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Single Case

Genetically Confirmed *Edwardsiella tarda* Peritonitis was Associated with Improper Caregiver's Hand Hygiene during Peritoneal Dialysis Bag Exchange

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Keywords
Edwardsiella tarda · Peritonitis · Touch contamination · Hand hygiene

Abstract
Edwardsiella tarda is a Gram-negative bacillus and is responsible for waterborne disease. This is the first case report of peritoneal dialysis (PD)-associated peritonitis caused by genetically confirmed *E. tarda*, which was transmitted from the caregiver's hand during PD bag exchange. Aside from that, the caregiver was a fishmonger and a gastrointestinal carrier of the pathogen. Prior to the onset of peritonitis, the caregiver reported that she did not wash her hands every time when performing the PD bag exchange. Although extraintestinal edwardsiellosis usually poses a poor outcome, PD-associated peritonitis with this species is paradoxical if diagnosed early, and treatment is promptly provided, as presented here. This case emphasizes the importance of hand hygiene in preventing environment-bound infection in patients on PD and demonstrates the unusual route of infection, contamination during PD bag exchange.

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Introduction

Peritoneal dialysis (PD)-associated peritonitis remains the leading cause of hemodialysis transfer and patient death [1]. Identification of the causative microorganism is critical in guiding antimicrobial treatment and optimizing treatment outcomes. *Edwardsiella tarda* is a member of the Enterobacteriaceae family, and infection with this organism is classified as a waterborne illness [2]. Although edwardsiellosis is rare, yet it can cause severe disease and death [3]. Generally, the infected patients present with gastroenteritis after consumption of raw or undercooked aquatic animals [4]. Extraintestinal infections, albeit uncommon, including endocarditis, aneurysm, hepatobiliary infections, intra-abdominal abscesses, osteomyelitis, wound infections, and meningitis, are frequently accompanied by bacteremia (32%) and have a fatal outcome (40%) [4]. Although PD-associated peritonitis caused by this organism is classified as an extraintestinal infection, the prognosis is obscure due to limited information. As far as we know, there was only a single case who had peritonitis and had an excellent clinical outcome after treatment; however, there were no details regarding the manifestation of the infection, microbiological isolation technique used, and route of infection [3]. We, therefore, reported our first case who had genetically confirmed *E. tarda* peritonitis as well as proposed a new route of entry of the pathogen and a properly taxonomic confirmation of *Edwardsiella* isolation.

Case Report/Case Presentation

An 80-year-old Thai diabetic woman on continuous ambulatory PD (1.5% dextrose, 2L × 4 exchanges daily) for 3 years with caregiver-assisted exchanges presented to the Sawanpracharak Hospital with turbid PD effluent (PDE) and constant abdominal pain without diarrhea for 3 days. She had no history of peritonitis, adequate solute clearances, and a high-average transporter based on a peritoneal equilibration test. Her physical examinations revealed afebrile, mild pale conjunctivae, diffuse abdominal tenderness, and normal catheter exit site. The other characteristics from the physical examination were unremarkable. Her laboratory results revealed that she had mild anemia (a hemoglobin level of 9.9 g/dL while having a regular administration of alpha-erythropoietin at a dosage of 4,000 U × 2 times/week), leukopenia (leukocyte count of 2,600 × 10^6/L of which 75% were neutrophils and 15% were lymphocytes), and hyperglycemia (fasting blood sugar of 415 mg/dL).

PDE examination on day 0 confirmed a diagnosis of peritonitis (a leukocyte count of 2,438/μL of which 94% were neutrophils). PDE Gram stain revealed no organism. Cream-colored colonies were detected on blood and chocolate agars after 24-h incubation (Fig. 1a, b). The organisms harvested from the agar plates and broths were identified as *E. tarda* using the API20c AUX kit (bioM'erieux, Marcy l'Etoile, France) on day +3 and confirmed by DNA sequencing of the 16S rDNA and *gyrB* genes. The pathogen was susceptible to cefazolin, ceftriaxone, ceftazidime, gentamicin, and ofloxacin. Empirical antibiotic with cefazolin 1 g/day was started intraperitoneally (IP) on day 0 and continued for 3 weeks. On day +21, the follow-up PDE revealed 0 cell count, and the peripheral blood leukocyte count bounced back to 6,000 cell/μL. There was no relapse or recurrent peritonitis after 6 months of follow-up.

To identify the etiology of the infection, the attending physician performed a root-cause analysis. The patient was a strict vegetarian. Recently, she did not have any direct contact or exposure to aquatic animals and natural water sources. Since her daughter was a fishmonger and her caregiver who exchanged her PD bags and dressed the exit site, thus the investigations were then focused on to her caregiver. The caregiver was well and did not have any gastrointestinal (GI) symptoms. The caregiver disclosed that prior to the infection episode, the caregiver did not wash her hands properly when performing the PD bag exchange.

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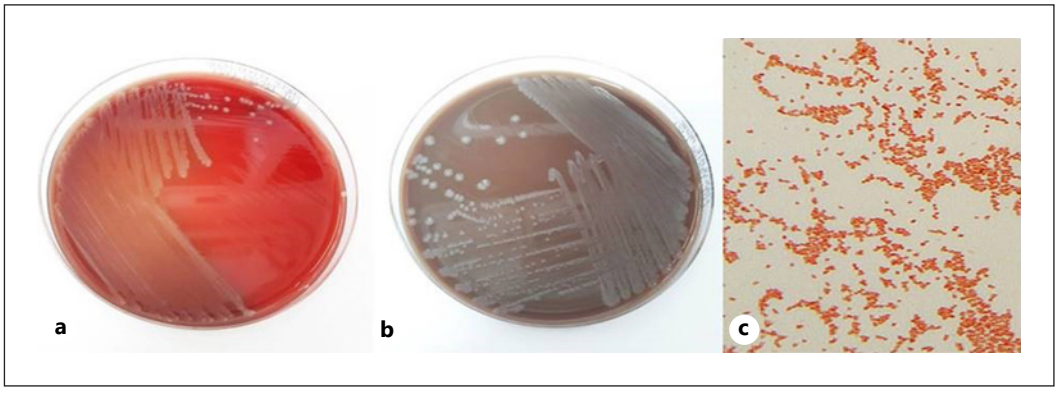

Fig. 1. *Edwardsiella tarda*, which grow on blood agar (**a**) and chocolate agar (**b**), are Gram-negative coccobacilli (**c**).

Multiple stools and nail dirt samples were collected from both the patient and her caregiver. These samples were inoculated into bacterial broths. Only *E. tarda* was isolated from her caregiver's stool sample. Therefore, it was concluded that the GI colonization was by *E. tarda* which was acquired from her caregiver who had inadequate hand hygiene practice. Poor hand hygiene is the most likely source of the infection. As a result, we retrained the caregiver on the aseptic technique and emphasized the importance of having good hand hygiene.

Discussion/Conclusion

Cloudy effluent and elevated levels of neutrophils in PDE are hallmarks in diagnosing PD-associated peritonitis and should be promptly managed to avoid poor outcomes. Identifying the organisms and analyzing their antimicrobial susceptibilities can guide the physician to select the most appropriate antimicrobial treatment for the patient. Additionally, the type of organism frequently indicates the possible source of infection, and this information can help the patient avoid these matters to prevent recurrence of peritonitis. Herein, we report a case of peritonitis due to genetically confirmed *E. tarda* with transient leukopenia. After a 3-week course of intraperitoneal antibiotics, the patient recovered from the infection. The suspected source of infection was her caregiver's improper hand hygiene when exchanging the PD bag. Her caregiver was a fishmonger and an asymptomatic GI carrier of the pathogen.

E. tarda is a motile, facultatively anaerobic, and Gram-negative rod bacterium (Fig. 1c) [2]. The infection caused by this organism is classified as a waterborne disease. Other bacteria causing waterborne-related infections include *Mycobacterium marinum*, *Aeromonas* spp., *Erysipelothrix rhusiopathiae*, *Shewanella* spp., and *Vibrio vulnificus* [4, 5]. Reservoirs of *E. tarda* are aquatic animals that live in fresh or brackish water environments (such as river mouths) such as fish (eel, flounder, catfish, largemouth bass, and rainbow trout), cockles, reptiles, turtles, and alligators [6]. Human infections with *E. tarda* are more common in tropical and subtropical areas, and infected people usually present with gastroenteritis [3]. Extraintestinal infection frequently manifests in patients with hepatobiliary tract diseases and increases the likelihood of poor outcomes [3]. The most common extraintestinal tract infections are hepatobiliary tract infection (41%), followed by wound infection (18%) and sepsis without organ-specific infection (18%) [3]. Previously, there was a case report of a PD patient with *E. tarda* peritonitis; however, it was reported as part of a case series of 22 patients that presented with extraintestinal infection. Hence, there was limited information available on the patient with

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E. tarda peritonitis [3]. For example, the route of entry and microbiological identification technique of the infection cannot be ascertained from the report. Nevertheless, the reported patient fully recovered with a combination treatment of cephalothin and gentamicin, which contradicts the outcomes of other extraintestinal infections caused by this pathogen.

Identification of this pathogen is challenging since historically it was classified as *E. tarda*; there are 3 genetically distinct yet phenotypically indistinguishable species: *E. tarda*, *E. piscicida*, and *E. anguillarum* [7]. In fact, biochemistry and commercial test panel configurations (API-20E) could not distinguish within the taxa formerly classified as *E. tarda* [7, 8]. We employed gene sequencing of both 16S and *gyrB* genes to confirm the genuine species of *E. tarda* [8]. It is unclear whether the previous report was *E. tarda* based on the current definition or whether it was one of the other *Edwardsiella* species.

Our patient was a strict vegetarian and refused to consume aquatic animals. Furthermore, the stool culture from the patient revealed a negative culture for *E. tarda,* which excluded the enteric route as a potential source of the infection. However, her caregiver was highly suspected of being the source of infection because the caregiver was a fishmonger and an asymptomatic GI carrier who did not wash the hands properly before exchanging the PD bag for the patient. Therefore, the source of infection is via touch contamination. Although the caregiver's hands did not definitively establish that it was the source of infection by culture yet, it is possible that there was a temporary transit nature of *E. tarda* on the skin.

According to the ISPD Peritonitis Guideline 2016, peritonitis from *E. tarda* falls into the category of non-*Pseudomonas* Gram-negative peritonitis; therefore, this infection should be treated with effective antibiotics for at least 3 weeks (2C) [9]. Our case recovered using the standard empirical antibiotics recommended by the guideline [9]. Although the organism's natural resistance to colistin has been demonstrated [10], the mechanism of resistance is still unclear. It is probably related to the excessive use of antibiotics in fish farms [2]. Consistent with the above guidelines, the infection was cured without any relapses after a 3-week course of IP cefazolin. If appropriate treatment is given to the patient who has *E. tarda*, then the prognosis will be good, as shown in the previous case report [3] and our patient. PD catheter removal is not required.

In conclusion, we present a case of PD-associated peritonitis from genetically confirmed *E. tarda* caused by improper caregiver's hand hygiene during PD bag exchange. Although *E. tarda* is categorized as a waterborne infection after ingesting raw aquatic animals, this case demonstrates the importance of considering touch contamination as another route of infection. As always, hand hygiene should be reemphasized and require special attention in every patient with PD. Our study also raises the limitations of using phenotypic and biochemical analysis of the *Edwardsiella* genus; an additional confirmation must be warranted.

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Statement of Ethics

Written informed consent was obtained from the participant for publication of the details of the medical case and any accompanying images. The Research Affairs Institutional Review Board Office, Faculty of Medicine, Chulalongkorn University, does not require ethical approval for reporting individual cases or case series (less than 4 cases).

Conflict of Interest Statement

All of the authors declared that there were no conflicts of interest.

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Author Contributions

R.C., W.M., N.U., and T.K. contributed to the study design. R.C., W.M., and L.P. collected data for the analysis. N.U. performed the microbiologic examination. R.C., W.M., N.U., and T.K. developed the first draft of the manuscript, which was then reviewed by L.P. and T.K. Prior to submission. All authors have intensively reviewed and approved the manuscript for submission.

Data Availability Statement

The data that supported the findings of this study are available from the corresponding author upon reasonable request.

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