 24].

With these recommendations in mind, it is puzzling to the authors why our cases resolved when *P. bivia* is resistant to ciprofloxacin. We surmise that the antibiotic used in our cases acted on the aerobic species and indirectly caused a resolution of all symptoms. Based on the limited studies available on the pathogenicity of *P. bivia* and other anaerobes, it seems plausible that the ciprofloxacin could have destroyed the aerobic colonies, thereby leaving the *P. bivia* inert and unworthy of further antibiotic intervention [5, 12, 13]. Due to the time lag in anaerobic culturing and

the lack of routine susceptibility testing on anaerobic strains, the most rapid and effective way to treat these mixed infections may be to prescribe aerobic specific antibiotic therapy and indirectly prevent *P. bivia* from thriving. Although one might argue that the use of broad spectrum antibiotics immediately after surgery is still the safest treatment choice for addressing the anaerobic species, it may not always be the best choice for the aerobic species. In our second case, we originally chose clindamycin, as the literature recommended, only to find that our aerobic species *P. aeruginosa* was not sensitive to clindamycin.

The three objective, lab-based criteria used to select an appropriate antibiotic have traditionally been: Gram-stain, culturing, and susceptibility testing [25–27]. It is quite expensive to test the sensitivity of Gram-negative anaerobes, and for that reason it is not routinely done [9, 22]. In the only other noted case of paronychia caused by *P. bivia*, susceptibility testing was not performed until after the third office visit and the second microbial culture [1]. The patient in that report also presented with a mixed infection of a beta-hemolytic streptococci species and *P. bivia* which was initially treated with the aerobic focused antibiotic flucloxacillin (Table 1). The infection subsequently worsened, susceptibility testing was finally done, anaerobic sensitive antibiotics were implemented (i.e. metronidazole), but, unfortunately, it was too late and amputation was necessary. The authors concluded that earlier susceptibility testing may have decreased morbidity in their case. It should also be noted that their patient suffered from non-insulin-dependent diabetes mellitus which may have affected healing. In our cases, there was no susceptibility testing done, as the testing lab does not routinely perform such procedures on gram-negative anaerobes such as *P. bivia*. Keeping all this in mind, future studies examining more cost-effective means of anaerobic susceptibility testing may be beneficial. Until that is achievable, our cases show that successful outcomes are still possible without susceptibility testing.

Conclusion

Although *P. bivia* is a rare infectious agent, it is important for the surgeon to be aware of it in his or her treatment

Table 1 Comparison of paronychial infections with *P. bivia*

Authors	Age	Gender	Initial Antibiotic Treatment	Secondary Antibiotic Treatment	Duration	Outcome
Mirza et al., 2012	17	female	oral ciprofloxacin	N/A	3 weeks	Resolved
Mirza et al., 2012	55	female	oral ciprofloxacin ^a	oral ciprofloxacin	3 weeks	Resolved
Riesbeck, 2003	45	male	oral flucloxacillin ^b	intravenous cefuroxime & metronidazole	1 week	Amputation

^a Pt was switched to oral clindamycin post -op for added coverage/fear of resistance only to switch back to cipro once sensitivities returned

^b Pt was switched to oral clindamycin post -amputation for an additional 4 weeks

protocol. If there is a history of contact of the infected area with an endogenous mucosal membrane, it is important to take anaerobic cultures. If cultures are positive for anaerobic Gram-negative rods and timely, cost-effective susceptibility testing is available, it should always be done as a precaution. Although the literature suggests the use of broad spectrum antibiotics such as oral clindamycin or amoxicillin/clavulanate, our cases are evidence that this is not always necessary. Timely administration of aerobic specific antibiotics may give the patient the best chance at a positive outcome.

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