Misplacement of a left internal jugular vein puncture into the subclavian vein in a patient undergoing ECMO: a case report

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Key Clinical Message

The left internal jugular vein, as an alternative central venous vascular access for VV-ECMO patients, must be guided and evaluated in real time using ultrasound during puncture to minimize catheter misplacement.

Abstract

Extracorporeal membrane oxygenation (VV-ECMO) represents a crucial therapeutic modality employed in the management of severe respiratory failure. Most of the time, the femoral vein is chosen as the draining vein for VV-ECMO, and the blood that has been oxygenated through membrane oxygenation is put back into the right internal jugular vein. In the context of resuscitation protocols for patients with critical illnesses, it is customary to retain a central vein. However, in the case of patients undergoing VV-ECMO, the utilization of the left internal jugular vein can serve as a viable alternative for central venous access, particularly if a catheter has not been previously inserted in the subclavian vein prior to the operation. The purpose of these procedures is to optimize the safeguarding of the lungs and minimize the potential for lung injury resulting from the puncture procedure. The present case pertains to a male patient of 76 years who is currently experiencing acute respiratory failure as a result of a severe pneumonia infection. During the course of VV-ECMO, the patient underwent a procedure involving the puncture of the left internal jugular vein. Despite the utilization of ultrasound guidance during the puncture procedure, an occurrence of catheter misplacement took place, leading to the inadvertent entry of the catheter tip into the ipsilateral subclavian vein.

Keywords

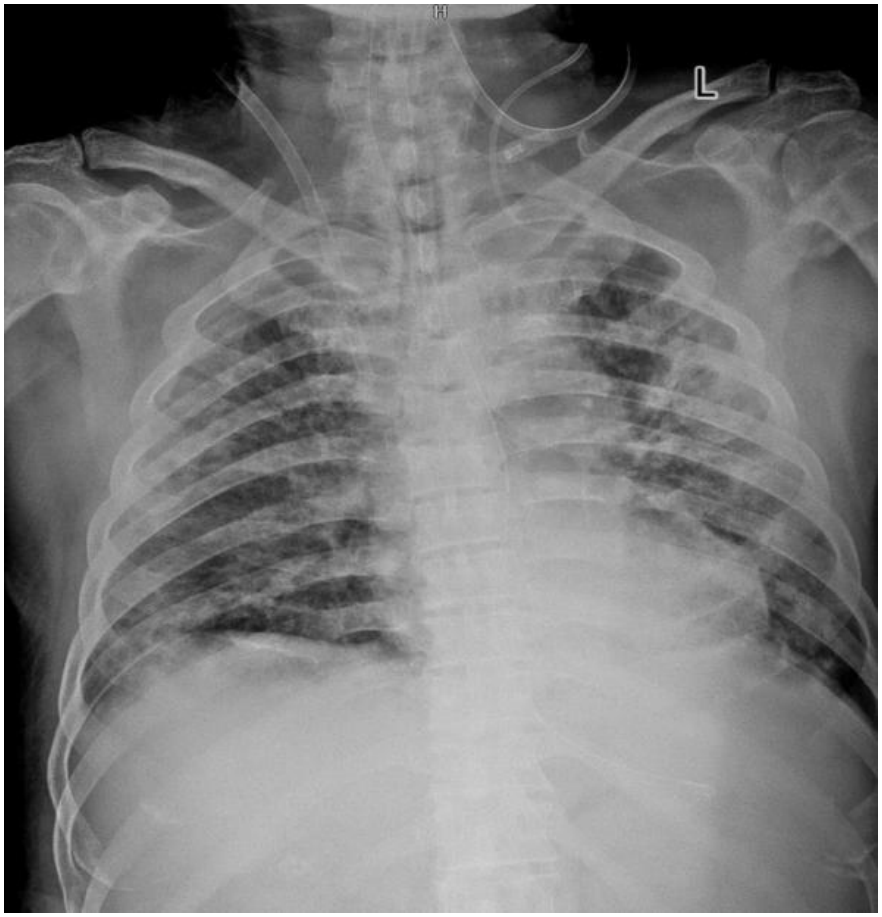
left internal jugular vein puncture; subclavian vein; catheter misplacement; ECMO; ultrasound guidance

1 INTRODUCTION

Veno-venous Extracorporeal Membrane Oxygenation (VV-ECMO) is considered a final therapeutic option for managing cases of severe respiratory failure. Typically, the right internal jugular vein and femoral vein are selected as the preferred sites for catheterization access in VV-ECMO procedures.[1] The central venous catheter (CVC) serves as a crucial vascular access point for patients in critical conditions. The placement of catheters in patients experiencing severe respiratory failure presents a significant clinical challenge that necessitates attention. The subclavian vein is the preferred anatomical location for central venous puncture.[2] The primary complications resulting from the puncture primarily encompass pneumothorax, hemothorax, and catheter embolism.[3] However, in individuals experiencing severe respiratory failure and undergoing VV-ECMO, the likelihood of encountering secondary lung complications, such as pneumothorax and hemothorax, is significantly heightened when subclavian vein puncture is employed. This is primarily due to the already compromised lung function and the application of a higher positive end-expiratory pressure, typically equal to or greater than 10cmH_2O, by the ventilator. Therefore, the utilization of a left internal jugular vein catheter emerges as a more favorable option. This paper presents a case study wherein a puncture of the left internal jugular vein led to the inadvertent insertion of the catheter tip into the ipsilateral subclavian vein. Although no adverse consequences were observed, it is crucial to present a concise overview of this case in order to mitigate the likelihood of future instances of catheter misplacement.

2 CASE REPORT

The patient is a 76-year-old man who was confined to our hospital's intensive care unit after experiencing fever for over ten days and dyspnea for one week. The patient developed a fever more than ten days prior to admission, with a maximum temperature of 38.5°C, accompanied by a cough, and gradually developed respiratory distress during treatment in an outside hospital, with oxygen saturation persistently lower than 90%. His condition continued to deteriorate despite tracheal intubation, mechanical ventilation, and anti-infective treatment before he was transferred to our hospital and admitted to our department. Physical examination upon entry: Temperature: 36.7°C; heart rate: 112; respiration: 19; blood pressure: 61/41mmHg; oxygen saturation: 87% (inhaled oxygen concentration: 100%); tracheal intubation; mechanical ventilation. The patient's oxygen saturation could not be maintained, fluctuated between 76 and 88%, and was treated urgently with extracorporeal membrane oxygenation (ECMO). The mode was VV-ECMO. The catheterization sites were the right femoral vein and the right internal jugular vein. The mode was VV-ECMO. The placement of a left femoral vein catheter to sustain venous access and a left femoral artery catheter for invasive hemodynamic monitoring occurred simultaneously. Postoperative thoracic digital radiography (DR) revealed a lung infection and a catheter for ECMO(Figure 1). A diagnosis of severe pneumonia and acute respiratory distress syndrome was made for the patient. With ECMO support, prone ventilation was administered. During prone ventilation, the patient's left femoral vein and left femoral artery catheter demonstrated severe blood leakage, and the effect of compression to halt bleeding was ineffective. To avoid continuous bleeding and bloodstream infections, the catheters were removed. The subclavian vein was not punctured to prevent pulmonary injury. Therefore, the left internal jugular vein was chosen for puncture and catheterization. The patient was positioned in a flat-lying position with the head turned to the right, and after routine disinfection and towelling, a double lumen venous catheter was successfully inserted using Seldinger's technique. The left internal jugular vein catheter tip was in the subclavian vein (Figure 2). Due to the patient's requirement for protracted fluid therapy, and catheter infusion unobstructed, a peripherally inserted central catheter (PICC) was placed in the left brachial vein 2 weeks after the left internal jugular vein. After bedside DR (Figure 3) confirmed that the head of the PICC catheter had entered the superior vena cava, the left internal jugular catheter was removed. The patient was effectively weaned from ECMO on the 35th day of treatment (Figure 4) and from the ventilator on the 50th day of treatment before being transferred to the general ward for further treatment.



3 DISCUSSION

Critical patients often necessitate the use of a central venous catheter that remains in place for the purpose of monitoring hemodynamics, administering fluid therapy, and obtaining blood samples to assess oxygen dynamics.[4] The user's text is too short to be rewritten academically. Ensuring the accurate placement of the catheter tip is an essential prerequisite for the effective functioning of a central venous catheter. The internal jugular vein, which is the largest venous trunk in the neck, can be found in the region between the sternal head and the clavicular head of the sternocleidomastoid muscle. Due to its superficial location, it is utilized as a common site for central venous puncture procedures.[5] The selection of the right internal jugular vein for puncture is a common practice in clinical settings due to several advantageous anatomical characteristics. Firstly, this vein is typically thicker and offers a more direct route to the superior vena cava. Additionally, it is situated lower within the right pleural vault and lacks a thoracic duct, further facilitating the procedure. Lastly, the right internal jugular vein is particularly convenient for right-handed manipulation.[6] In cases where the right internal jugular vein is currently occupied or if there are contraindications to puncture, such as stenosis or occlusion, the left internal jugular vein may be chosen as an alternative option.

Common internal jugular vein puncture complications include arterial puncture, catheter misplacement, hemothorax, pneumothorax, and infection.[7] The incidence of catheter misplacement in the internal jugular vein is 5.3%, and the risk of catheter misplacement in the left internal jugular vein is higher than in the right.[8,9] Common complications of catheter misplacement include the wrong choice of vessels at the puncture

site, mispuncturing of the artery. However, infrequently, the tip of the internal jugular vein catheter is misplaced in the subclavian vein.

The use of ultrasound has considerably increased the success rate of puncture and tube placement and decreased the risk of catheter misplacement. [10]The use of ultrasound-guided puncture reduced the incidence of catheter misplacement complications (RR:0.29, 95%CI:0.17-0.52) and had a higher first puncture success rate and overall success rate (RR:1.12, 95%CI:1.08-1.17), according to a meta-analysis.[11] Ultrasound-guided puncture does not directly reduce the risk of catheter tip misplacement. The risk of catheter tip misplacement is increased because the use of ultrasound to check the position of the guidewire tip and the venous catheter tip is frequently neglected during the puncture procedure, intraoperative adjustment of catheter tip position is not performed, and the correct position of the venous catheter is only observed by x-ray or other means after catheter placement is complete.

In this case, the ECMO catheter was already in the right internal jugular vein, and the ventilator's PEEP was 10 cmH_2O, so the left internal jugular vein was punctured and cannulated instead of the subclavian vein to avoid damaging the lungs. Normally, during internal jugular vein puncture and cannulation, the inserted finger guide wire usually enters the proximal end of the brachial vein along the direction of the vein and blood flow, so that the intravenous catheter reaches the target position. In this case, the PICC line path showed that the patient's subclavian vein and head and arm veins had no abnormal variations, but the catheter tip entered the subclavian vein. The reasons were analyzed as follows: 1. The patient's head was turned to the right at a large angle and the head was tilted to the right, which increased the angle of the venous angle; 2. During puncture, the bevelled surface of the tip of the puncture needle was not oriented towards the proximal end, and at the same time, when the right hand placed the guidewire, due to the blockage of the head, the J-side of the tip of the guidewire was not oriented towards the proximal end but towards the distal subclavian vein, and the catheter tip entered the subclavian vein after the guidewire entered the venous angle; 3. Failure to perform timely ultrasound exploration of adjacent vessels to rule out guidewire misplacement after guidewire placement and subsequent placement of the intravenous catheter into the subclavian vein, resulting in catheter misplacement.

The subclavian vein is the preferred site for initial central venous cannulation in VV-ECMO patients. A PICC can be used if the patient is hemodynamically stable and requires protracted intravenous fluid support.[12] If the left internal jugular vein catheter is required for specific reasons, imaging should be performed on the patient's local and adjacent vessels prior to the procedure. The bevel of the puncture needle should be directed proximally during the procedure. To reduce the risk of catheter misplacement, the J-side of the guidewire point should face proximally during placement. If significant resistance is encountered during guidewire insertion, a misplaced catheter is possible. In this instance, do not force the guidewire and place an intravenous catheter; instead, use ultrasonography to determine the position of the guidewire and remove it for re-insertion if necessary. Postoperative x-rays can accurately depict the catheter tip's location, but there is a significant delay.[13] Consequently, during the puncture procedure, ultrasound guidance must be used throughout the catheterization procedure, and during the catheterization procedure, the subclavian vein, superior vena cava, and right atrium must be probed in a timely manner for catheter echoes. If necessary, ultrasound can be called in to assist, which can help identify early ectopic catheters, and adjustments can be made to ensure the catheter tip is in the correct position.[14]

CONSENT

A written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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