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A Case of Severe Skin and Soft Tissue Infection in the Left Upper Limb Caused by Aeromonas Veronii

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1. Abstract

We report a case of severe infection by Aeromonas veronii in the left upper limb caused by accidentally injuring the left thumb while cutting a fish. Bacterial culture was performed to confirm the pathogen and the whole-genome sequencing revealed the drug resistance genes and virulence genes further. The drug sensitivity test showed that Aeromonas veronii was sensitive to cephalosporins, aminoglycosides, and quinolones but resistant to penicillin and carbapenems. Meanwhile, there are 27 drug-resistant genes in the Aeromonas veronii, including the CphA and OXA genes that can produce drug resistance by hydrolyzing carbapenem and penicillin antibiotics. Multiple operations to control the wound infection and appropriate antibiotic therapy were performed. Finally, the patient recovered and was discharged 1 month after the injury. Early diagnosis, surgical intervention, and administration of appropriate antibiotics are crucial for patients who were suspected of having skin and soft tissue infection or septicaemia caused by Aeromonas veronii.

2. Introduction

Aeromonas is a group of Gram-negative bacilli widely distributed in aquatic environments and can infect the human body through the faecal-oral route or wounds to cause diseases, mainly manifested as gastroenteritis, wound infections, and septicaemia. This genus comprises 36 species and Aeromonas caviae, Aeromonas dhakensis, Aeromonas veronii, and Aeromonas hydrophila are main four species associated with human infection [1, 2]. The virulence of Aeromonas has been linked to the expression of genes that encode different toxins (exoA, alt, act, etc.), structural components (flaA, maf-5, flp, etc.), secretion systems (T3SS, T6SS, etc.), and proteins associated with metals, which can allow the bacteria to overcome the immune response mechanism of the host and cause disease [3, 4]. We report a case of severe infection by Aeromonas veronii in the left upper limb caused by accidentally injuring the left thumb while cutting a fish.

3. Case Report

A 50-year-old woman accidentally injured her left thumb while cutting a fish and applied a bandage. However, her left thumb became red and swollen on the night of the incident, which gradually spread to the left dorsal hand and extended to the forearm within 12 h after the injury, warranting a visit to the emergency department of our hospital a day after the injury. She had a history of dilated cardiomyopathy, chronic heart failure, atrial fibrillation and type 2 diabetes. During admission, there was significant swelling on the dorsum of left hand and left forearm, high tension, and severe infection. Physical examination on admission showed a temperature of 36.8°C, pulse rate of 80 bpm, respiratory rate of 20 bpm, and blood pressure of 87/54 mmHg. A linear wound was also observed at approximately 0.5 cm in length at the left thumb interphalangeal joint on the radial side. The skin and soft tissues of the left hand and the left forearm were red and swollen, especially the left dorsal hand extended to the left dorsal forearm. A purple ecchymosis was noted on the skin of the left dorsal hand, accom-

panied by scattered tiny tension blisters, high skin tension, significant tenderness, slightly high skin temperature, and weak pulse in the ulnar and radial arteries (Figure 1). Emergency laboratory and clinical examinations performed revealed WBC 21.41×109/L, N 92.0%, PCT 6.72 ng/mL, GLU 16.4 mmol/L, HbA1c 8.0%, and BNP >5002 pg/mL. A standard 12-lead ECG showed atrial fibrillation, while plain CT scan of the left forearm and left hand revealed moderate to severe swollen skin and soft tissue of the left forearm and left hand. Initial diagnosis was skin and soft tissue infection in the left upper limb, dilated cardiomyopathy, CHF (Grade III cardiac function), atrial fibrillation, postoperative state of cardiac pacemaker implantation, type 2 DM. Combining the patient's history of injury, the possibility of infection by aquatic life-related bacteria such as Vibrio, Aeromonas, and Mycobacterium marinum was considered [5]. Emergency open decompression was performed on the left upper limb. A longitudinal incision was made to the deep fascial layer along with the most significantly swollen site to achieve complete tension reduction and drainage (Figure 2). Intraoperatively, a large amount of clear yellow discharge was found in the deep fascia of the dorsal area of the left wrist and hand. We sent the discharge for bacterial culture. The wound was thoroughly flushed with a large amount of hydrogen peroxide, normal saline, and iodophor and then packed and bandaged with iodoform gauze. Post-operatively, we administered antibiotics such as cefoperazone-sulbactam sodium 3 g intravenously twice a day combined with moxifloxacin 0.4 g once a day. During post-operative change of dressing, we found that the wound infection continued to spread partly to the second phalanxes, accompanied by skin blackening and tissue necrosis (Figure 3). On the second day after admission, surgical debridement was performed on the left upper limb. Further open decompression and drainage were conducted. During the operation, the viability of fat and tendon tissues was found to be poor and subcutaneous venous network was scattered and embolized (Figure 4); therefore, another discharge sample was sent for bacterial culture. The wound was flushed with a large amount of hydrogen peroxide, normal saline, and iodine and then packed and bandaged with iodoform gauze. On the forth day after admission, the results of bacterial culture were reported as A. veronii and A. ichthiosmia. The drug sensitivity test results showed that the two bacteria were sensitive to cephalosporins, aminoglycosides, and quinolones but resistant to penicillin and carbapenems. Based on the drug sensitivity test results of bacterial culture, we administered cefoperazone-sulbactam sodium 3 g intravenously BID combined with levofloxacin 0.5 g QD. Subsequently, multiple operations to control the wound infection and further skin grafting to close the wound were performed. Finally, the patient recovered and was discharged 1 month after the injury. After 3 months of rehabilitaion, the left hand recovered well in appearance and function (Figure 5).

Figure 1: A linear wound was observed at the left thumb and the left hand showed redness, swelling, purple ecchymosis and tiny tension blisters.

Figure 2: A longitudinal incision was made to achieve complete tension reduction and the discharge was sent for bacterial culture.

Figure 3: Wound infection continued to spread to the fingers, accompanied by skin and soft tissue necrosis.

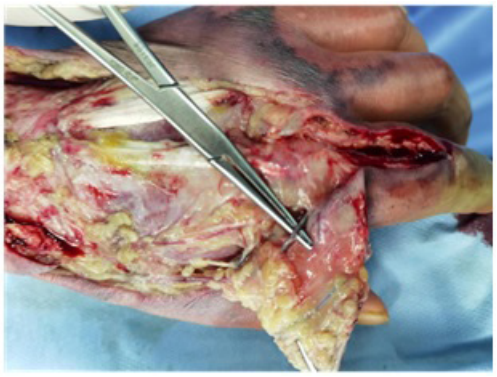

Figure 4: Subcutaneous venous network was embolized.

Figure 5: After 3 months of follow-up, the left hand recovered well in appearance and function.

4. Discussion

To further confirm whether the infection was caused by the pathogenic bacteria carried by the fish, we tried to trace the original fish, but it was no longer available. We then caught the same species of fish from the same river for bacterial culture and found that the main parasitic bacteria on the fish surface was Aeromonas veronii was consistent with the bacterial culture results of the patient. Therefore, it was preliminarily determined that the infectious bacteria in this patient came from the fish. However, the drug sensitivity test results showed that A. veronii was sensitive to all drugs other than penicillin and carbapenem antibiotics, which was inconsistent with the drug sensitivity test results of the cultured bacteria from the wound of our patient. We then conducted whole-genome sequencing of the cultured A. veronii and A. ichthiosmia from the wound surface and cultured A. veronii from the fish skin surface to clarify the difference in drug resistance between these two bacteria. The results showed that both cultured bacteria from the wound surface were A. veronii. A. veronii and A. ichthiosmia are highly homologous in gene sequences, so it is sometimes difficult to distinguish them by general bacterial culture or by using 16S rRNA [6, 7]. And there are 27 drug-resistant genes in the A. veronii, including the CphA and OXA genes (those that produce metallo-β-lactamase and penicillinase, which can produce drug resistance by hydrolyzing carbapenem and penicillin antibiotics) [8, 9]. However, no drug-resistant genes were found from the cultured A. veronii from the fish skin surface. In recent years, with the wide application of antibiotics in clinical practice and aquaculture, several studies have reported that Aeromonas evolved and mutated to have contain drug-resistant genes, and A. veronii showed high drug resistance to penicillin (except piperacillin) and carbapenem antibiotics [10, 11]. Sanchez-Cespedes et al. reported a case of cholangitis caused by A. veronii, in which the drug sensitivity test results showed resistance to imipenem, considered to be caused by the patient's long-term use of penicillin antibiotics. This induced carbapenem resistance in the A. veronii in the human bile duct [12]. In our case, the patient was not on antibiotics before admission and when the first bacterial culture was taken, and the time from the injury to the first bacterial culture was <36 hours; therefore, we did not consider drug resistance caused by a bacterial gene mutation in the human body. Further investigation revealed that sulfonamides and macrolides had been used in the aquaculture lake for a long time, which is the possible reason for A. veronii's resistance to penicillin and carbapenem antibiotics. To date, several studies have reported on human infections caused by A. veronii, mainly in patients with immune disorders such as acute and chronic lymphoblastic leukaemia, acute myeloid leukaemia, acquired immunodeficiency syndrome, and diabetes. This often results in severe septicaemia and mortality [13]. Our patient had a history of underlying diseases, such as diabetes and chronic heart disease, which might be an important factor causing the susceptibility and serious illness after infection. In addition, the whole-genome sequencing showed that the cultured A. veronii from the fish skin contained only virulence genes act, aerA, hlyA, and fla, whereas that from the wound surface contained virulence genes laf, lip, ascV, aexT and ascF-ascG in addition to the aforementioned virulence genes. These genes promote bacterial invasion and release of virulence factors and induce a non-specific inflammatory response of the human body. This may be the reason A. veronii has stronger virulence and pathogenicity, which leads to the rapid progress of patients' illness [14, 15].

5. Conclusions

In conclusion, we should be alert to the possible Aeromonas infection in patients suspected of having skin and soft tissue infection or septicaemia caused by aquatic life-related bacteria. What's more, early diagnosis, surgical intervention, and administration of appropriate antibiotics are crucial for patients' good prognosis.

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