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Case report

A case of catheter related bloodstream infection by *Corynebacterium striatum*

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ABSTRACT

Background: C. striatum is an innocuous inhabitant of the normal human epithelial and mucosal surfaces. The *C. striatum*'s thogenic potential is increasingly recognized in our time.
Methods: We present a rare case of CRBSI by *C. striatum* in a 57-yr-old male patient. The patient suffered from many basic diseases and was admitted to hospital of shock.
Results: The patient finally died of septic shock caused by CRBSI due to multidrug-resistant *C. striatum* which responded neither to empiric nor to targeted treatment.
Conclusions: C. striatum can cause CRBSI in immunocompromised patients when they were treated by intravenous catheters.

Background

Corynebacteria are gram-positive and non-spore forming, usually aerobic or facultatively anaerobic rods [1]. They are commensal organisms of skin and mucosal and traditionally regarded as avirulent members. Like other *Corynebacterium* species, *C. striatum* is an innocuous inhabitant of the normal human epithelial and mucosal surfaces. However, the *C. striatum*'s thogenic potential is recognized and it has been increasingly associated with severe infections in hosts. For example, it has been reported that *C. striatum* infection outbreaks in long-stay patients with underlying disease in 2007 [2] and 281 cases of prosthetic device-related *Corynebacterium* infection, including central venous catheters (CVCs) in 2014 [3]. Here, we report a case of catheter related bloodstream infection (CRBSI) by *C. striatum* in China.

Patient and methods

A 57-yr-old man presented to the Emergency Department complaining of chest tightness, shortness of breath and difficulty breathing without obvious causes. He was admitted to our hospital of shock in intensive care unit (ICU). He had history of chronic renal impairment (CKD5), lung infection, pleural effusion, cerebral infarction, hypertension, type 2 diabetes, heart failure and other basic diseases. He had been on hemodialysis. Cultures from sputum and pleural fluid yielded no isolates, so there was no etiological basis for his lung infection this time and empiric antimicrobial treatment with piperacillin-tazobactam was given only.

The main clinical findings of this patient were as follows: temperature (35.6℃), heart rate (48 heats per minute), blood pressure (103/51 mmHg) and breathe (68 breaths per minute). Initial complete blood count revealed (Table 1): WBC count, 11.7×10^9/L ($3.5-9.5 \times 10^9$/L, 83.76 % segmented neutrophils); hemoglobin, 65 g/L (130–175 g/L); and platelet count, 144×10^9/L ($125-350 \times 10^9$/L). C-reactive protein (CRP) level was 110.73 mg/L (0–4 mg/L), creatinine level was 598 μmol/L (57–97 μmol/L), procalcitonin level was 1.07 ng/mL (<0.5 ng/mL) and glucose was 6.2 mmol/L (3.9–6.1 mmol/L). His lymphocyte count remained below normal after admission and the indicator helped explain his weakened immunity. A CVC was inserted into his femoral vein to open deep vein access and use of blood pressure drugs. After 48 h, a subclavian access was opened to replace femoral access, and this situation had been remained. Continuous renal replacement therapy (CRRT) treatment was given after his admission and right internal jugular vein catheterization to maintain hemodialysis.

The patient's WBC count decreased to 6.1×10^9/L and neutrophil count was 5.3×10^9/L on day 2. But his blood sugar control was not very good from day 4. His condition had eased in the next few days and transferred to nephrology from ICU on day 6. Continuous of empiric antimicrobial treatment with piperacillin-tazobactamas and other symptomatic treatment measures during this time.

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Table 1
Patient's main findings of parameter in blood of hospitalization.

Parameter in blood(units)	Reference range	Day 1 morning ICU admission	Day 1 afternoon	Day 2 morning	Day 2 afternoon	Day 3 morning	Day 4 morning	Day 4 afternoon	Day 6 morning Nephrology admission	Day 8 morning	Day 10 morning	Day 10 afternoon	Day 11 morning	Day 12 morning	Day 13 morning	Day 14 morning ICU admission	Day 14 afternoon	Day 15 morning
WBCs(109/L)	3.5–9.5	11.7	8.3	6.1	5.8	4.9	4	4.8	5.3	6	1.3	1.2	2.1	2.3	1.4	5.2	2.8	5.5
Neus(109/L)	1.8–6.3	9.8	6.9	5.3	5.1	4.1	3.1	4	4.5	5.1	0.5	0.4	1.4	1.5	0.9	4.4	1.6	4.5
Lyms(109/L)	1.1–3.2	1	1	0.5	0.3	0.4	0.4	0.2	0.5	0.5	0.5	0.6	0.4	0.5	0.5	0.8	0.8	0.9
Plts(109/L)	125–350	144	89	70	76	56	60	34	28	24	16	18	15	34	15	27	14	28
CRP(mg/L)	0–4	110.73		129.86		141.68	159.73		147.36	112.17	210.22	149.82	230.13	185.5	132.85	113.49		127.7
PCT(ng/mL)	< 0.5	1.07							2.46		2.39		3.07	2.81	2.67	3.06		4.14
CRE(μmol/L)	57–97	595	515	435	471	484	549	444	551	552	636		717	628	690	628	478	451
BUN(mmol/L)	3.1–8	37.8	38.3	29.7	31.2	32.1	32	25	26.5	27.2	32		38.6	37.7	42.3	37.7	31.2	28.9
CK-MB(U/L)	< 25	76	102	67	31	21	16	14	11	8	8		19	6	7	14	25	38
TNT(ng/L)	0–14	2581		3410		3752	3404		2760	1645	1563		1417	931	915	1036	635	1284
ALT(U/L)	9–50	624	1186	1506	1188	992	333	552	335	167	96		75	11	49	48	196	265
AST(U/L)	15–40	1322	2803	3121	1796	989	104	222	67	25	17		21	56	11	45	799	1049
LDH(U/L)	120–250	1988	2218	2452	1240	686	348	309	256	245	221		285	190	204	273	867	910
GLU(mmol/L)	3.9–6.1	4.4	5.8	4.1	5.8	7.1	9.7	8.8	8.1	9.9	11.4		15.7	19.1	18	10.7	5	10.7

WBC: white bloodcells, Neu: neutrophils, Lym: lymphocytes, Plt: platelets, CRP: C-reactive protein, PCT: procalcitonin, CRE: creatinine, BUN: blood urea nitrogen, CK-MB: creatine kinase-MB, TNT: troponin t, ALT: alanine aminotransferase, AST: aspartate aminotransferase, LDH: lactate dehydrogenase, GLU: glucose, ICU: intensive care unit.

Table 2
Antimicrobial susceptibility results of *C. striatum*.

Antimicrobials(μg/mL)	S	I	R	MIC	Result
Penicillin	≤1	2	≥4	>32	R
Erythromycin	≤0.5	1	≥2	8	R
Clindamycin	0.5	1~2	4	>256	R
Moxifloxacin	–	–	–	16	–
Ciprofloxacin	≤1	2	≥4	>32	R
Levofloxacin	–	–	–	>32	–
Clarithromycin	–	–	–	12	–
Vancomycin	≤2	–	–	0.5	S

S: susceptible, I: intermediate, R: resistant, MIC: minimal inhibitory concentration.

Results

On the 10th day, the patient's condition suddenly deteriorated. His temperature and CRP level increased to 38.9°Cand 210.22 mg/L, respectively. The WBC count decreased to 1.3 × 10^9/L, neutrophil count was 0.5 × 10^9/L and glucose was 11.4 mmol/L (Table 1). Since the symptoms of infection worsen, empiric antimicrobial treatment with a combination of piperacillin-tazobactam and moxifloxacin. Cultures from sputum and pleural fluid still had no isolates. Two aerobic and two anaerobic blood culture sets were incubated in the automatic blood culture system (BACTEC 9120, Becton, Dickinson and Company, US). Simultaneously, the catheter tip was collected to culture and it had bacterial growing after 24-hr. Bacterial growth after 18-hr was noted in aerobic culture bottles and after 50-hr was noted in anaerobic culture bottles. Blood and catheter tip cultures yielded *Corynebacterium spp*. The pathogen was gram-positive diphtheroid type rod and was identified as *C. striatum* by VITEK 2 (bioMérieux, Marcy l'Etoile, France) bacteria identification system (98 % probability,excellent identification). Meanwhile, the VITEK MS (bioMérieux, Marcy l'Etoile, France) system was used to confirm the pathogen (confidence coefficient: 99.9 %). The 16S rRNA genes of the isolates were sequenced to obtain more reliable phenotypic data and species identification. All sequences were analyzed by BLAST (basic local alignment search tool) and ribosomal database project. The sequence showed 99 % similarity to that of *C. striatum*. Minimal inhibitory concentration (MIC) was determined by using broth microdilution according to the Clinical and Laboratory Standards Institute (CLSI) guidelines [4]. The pathogen was susceptible to vancomycin (MIC 0.5 μg/mL) and resistant to penicillin (>32 μg/mL), ciprofloxacin (>32 μg/mL), clindamycin (>256 μg/mL), and erythromycin (>8 μg/mL) (Table 2). While waiting for the microbiological results, the patient's clinical status and laboratory values continued to deteriorate (Table 1). On day 14, the patient was transferred to ICU again due to septic shock. Treatment was switched to vancomycin, but his symptoms had not improved and died one day later. Lactate level were elevated and remained high when he was in the ICU (Fig. 1). The patient was in a state of persistent acidosis. No other pathogens were isolated from the patient during his hospitalization.

Discussion

C. striatum is a non-spore Gram-positive coryneform bacteria, which is considered to be a parasitic bacteria on the skin or mucous membrane surface [5,6]. There have been more researches on infections caused by *C. striatum*. *C. striatum* isolates have been included among the etiologic agents of bacteremia [7], such as endocarditis [8], septic arthritis [6], with or without CVC in place [9,10] and other invasive disease.

CVC is a life pathway for effective treatment of critically ill patients in clinical departments such as emergency department

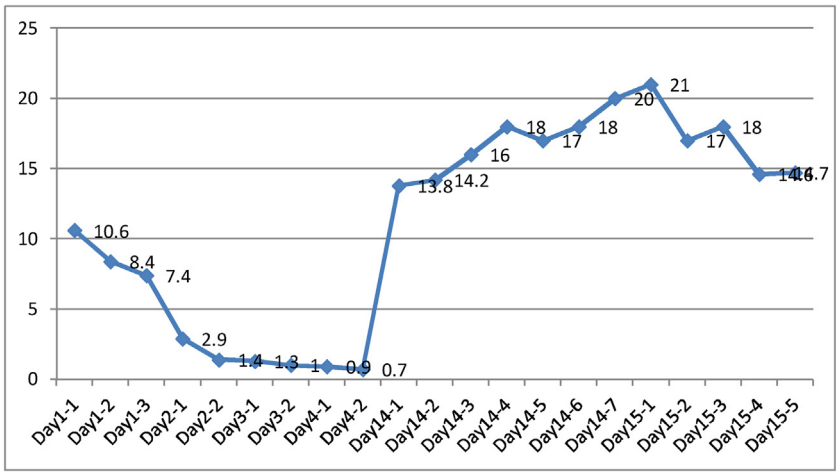

Fig. 1. Changes of the patient's lactate level in blood of hospitalization when he was ICU.

and ICU. With the widespread use of CVC, catheter-related infections have also increased and CRBSI is the most common serious infection. There are many pathogenic bacteria which cause CRBSI, such as *Staphylococcus aureus*, *Escherichia coil* and *Candida albicans*, etc [11–13]. However, CRBSI caused by *C. striatum* is relatively rare.

In our case, the patient was diagnosed with various underlying diseases when he was admitted to hospital. Deep venous catheters and hemodialysis catheters needed to be reserved for treatment needs. The patient's condition was relatively stable within a week of admission. After the 10th day, he had fever, lower WBCs and elevated CRP levels. There was no bacterial growth in sputum and pleural fluid culture, but same species *C. striatum*was isolated from CVC tip and peripheral venous blood. Three identification systems were used to identify the pathogen as *C. striatum*. Combined with clinical symptoms and other laboratory values, we considered the patient as CRBSI caused by *C. striatum*. According to the drug sensitivity results, *C. striatum* was only sensitive to vancomycin and resistant to penicillin, ciprofloxacin, clindamycin and erythromycin. It was a multidrug-resistant strain, so the empiric antimicrobial treatment didn't have a good effect. Then, he finally died of septic shock caused by CRBSI due to multidrug-resistant *C. striatum* which responded neither to empiric nor to targeted treatment.

Retrospective analysis found that the patient had many underlying diseases and lower immunity. During the whole treatment, his lymphocyte count had been below normal and his blood sugar was not well controlled. This may be another important factor causing his bloodstream infection. Due to restrictions on antibiotic use in China, most empirical antibacterial treatment only targets common bacterial infections. Vancomycin is used to treat serious infections for which other antibiotics are ineffective and should be used according to the results of culture and drug sensitivity. So, the patient received vancomycin until Day 14 according to the drug sensitivity results. This is also an important factor in our report of this case. We hope that through the patient's condition, clinicians could pay attention to infections caused by rare bacteria such as *C. striatum* and use effective antibiotics as early as possible for treatment.

Conclusions

CRBSI is a common serious infection of CVC, but caused by *C. striatum* is relatively rare. The culture of *C. striatum* from peripheral venous blood is an effective method for clinical diagnosis. Therefore, we should pay attention to the following points in the process of clinical diagnosis and treatment. First, the standardized operation of catheterization and nursing of CVC should be improved to prevent the occurrence of CRBSI. Secondly, close collaboration between the laboratory and clinicians is essential to establish a correct diagnosis. Meantime, empirical antibacterial treatment should be performed and then antibiotics should be adjusted according to the results of culture and drug sensitivity. The most important thing is to avoid the outbreak of *C. striatum* infection in the hospital.

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Ethical approval

The report was approved by the Ethics Committee of Nanjing Tongren Hospital Affiliated to Medical School of Southeast University.

Informed consent

Retrospective research, informed consent not needed.

Authors contribution

JCL and SZF carried out the case collection, WLJ carried out laboratory detection. YMG and HCT drafted and revised the manuscript. All authors read and approved the final manuscript.

Declaration of Competing Interest

The authors report no declarations of interest.

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