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CASE REPORT

Lumbar methicillin-resistant *Staphylococcus aureus* infection caused by a peripherally inserted central catheter: A case report

Xiao-Xiao Yuan, Qiong-Qiong Tan, Chen Chen, Qing-Qing He, Yan-Ning Li

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Abstract

BACKGROUND

Peripherally inserted central catheters (PICCs) are widely used for administering chemotherapy to breast cancer patients due to their long-term indwelling capability, versatility in drug administration, and flexibility. PICCs infection are a relatively common occurrence, yet there were no reported instances that it can metastasise to the lumbar spine.

CASE SUMMARY

This case report describes a breast cancer patient who developed a methicillin-resistant Staphylococcus aureus lumbar vertebral infection secondary to a PICC-related infection during chemotherapy. Following PICC removal, bacterial culture confirmed the presence of highly virulent methicillin-resistant Staphylococcus aureus. The patient presented with fever and severe lumbar pain. Lumbar magnetic resonance imaging revealed paraspinal muscle edema from L1 to L3 with abnormal signal intensity in the affected regions, suggestive of vertebral osteomyelitis. Prompt initiation of appropriate antibiotic therapy based on the culture results led to significant improvement in the patient's lumbar pain.

CONCLUSION

This case highlights the importance of vigilant infection prevention and control measures to minimize the risk of PICC-related complications, such as bloodstream infections and subsequent metastatic infections.

Key Words: Peripherally inserted central catheter; Methicillin-resistant Staphylococcus aureus infection; Lumbar magnetic resonance imaging; Breast cancer; Chemotherapy;

Case report

Core Tip: Peripherally inserted central catheters (PICCs) are used for chemo in breast cancer patients because they last a long time, can be used for different drugs, and are flexible. This case report describes a breast cancer patient who developed a methicillin-resistant *Staphylococcus aureus* infection in their spine during chemotherapy. A culture of the wound after removing the PICC showed methicillin-resistant *Staphylococcus aureus*. The patient had a fever and severe back pain. A magnetic resonance imaging showed that the muscles around the lumbar vertebrae were swollen and had an abnormal signal. This is a sign of vertebral osteomyelitis. The patient's pain improved when they started antibiotics based on the culture results. This case shows the importance of infection prevention and control to avoid complications from PICCs.

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INTRODUCTION

The utilization of peripherally inserted central catheters (PICCs) in breast cancer patients receiving chemotherapy has been shown to effectively reduce the frequency of peripheral venipuncture[1], alleviate patient discomfort, and address the challenges of intravenous (IV) infusion associated with compromised peripheral vascular access[2]. Additionally, PICCs facilitate the administration of multi-cycle chemotherapy regimens, ensuring the uninterrupted progression of treatment. However, inadequate maintenance of PICCs can lead to significant complications, including catheter-related bloodstream infections (CRBSIs), which are relatively common and serious[3]. CRBSIs can be difficult to manage and may result in patient deterioration, potentially progressing to sepsis in severe cases[4]. Therefore, preventing CRBSIs is paramount, and timely treatment is essential once an infection occurs. This case report presents a patient with breast cancer who developed a PICC-related methicillin-resistant *Staphylococcus aureus* (MRSA) lumbar vertebral infection during chemotherapy. The patient was admitted to our hospital for management of these complications. By sharing this clinical case and its management strategies, we aim to provide healthcare professionals with valuable insights to improve vascular access management for breast cancer patients and reduce the incidence of catheter-related infections.

CASE PRESENTATION

Chief complaints

Two weeks after chemotherapy, the patient experienced severe lower back pain, limited mobility and a persistent rise in body temperature for no apparent reason.

History of present illness

The patient was a 63-year-old female who was admitted to our department for the administration of chemotherapy following a surgical procedure for right breast cancer, in addition to the development of a fever.

History of past illness

She underwent a radical mastectomy on the right side of her body, along with breast-conserving surgery and axillary lymph node dissection, at an external medical facility. The postoperative pathological examination revealed the presence of invasive ductal carcinoma (stage II/III), and the intention was to administer chemotherapy drugs for the purpose of treatment. Following a comprehensive evaluation, it was deemed that there were no contraindications to the insertion of a PICC. The procedure was subsequently performed by a PICC specialist nurse under local anaesthesia in the basilic vein of the left upper arm. In an external medical facility, the patient received the chemotherapy regimens paclitaxel liposome + lobaplatin + trastuzumab for injection in the first, second, and third cycles. Subsequently, she completed 10 rounds of whole breast radiation therapy with a tumor absorption dose of 20 Gary. In our medical facility, the patient underwent the fourth cycle of chemotherapy, which consisted of paclitaxel liposome, lobaplatin, and trastuzumab for injection.

Personal and family history

She underwent a radical mastectomy on the right side of her body, along with breast-conserving surgery and axillary lymph node dissection, at an external medical facility. Subsequently, she completed 10 rounds of whole breast radiation therapy with a tumor absorption dose of 20 Gary.

Physical examination

The body temperature was 39.4 °C.

Laboratory examinations

The test results demonstrated the following: The C-reactive protein level was 121 mg/L, the erythrocyte sedimentation rate was 86 mm/hour, the leukocyte count was 7.09 × 10^9/L. The results of the blood culture were as follows: The MRSA infection was classified as "+".

Imaging examinations

The lumbar magnetic resonance imaging (MRI) revealed the presence of edema in the left paraspinal muscle from L1 to L3, accompanied by abnormal internal signals and no evidence of fluid levels.

FINAL DIAGNOSIS

Considering the possibility of lumbar spine infection in conjunction with orthopedic consultation. The results of catheter bacterial culture are consistent with those of blood culture (Table 1).

TREATMENT

Therapeutic interventions included level-I nursing care, lumbar immobilization, and a lumbar elastic bandage. The patient was isolated in a single-patient room with restricted visitation. The room was disinfected with ultraviolet light three times daily per standard protocol. To prevent cross-infection, masks for both the patient and visitors were replaced regularly, among other precautionary measures. Given the patient's critical condition and high dependency, family members were informed of their status and provided regular updates. Vital signs were closely monitored, and laboratory tests, including liver and kidney function tests, complete blood count, and procalcitonin, were performed frequently. Any abnormalities were addressed promptly.

Based on the results of the drug sensitivity test (Table 1), the patient received IV cefazolin sodium 2.5 g twice daily diluted in 100 mL of 0.9% sodium chloride solution. After three days, the patient's fever persisted, and lumbar pain showed no significant improvement. In consultation with the pharmacy department, the treatment regimen was changed to IV vancomycin 0.5 g daily diluted in 100 mL of 0.9% sodium chloride solution, along with oral Xinnuoming and Xinstigmine. The patient's infection symptoms and lumbar pain significantly improved. After two days, the fever resolved, and the lower back pain subsided. The treatment was continued for six days, leading to further improvement in infection and pain. Vancomycin was discontinued, and oral administration of Xinnuoming was continued. During this period, the patient's blood count, biochemistry, and C-reactive protein were monitored twice (Table 2), procalcitonin levels were monitored continuous (Table 3). Vancomycin blood levels and lumbar MRI were assessed once. Additionally, fluid, electrolyte, acid-base balance, and nutritional support were provided. The patient and their family members were educated about the potential causes of lumbar MRSA infection related to PICC placement and the available treatment options for lumbar pain. This was done to alleviate their anxiety and instill confidence in the recovery process. After completing active treatment, the patient's self-care ability improved to moderate dependence, and they were discharged in stable condition.

OUTCOME AND FOLLOW-UP

The patient was readmitted to our department for advanced-stage targeted therapy. They received an IV infusion of 440 mg trastuzumab *via* a disposable needle puncture without complications. A follow-up lumbar MRI was performed. The radiology report indicated resolution of the bilateral psoas abscesses and improvement in the lumbar intervertebral space infection. The patient's self-care ability improved to mild dependence. The patient received monthly targeted therapy at our department, resulting in significant improvement. Initially, the patient experienced severe lower back pain, limiting their mobility. Over time, the pain gradually subsided, and the patient was able to walk independently with assistance. By the third visit, the patient had regained normal mobility and was pain-free. The treatment demonstrated notable efficacy.

DISCUSSION

The factors contributing to the development of MRSA lumbar spine infection during chemotherapy were analyzed in the present study. The patient's compromised immune system, a consequence of cancer treatment, renders them susceptible to external pathogens[5]. Contact with external pathogens can lead to infection, which may extend to the catheter[6]. Skin tissue damage during catheter insertion can trigger inflammatory reactions, compromising the body's defense mechanisms and facilitating bacterial invasion through the bloodstream[7]. Pathogens on the skin's surface may migrate

Table 1 Blood and catheter bacterial culture + drug sensitivity

Sample type	Project application	Result	Antibacterial drugs	Sensitivity	KB (mm), MIC (mg/L)	Cut off point R	Cut off point S
Blood	Bacterial culture + drug sensitivity	*Staphylococcus aureus* (+); MRSA (+)	Penicillin G	R	≥ 0.5	≥ 0.25	≤ 0.12
			Ciprofloxacin	S	1	≥ 4	≤ 1
			Moxifloxacin	S	≤ 0.25	≥ 2	≤ 0.5
			Gentamicin	S	≤ 0.5	≥ 16	≤ 4
			Clindamycin	R	≥ 8	≥ 4	≤ 0.5
			Compound sulfamethoxazole	S	≤ 10	≥ 76	≤ 38
			Linezolid	S	2	≥ 8	≤ 4
			Benzylpenicillin	R	≥ 4	≥ 4	≤ 2
			Levofloxacin	S	0.5	≥ 4	≤ 1
			Vancomycin	S	1	≥ 16	≤ 2
			Erythromycin	R	≥ 8	≥ 8	≤ 0.5
			Tetracycline	S	≤ 1	≥ 16	≤ 4
			Tigecycline	S	≤ 0.12	-	-
			Rifampicin	S	≤ 0.5	≥ 4	≤ 1
Catheter	Bacterial culture + drug sensitivity	*Staphylococcus aureus* (+++); MRSA (+)	Penicillin G	R	≥ 0.5	≥ 0.25	≤ 0.12
			Ciprofloxacin	I	2	≥ 4	≤ 1
			Moxifloxacin	S	≤ 0.25	≥ 2	≤ 0.5
			Gentamicin	S	≤ 0.5	≥ 16	≤ 4
			Clindamycin	R	≥ 8	≥ 4	≤ 0.5
			Compound sulfamethoxazole	S	≤ 10	≥ 76	≤ 38
			Linezolid	S	2	≥ 8	≤ 4
			Quinupristin/dalfopristin	S	≤ 0.25	≥ 4	≤ 1
			Benzylpenicillin	R	≥ 4	-	≤2
			Levofloxacin	S	1	≥ 4	≤ 1
			Vancomycin	S	1	≥ 16	≤ 2
			Erythromycin	R	≥ 8	≥ 8	≤ 0.5
			Tetracycline	S	≤ 1	≥ 16	≤ 4
			Tigecycline	S	≤ 0.12	-	-
			Rifampicin	S	≤ 0.5	≥ 4	≤ 1

KB: Kirby-Bauer (disk diffusion method); MIC: Minimum inhibitory concentration; MRSA: Methicillin-resistant *Staphylococcus aureus*; S: Sensitive; I: Intermediate; R: Resistant.

to the catheter tip along the puncture site[8]. Additionally, contact between the catheter and unsterilized surfaces can introduce bacteria, increasing the risk of catheter-related infections. The deposition of fibrinogen within the PICC catheter creates a favorable environment for microbial growth, promoting bacterial colonization and infection[9].

Aseptic operation techniques were not strictly adhered to by specialist nurses during PICC catheter insertion, and the puncture site and surrounding area were not adequately disinfected[10]. When changing the PICC dressing, aseptic principles were not followed, and a dislodged catheter was reinserted without proper sterilization[11]. Furthermore, PICC flushing and locking with prefilled 10 mL normal saline syringes using a pulsatile method before and after drug administration were performed without adhering to sterile techniques, and the catheter outlet site was not repaired using sterile methods[12].

Table 2 Blood count, biochemistry, and C-reactive protein were monitored twice

Report date	Report item name	Result	Normal reference value
Blood count			
During treatment	White blood cell count (10^9/L)	12.10	3.50-9.50
	Neutrophil (%)	77.5	40.0-75.0
	Lymphocyte (%)	11.6	20.0-50.0
	Monocyte (%)	10.7	3.0-10.0
	Eosinophil (%)	0.1	0.4-8.0
	Absolute neutrophil count (10^9/L)	9.38	1.80-6.30
	Absolute monocyte count (10^9/L)	1.30	0.10-0.60
	Absolute eosinophil count (10^9/L)	0.01	0.02-0.52
	Red blood cell count (10^{12}/L)	2.94	3.80-5.10
	Hemoglobin level (g/L)	94	115-150
	Hematocrit (%)	26.7	35.0-45.0
After treatment	White blood cell count (10^9/L)	9.58	3.50-9.50
	Neutrophil (%)	85.6	40.0-75.0
	Lymphocyte (%)	8.8	20.0-50.0
	Eosinophil (%)	0.2	0.4-8.0
	Absolute neutrophil count (10^9/L)	8.20	1.80-6.30
	Absolute lymphocyte count (10^9/L)	0.84	1.10-3.20
	Red blood cell count (10^{12}/L)	2.80	3.80-5.10
	Hemoglobin level (g/L)	90	115-150
	Hematocrit (%)	27.3	35.0-45.0
Biochemistry			
Pre-treatment	Emergency K test (mmol/L)	4.49	3.6-5.0
	Emergency Na test (mmol/L)	134.8	137-145
	Emergency CI test (mmol/L)	97.7	98.0-107.0
	Emergency Ca test (mmol/L)	1.96	2.1-2.55
	Emergency CO2-CP test (mmol/L)	28	22.0-30.0
	Emergency blood glucose test (mmol/L)	7.30	3.6-5.8
	Emergency creatinine test (μmol/L)	58.10	20-110
	Emergency urea nitrogen test (mmol/L)	4.1	2.5-6.1
	Emergency aspartate aminotransferase test (U/L)	29	17-59
During treatment	Emergency UA test (μmol/L)	236	143-440
	Emergency K test (mmol/L)	4.64	3.5-5.5
	Emergency Na test (mmol/L)	135.4	135-150
	Emergency Cl test (mmol/L)	104.5	95-115
	Emergency Ca test (mmol/L)	2.16	2.08-2.60
	Emergency CO2-CP test (mmol/L)	24.6	21.0-31.0
	Emergency glucose test (mmol/L)	5.74	3.90-6.10
	Emergency creatinine test (μmol/L)	71	45-115
	Emergency urea nitrogen test (mmol/L)	5.0	2.6-8.3
	Emergency AG test (mmol/L)	10.94	6.00-22.00

	Emergency osmolality test (mmol/L)	285.8	280-320
	Emergency phosphorus test (mmol/L)	1.14	0.81-1.55
CRP			
During treatment	CRP (mg/L)	63.20	0-8
After treatment	CRP (mg/L)	28.40	0-8

K: Potassium; Na: Sodium; CI: Chloride; Ca: Calcium; CO2-CP: Carbon dioxide combining power; UA: Uric acid; AG: Anion gap; CRP: C-reactive protein.

Table 3 Procalcitonin levels were monitored continuous

Report item name	Result	Normal reference value
PCT (ng/mL)	7.31	0-0.05
	1.29	
	0.48	
	0.23	
	0.1	
	0.07	

PCT: Procalcitonin.

Building on our analysis of the causes of PICC CRBSIs, it is recommended that if a patient presents with systemic symptoms such as fever and altered blood count following catheter insertion, especially if *Staphylococcus aureus*, a common pathogen in CRBSIs, is isolated, a diagnosis of PICC catheter-related infection should be considered, and the catheter should be promptly removed[13]. In this case, the patient was diagnosed with a PICC CRBSI based on bacterial culture results. The infection had disseminated hematogenously to the adjacent paraspinal muscles. Furthermore, pre-existing lumbar spine lesions may have contributed to secondary lumbar infection, manifesting as fever and lower back pain.

The surrounding environment and all surgical equipment must be rigorously disinfected. Preoperatively, the area should be exposed to ultraviolet light for 30 minutes, and personnel should avoid walking or cleaning the floor near the operating area[14]. Surgical staff must wear sterile gloves, hats, and masks, and clean the arm where the PICC line will be inserted with 75% alcohol followed by iodine disinfection[15]. A strict aseptic technique must be maintained throughout the PICC insertion procedure. Additionally, the selected PICC catheter should have a smooth surface, high quality, and good biocompatibility to minimize vascular wall damage and infection risk[16]. Nurses should educate patients and their families on the importance of catheter care, including proper catheter protection and timely dressing changes. Upon the insertion of a PICC catheter, the implementation of compulsory follow-up protocols has demonstrated substantial efficacy. Regular alterations of the dressing represent a fundamental component of this follow-up regimen. Such dressing changes are to be executed at predetermined intervals, commonly every seven days or in accordance with the specific protocol of the institution. In conjunction with dressing changes, the persistent surveillance of potential infections is critical. This entails vigilant monitoring of the patient's body temperature, as an abrupt rise may signify an incipient infection. The regular performance of blood tests, including the assessment of white blood cell counts and C-reactive protein levels, is mandatory. Should any irregularities be identified, immediate initiation of further diagnostic measures, such as blood cultures, is required. The catheter should be removed promptly once treatment goals are achieved to minimize indwelling time[17]. Implementing effective infection prevention strategies is crucial to reduce the risk of PICC-related bloodstream infections.

CONCLUSION

PICC has the advantages of long indwelling time, suitability for a wide range of infusion drugs, good catheter elasticity and no impact on quality of life. In the chemotherapy cycle of breast cancer patients, it is one of the most important lifelines. Therefore, good catheter maintenance and reducing the incidence of PICC infections are important health measures. If a PICC catheter infection occurs, it should be removed immediately and anti-infection treatment should be given. If there are secondary lesions in other parts, they should be detected in time, and psychological care for patients and their relatives should be done well to reduce patients' nervousness and anxiety. Reduce patient suffering in addition to the disease and avoid medical disputes.

FOOTNOTES

Author contributions: Yuan XX and Li YN study conception and drafted the manuscript; Yuan XX and Tan QQ contributed equally to this article, they are the co-first authors of this manuscript; Tan QQ and Chen C contributed data acquisition to the manuscript; He QQ contributed critical revisions to the manuscript; He QQ and Li YN contributed equally to this article, they are the co-corresponding authors of this manuscript; and all authors have read and approved the final manuscript.

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