

Case report

Successful use of alteplase for the treatment of hemodialysis catheter dysfunction due to thrombosis

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Abstract:

Venous catheter dysfunction due to thrombosis is a prevalent complication among patients undergoing hemodialysis, impeding the normal operation of the dialysis process. The condition is typically managed using thrombolytic therapy, with alteplase being a widely used drug for dissolving clots in venous catheter. Alteplase works by activating plasminogen to plasmin, which in turn breaks down the fibrin clots, restoring blood flow through the catheter. This treatment is crucial in preventing further complications and ensuring the continuation of hemodialysis.

In this case report, a 52-year-old female patient with chronic kidney disease (CKD) who had been undergoing hemodialysis employing a venous catheter received a diagnosis of catheter-related thrombosis. Alteplase was administered intravenously in the catheter at an appropriate dose, which successfully dissolved the clot, improved blood circulation in the catheter and allowed the dialysis procedure to proceed normally. The patient experienced no significant side effects, and dialysis continued without the need for catheter replacement.

Keywords : ● Venous catheter thrombosis ● Hemodialysis ● Alteplase

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รายงานผู้ป่วย

การรักษาภาวะลิ่มเลือดอุดตันในสายสวนหลอดเลือดดำของผู้ป่วยฟอกเลือดด้วยเครื่องไตเทียมโดยใช้ยา Alteplase

จิตรลดา คงอินทร์ คติมาภรณ์ อ่อนพุทธา และ วรัญญา ชลัทธิธรรมเนียม

โรงพยาบาลเวชศาสตร์เขตร้อน คณะเวชศาสตร์เขตร้อน มหาวิทยาลัยมหิดล

บทคัดย่อ

ภาวะลิ่มเลือดอุดตันในสายสวนหลอดเลือดดำของผู้ป่วยฟอกเลือดด้วยเครื่องไตเทียม เป็นปัญหาที่พบบ่อยในผู้ป่วยที่ได้รับการรักษาด้วยการฟอกเลือด ซึ่งทำให้การฟอกเลือดไม่สามารถดำเนินการได้ตามปกติ การรักษาภาวะนี้ส่วนใหญ่จะใช้วิธีการให้ยาละลายลิ่มเลือด โดยยา Alteplase เป็นยาที่ใช้กันอย่างแพร่หลายในการรักษาภาวะลิ่มเลือดอุดตันในผู้ป่วยฟอกเลือด ด้วยกลไกการทำงานที่สามารถละลายลิ่มเลือด และช่วยในการไหลเวียนของเลือดในสายสวน การใช้ยา Alteplase ในผู้ป่วยที่มีภาวะลิ่มเลือดอุดตันในสายสวนหลอดเลือดดำที่ได้รับการฟอกเลือดด้วยเครื่องไตเทียม จึงมีบทบาทสำคัญในการรักษาและลดความเสี่ยงในการเกิดภาวะแทรกซ้อนที่อาจตามมา

ผู้เขียนได้รายงานผู้ป่วยหญิงอายุ 52 ปี อาศัยอยู่ในกรุงเทพฯ เข้ารับการรักษาตัวที่โรงพยาบาลเวชศาสตร์เขตร้อน มีโรคประจำตัวเป็นโรคไตวายเรื้อรัง ได้รับการรักษาด้วยการฟอกเลือดด้วยเครื่องไตเทียมโดยใช้สายสวนหลอดเลือดดำ พบว่ามีภาวะลิ่มเลือดอุดตันในสายสวน ซึ่งการใช้ยา Alteplase โดยการฉีดเข้าไปในสายสวนหลอดเลือดดำในปริมาณที่เหมาะสม ช่วยละลายลิ่มเลือดที่อุดตัน ทำให้การไหลเวียนของเลือดในสายสวนดีขึ้น และสามารถฟอกเลือดได้ตามปกติ

คำสำคัญ : ● ภาวะลิ่มเลือดอุดตัน ● การฟอกเลือดด้วยเครื่องไตเทียม ● Alteplase

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Introduction

Chronic kidney disease (CKD) is a progressive condition often leading to kidney failure, requiring hemodialysis as a life-sustaining therapy. Hemodialysis relies on the use of vascular access, such as venous catheters, to facilitate the flow of blood during the procedure. However, a significant complication associated with prolonged use of venous catheters is catheter-related thrombosis (CRT), which can occur in up to 30% of patients with prolonged catheter use. CRT obstructs blood flow, preventing the proper function of the dialysis machine and potentially leading to serious complications including infections, loss of vascular access and progression to further kidney damage.

Managing CRT involves several treatment strategies, one of the most common being thrombolytic therapy. Alteplase, a recombinant tissue plasminogen activator, is an effective drug for dissolving blood clots and is commonly used in CRT cases to restore blood flow through the catheter. This case report reviews the mechanism of action of alteplase, its role in the treatment of CRT and its clinical application in a case study.

Pathophysiology of Catheter-related Thrombosis

CRT occurs when a blood clot forms in the catheter, obstructing the flow of blood. This blockage can reduce the efficiency of the dialysis process and increase the risk of complications. The formation of a thrombus in the catheter is often due to the interaction of blood components with the catheter surface, which can lead to clotting. Over time, the clot may enlarge and cause complete occlusion of the catheter, preventing blood from being aspirated or returned to the patient's circulatory system.

Treatment Options for Catheter-related Thrombosis

CRT treatment aims to restore blood flow through the catheter, thereby ensuring effective dialysis. Several therapeutic options available are described below.

Anticoagulants: These medications, such as heparin and citra-lock help prevent further clot formation. However, their use requires careful monitoring to avoid complications such as bleeding.

Catheter Replacement: In cases of severe thrombosis or catheter dysfunction, replacement is necessary to restore proper blood flow.

Coated Catheters: New technologies, such as catheters coated with anticoagulants or antithrombotic agents, may reduce the incidence of clot formation.

Thrombolytic Therapy: Alteplase is the most commonly used thrombolytic agent for CRT. It works by converting plasminogen into plasmin, which breaks down fibrin and dissolves the clot. This therapy is particularly effective in dissolving clots that obstruct the catheter and is administered directly in the catheter.⁸

The Role of Alteplase in Treating Catheter-related Thrombosis

Alteplase is a recombinant tissue plasminogen activator (rt-PA) that activates plasminogen to plasmin, a serine protease that breaks down fibrin, the major component of blood clots. When administered in the catheter, alteplase dissolves the thrombus, restoring blood flow and enabling the dialysis procedure to proceed. The drug is administered in a precise dose, and the duration of treatment depends on the severity of the clot and the clinical judgment of the healthcare provider.

Alteplase is typically given as a bolus injection directly in the catheter, followed by a dwell time allowing the medication to act on the clot. In many cases, the catheter is flushed with saline before and after administration to ensure adequate distribution of the medication. The effectiveness of the treatment is evaluated by assessing blood flow through the catheter after the prescribed dwell time.

Case Report

A 52-year-old female civil servant presented to the Tropical Medicine Hospital with a history of chronic kidney disease (CKD) stage 5 and Immunoglobulin A-related Glomerulonephritis. The patient had been undergoing hemodialysis for one year using a right internal jugular vein catheter as the vascular access. She began her dialysis treatment March 21, 2023, with a treatment regimen of three sessions weekly, each lasting four

hours. Her dry weight was 50 kg, and the blood flow rate (BFR) was set at 250 mL/min with a dialysate flow rate (DFR) of 500 mL/min. The dialysate composition was Na^+ 138 mEq/L, Ca^{2+} 2.5 mEq/L, K^+ 3 mEq/L, and HCO_3^- 32 mEq/L. In this case, no anticoagulant was administered between hemodialysis sessions due to risk of hemoptysis, alveolar hemorrhage, and severe anemia (hemoglobin 6 g/dL, hematocrit 18.5%). However, citra-lock was used as the anticoagulant locking solution to maintain venous catheter flow. Before each dialysis session, the catheter was assessed for patency. During one of these assessments, a clot was discovered in the venous catheter. The clot obstructed blood flow, making it impossible to aspirate blood from the catheter. This resulted in the dialysis machine displaying continuous alarms, as the required blood pump flow rate could not be achieved. The blood tubing showed the presence of air bubbles, and arterial pre-pump pressure readings were significantly negative. These signs confirmed the presence of CRT⁹, which hindered the efficiency of the hemodialysis process. To address this issue, the physician decided to administer alteplase, a recombinant tissue plasminogen activator (rt-PA), to dissolve the clot. Alteplase was injected at a dose of 2 mg/2 mL, according to the recommended protocol for treating blocked venous catheters. After a dwell time of 30 minutes, the catheter was tested for functionality. Kidney Disease Outcomes Quality Initiative (KDOQI) recommends the intraluminal administration of 2 mg of alteplase per central venous catheter (CVC) port to restore the function of dysfunctional CVC due to thrombosis. This standard dose has been shown to effectively restore catheter functionality. The drug can be administered in two ways: the push protocol, completed in about 30 minutes, or the dwell protocol, where the medication remains in the catheter for an initial 30 minutes. If catheter function is not restored, the alteplase solution is left to dwell for an additional 90 minutes. Alteplase restores blood flow through the catheter, improves pre-pump pressure, and helps

eliminate air bubbles, so hemodialysis was successfully resumed. The patient experienced no adverse reactions or complications during or after the administration of alteplase. No evidence indicated bleeding, and no issues arose during subsequent dialysis sessions. Following the event, the nursing staff took preventive measures by regularly flushing the catheter with an anticoagulant locking solution to maintain patency. They also monitored signs of occlusion and infection.¹⁰ Patient education played a crucial role, emphasizing the importance of avoiding activities that could compromise the catheter. This comprehensive approach aimed to ensure proper catheter functionality and improve overall patient outcomes.

This case demonstrates the efficacy of alteplase in managing CRT among patients undergoing hemodialysis, allowing the continuation of dialysis therapy without the need for invasive procedures such as catheter replacement. The prompt administration of alteplase led to restoring blood flow, preventing further complications, and ensuring the patient could continue their dialysis regimen effectively.

Discussion

The case study highlights the effectiveness of alteplase in treating CRT and restoring proper blood flow through the catheter. This treatment allowed the patient to continue hemodialysis without the need for invasive procedures such as catheter replacement. Alteplase, when administered promptly and appropriately, can significantly improve the success of hemodialysis among patients with CRT, reducing the risk of further complications and improving patient outcomes.

However, the use of alteplase comes with risks. Potential side effects include bleeding complications, allergic reactions, and other systemic effects. Therefore, the drug needs to be administered under careful medical supervision, with appropriate monitoring during and after treatment. Alteplase is primarily used as a thrombolytic agent in treating CVC thrombosis. According to the

KDOQI guidelines, the success rate of rt-PA in restoring CVC patency ranges from 50 to 90%. Alteplase exhibits a mild antifibrinogen effect, a potent antithrombotic effect, and a relatively low risk of bleeding.¹¹

Conclusion

The use of alteplase in treating catheter-related thrombosis among patients undergoing hemodialysis is an effective and minimally invasive approach. This case highlights the importance of timely intervention to restore catheter function, ensuring that patients can continue their treatment without requiring catheter replacement. Further studies are needed to evaluate the long term efficacy and safety of alteplase in CRT management, as well as to determine optimal dosing protocols for different clinical scenarios.

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