

[ CASE REPORT ]

## Trauma Wound Related Infection Caused by *Enterobacter cancerogenus* and *Aeromonas hydrophila*

Yoshiro Hadano<sup>1</sup>, Keiichi Tamagawa<sup>2</sup> and Kiyofumi Ohkusu<sup>3</sup>

### Abstract:

We herein describe a case of trauma-related wound infection with a subcutaneous abscess caused by both *Enterobacter cancerogenus* and *Aeromonas hydrophila*. An 89-year-old Japanese man was admitted to our hospital because of an injury that he had suffered in a car accident. The right dorsal region of the foot around the wound was reddish and swelling. The pus culture on his right foot grew *E. cancerogenus* and *A. hydrophila*. The patient was successfully treated with a 10-day course of meropenem and a 25-day course of levofloxacin. *E. cancerogenus* can therefore be a causative pathogen in skin and soft tissue infections among trauma patients.

**Key words:** *Enterobacter cancerogenus*, trauma, skin and soft tissue infection

(Intern Med 57: 131-133, 2018)

(DOI: 10.2169/internalmedicine.9171-17)

### Introduction

*Enterobacter cancerogenus*, previously known as *Enterobacter taylorae*, is a facultative anaerobic gram-negative bacteria, which can be isolated from the environment (1). Although this organism can cause bone and joint infections after environmental exposure, such as either a crash injury or laceration, human infections caused by *E. cancerogenus* are rare (2-4). No cases of a wound infection associated with *E. cancerogenus* have yet been reported in Japan. In this article, we report a case of trauma wound-related infection with a subcutaneous abscess caused by both *E. cancerogenus* and *Aeromonas hydrophila*.

### Case Report

An 89-year-old Japanese man with chronic kidney disease and polymyalgia rheumatica was admitted to our hospital because of an injury that he had suffered in a car accident. He was hit by a light truck while he was walking a street running through a rice field. He fell into a dirty adjacent waterway next to a rice field after the car accident. He was initially taken to one hospital by ambulance, and later trans-

ferred to our hospital about 3 hours after the injury because of multiple wounds. His medications included prednisolone 2 mg/day and lansoprazole 15 mg/day.

On physical examination, the patient was 163 centimeters tall and his weight was 48 kilograms. His blood pressure was 181/89 mm Hg, pulse rate was 94 beats per minute, temperature was 35.9°C, respiratory rate was 24 breaths per minute, and his peripheral arterial oxygen saturation was 95%. His Glasgow Coma Scale score was evaluated as E4, V5, and M6. His physical examination was unremarkable, except for multiple superficial abrasions and a wound in the interdigital area between third and fourth toes, as well as between the fourth and fifth toes of the right foot. The wounds were superficial and measured 2.0 cm in diameter each.

Laboratory data obtained on admission revealed a white blood cell (WBC) count of 25,090/μL with 91% neutrophils, 4% lymphocytes, and 4% monocytes. The hemoglobin level was 10.3 mg/dL, and the platelet count was 214,000/μL. A serum chemistry analysis revealed the following results: sodium 139 mEq/L, potassium 5.5 mEq/L, chloride 104 mEq/L, blood urea nitrogen 35.6 mg/dL, creatinine 1.3 mg/dL, glucose 111 mg/dL, albumin 3.4 g/dL, total protein 6.4 g/dL, aspartate aminotransferase (AST) 45 IU/L, alanine aminotransferase (ALT) 26 IU/L, lactate dehydrogenase 353

<sup>1</sup>Division of Infectious Diseases, St. Mary's Hospital, Japan, <sup>2</sup>Division of Plastic Surgery, St. Mary's Hospital, Japan and <sup>3</sup>Department of Microbiology, Tokyo Medical University, Japan

Received: March 13, 2017; Accepted: April 30, 2017; Advance Publication by J-STAGE: October 16, 2017

Correspondence to Dr. Yoshiro Hadano, hatayoshiyoshi@gmail.com



**Figure.** Dorsal region of the right foot on day 3.

IU/L, alkaline phosphatase 218 U/L, total bilirubin 0.5 mg/dL, C-reactive protein 0.4 mg/dL, and HbA1c 5.8%. A urinalysis revealed no abnormalities.

After an initial work up in the emergency room, his primary diagnosis was multiple bruises with a laceration on the interdigital regions between the third and fourth toes, as well as between the fourth and fifth toes of the right foot. Tetanus toxoid-containing vaccine and tetanus immune globulin were thus administered. The patient was started on intravenous cefazolin with 1 g administered every 12 hours.

The interdigital region of the right foot wounds was closed after wound debridement and irrigation, and his clinical course seemed to go well. However, on day 3, he developed a fever. On physical examination, the right dorsal region of the foot around the wound was reddish and swelling (Figure). The wound was therefore re-opened, and a moderate amount of pus was drained. Osteomyelitis was clinically ruled out. The patient was then started on intravenous meropenem with 1 g administered every 12 hours empirically based on the diagnosis of cellulitis with a subcutaneous abscess. His blood culture was negative. The pus culture on his right foot grew *E. cancerogenus* and *A. hydrophila*. Identification of the bacterial species was performed with the MicroScan WalkAway 40 plus system (Siemens Healthcare Diagnostics, Tokyo, Japan), and the bacterium was classified as *E. cancerogenus* at a probability level of 99.9%.

In addition, we performed molecular identification by polymerase chain reaction (PCR) amplification and a sequencing analysis of the 16S rRNA gene using DNA extracted from the isolates. The universal primers 8UA (5'-AGAGTTT GATCMTGGCTCAG-3') and 1485B (5'-ACGGGCGGTGT GTRC-3') were used as described previously (5). A sequencing analysis was performed using a GenBank Basic Local Alignment Search Tool (BLAST) search and EzTaxon (<http://www.ezbiocloud.net/taxonomy>). The bacterial strain was identified as *E. cancerogenus* according to sequencing analysis of the 16S rRNA gene using DNA extracted from the isolates. The sequence of the 16S rRNA gene was 99.86% identical (1,408 bp over the entire 1,411 bp fragment) with that of the type strain *E. cancerogenus* (LMG2693, accession number Z96078). The isolates of *E. cancerogenus* exhibited susceptibility to piperacillin, piperacillin/tazobactam, ceftazidime, cefepime, meropenem, gentamicin,

levofloxacin, minocycline, and trimethoprim/sulfamethoxazole. However, the isolate from our patient was resistant to ceftriaxone.

On day 13, the patient was switched to treatment with levofloxacin based on the findings of the susceptibility test. The patient was successfully treated with a 10-day course of meropenem and a 25-day course of levofloxacin. No evidence of any infection relapse was noted at the 2-month follow-up.

## Discussion

We herein describe a case of trauma wound-related cellulitis with a subcutaneous abscess caused by both *E. cancerogenus* and *A. hydrophila*. To date, nineteen species in this genus have been identified, including *Enterobacter cloacae* and *Enterobacter aerogenes*, which are common organisms isolated from humans (6). In contrast, the other species are mostly isolated from environmental sources (1). *E. cancerogenus* has a DNA sequence homology of 61% to that of *E. cloacae* and it differs from it mostly by being ornithine decarboxylase negative and D-arabinose positive (3). *E. cancerogenus* is rarely recognized, but it is associated with human infections. Approximately 1% of *Enterobacter* infections are due to *E. cancerogenus* (4), and these infections seem to occur mostly in the setting of contaminated wounds, as in the present case. A previous case series from the United States showed 59 percent of all published cases of *E. cancerogenus* have been secondary to trauma, and the mortality rate was 11% (4). It is possible that the actual mortality rate caused by *E. cancerogenus* infection is lower because the mortality rate may be more closely related to the trauma itself rather than to the resulting *E. cancerogenus* infection. In addition, there have been case reports of *E. cancerogenus* causing osteomyelitis (3) bacteremia (7), urinary tract infection (8), and pneumonia (9). The pathogenicity of this organism remains unknown, therefore, further studies are needed to clarify the clinical characteristics of infections due to *E. cancerogenus*. Based on a previous study, *E. cancerogenus* is naturally resistant to amoxicillin, amoxicillin/clavulanic acid, cefaclor, cefazoline, and ceftiofex (10). In general, the  $\beta$ -lactam sensitivity of *E. cancerogenus* seems to be similar to that of other common *Enterobacter* species, such as *E. cloacae* and *E. aerogenes* (10). In the present case, the pattern of antibiotic susceptibility was similar to that described in previous reports.

The Aeromonads are Gram-negative, non acid-fast facultative anaerobes that are widely distributed in the soil and in aquatic environments (11). *Aeromonas* infection is also associated with both skin and soft tissue infections, especially wound infections (12). In the present case, the patient had a history of contact after falling into a dirty waterway after a car crash injury. Major traumatic events, such as car or motorcycle accidents, also can lead to severe infections (13). Although the typical presentation is cellulitis, the disease pattern can vary from an uncomplicated wound infection to

severe soft tissue infections, including myonecrosis and necrotizing fasciitis. In addition, fatal *Aeromonas* infections are often seen in patients with either liver diseases or malignancy (11, 12).

In conclusion, we herein reported a case of *E. cancerogenus* and *A. hydrophila* infection associated with trauma wound-related cellulitis and the development of a subcutaneous abscess. This is the first case report of a skin and soft tissue infection caused by *E. cancerogenus* in Japan. In addition to *A. hydrophila*, *E. cancerogenus* can be a causative pathogen in skin and soft tissue infections among trauma patients. *E. cancerogenus* may therefore be a more important human pathogen than previously thought. Further studies are needed to elucidate the typical characteristics of this infection.

**The authors state that they have no Conflict of Interest (COI).**

## References

- Dickey RS, Zummoff CH. Emended Description of *Enterobacter cancerogenus* comb. nov. (Formerly *Erwinia cancerogena*). *Int J Syst Evol Microbiol* **38**: 371-374, 1988.
- Abbott SL, Janda JM. *Enterobacter cancerogenus* (“*Enterobacter taylorae*”) infections associated with severe trauma or crush injuries. *Am J Clin Pathol* **107**: 359-361, 1997.
- Garazzino S, Aprato A, Maiello A, et al. Osteomyelitis caused by *Enterobacter cancerogenus* infection following a traumatic injury: case report and review of the literature. *J Clin Microbiol* **43**: 1459-1461, 2005.
- Hall AB, Dukes A, Anderson J. *Enterobacter cancerogenus* in trauma. *Am Surg* **78**: 1016-1018, 2012.
- Masaki T, Ohkusu K, Ezaki T, Miyamoto H. Nocardia elegans infection involving purulent arthritis in humans. *J Infect Chemother* **18**: 386-389, 2012.
- Brady C, Cleenwerck I, Venter S, Coutinho T, De Vos P. Taxonomic evaluation of the genus *Enterobacter* based on multilocus sequence analysis (MLSA): Proposal to reclassify *E. nimipressuralis* and *E. amnigenus* into *Lelliottia* gen. nov. as *Lelliottia nimipressuralis* comb. nov. and *Lelliottia amnigena* comb. nov., respectively, *E. gergoviae* and *E. pyrinus* into *Pluralibacter* gen. nov. as *Pluralibacter gergoviae* comb. nov. and *Pluralibacter pyrinus* comb. nov., respectively, *E. cowanii*, *E. radicincitans*, *E. oryzae* and *E. arachidis* into *Kosakonia* gen. nov. as *Kosakonia cowanii* comb. nov., *Kosakonia radicincitans* comb. nov., *Kosakonia oryzae* comb. nov. and *Kosakonia arachidis* comb. nov., respectively, and *E. turicensis*, *E. helveticus* and *E. pulveris* into *Cronobacter* as *Cronobacter zurichensis* nom. nov., *Cronobacter helveticus* comb. nov. and *Cronobacter pulveris* comb. nov., respectively, and emended description of the genera *Enterobacter* and *Cronobacter*. *Syst Appl Microbiol* **36**: 309-319, 2013.
- Bowles DW, Truesdale AE, Levi M, Trotter JF. *Enterobacter cancerogenus* bacteremia in a patient with poor dentition, cirrhosis, and a variceal bleed. *J Clin Gastroenterol* **40**: 456-457, 2006.
- Rubinstien EM, Klevjer-Anderson P, Smith CA, et al. *Enterobacter taylorae*, a new opportunistic pathogen: report of four cases. *J Clin Microbiol* **31**: 249-254, 1993.
- Demir T, Baran G, Buyukguclu T, Drouin MT, Patterson JE. Pneumonia due to *Enterobacter cancerogenus* infection. *Folia Microbiol (Praha)* **59**: 527-530, 2014.
- Stock I, Wiedemann B. Natural antibiotic susceptibility of *Enterobacter amnigenus*, *Enterobacter cancerogenus*, *Enterobacter gergoviae* and *Enterobacter sakazakii* strains. *Clin Microbiol Infect* **8**: 564-578, 2002.
- Janda JM, Abbott SL. The genus *Aeromonas*: taxonomy, pathogenicity, and infection. *Clin Microbiol Rev* **23**: 35-73, 2010.
- Parker JL, Shaw JG. *Aeromonas* spp. clinical microbiology and disease. *J Infect* **62**: 109-118, 2011.
- Monaghan SF, Anjaria D, Mohr A, Livingston DH. Necrotizing fasciitis and sepsis caused by *Aeromonas hydrophila* after crush injury of the lower extremity. *Surg Infect (Larchmt)* **9**: 459-467, 2008.

The Internal Medicine is an Open Access article distributed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. To view the details of this license, please visit (<https://creativecommons.org/licenses/by-nc-nd/4.0/>).