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Migration of a Correctly Positioned Tip of a Central Venous Catheter from the Superior Vena Cava to the Left Subclavian Vein within a Short Time

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Introduction

Complications from central venous catheterization include arrhythmia, embolism, and infection, among other events.^{1,2)} Checking the position of the catheter tip is essential and is routinely assessed by plain radiography of the chest immediately after placement.^{3,4)} However, subsequent assessments of the position during follow-up are not routinely performed. In the present study, we report a case in which the tip of a central venous catheter (CVC) migrated from the superior vena cava (SVC) to the left subclavian vein a few days after placement, even though its position was confirmed as appropriate immediately after catheterization.

Case Report

The patient was a 2-year-old girl who was admitted to our hospital with suspected anti-N-methyl-D-aspartate (NMDA) receptor encephalitis, which was confirmed by a blood test 2 weeks after hospitalization. Upon admission, she was in a turbulent state, with sudden cries and seizure-type body movements. We determined that she would require a long period of sustained sedation with drugs, and she was admitted to the intensive care unit (ICU) the day after hospital admission. A CVC (SMACTM Plus 17G × 8 cm, double-lumen type; Covidien, Tokyo, Japan) was inserted for 6.3 cm in her right internal jugular vein on day 3 in the ICU for infusion management and drug administration. Immediately after she was admitted to the ICU, we started continuous infusion of midazolam, and infusion of dexmedetomidine was subsequently begun after central venous catheterization. Her body movements continued to be seizure-like, despite this sedation. Deeper sedation required for whole body control was started on day 4 in the ICU, and tracheal intubation was performed for artificial ventilation. The artificial ventilation mode was as follows: pressure controlled (16 cmH₂O) synchronized intermittent

mandatory ventilation and pressure support of 8 cmH₂O with positive end-expiratory pressure of 5 cmH₂O, an inspired oxygen concentration of 0.4, and a respiratory ratio of 24/min. At that time, the central venous catheter was removed from the right internal jugular vein, as its length or placement in the body was insufficient. Instead, central venous catheterization using the same type of catheter was performed with the right subclavian vein approach, inserted for 8.0 cm. The catheter length from the junction between the SVC and innominate vein was approximately 3.5 cm judged by chest radiography. A chest radiograph taken immediately after placement showed that the tip nearly reached the inlet section of the SVC of the right atrium, which was deemed sufficient (Figure 1). On day 5 in the ICU, the patient was started on a continuous infusion of fentanyl. Seizure-type body movements, however, continued. A routine chest radiograph on the morning of day 11 in the ICU showed that there was no abnormality in the catheter tip position. However, the infusion pump obstruction alarm sounded and a second chest radiograph was obtained on the same day, which revealed that the catheter tip had migrated to the left subclavian vein (Figure 2). We believe that the migration of the catheter tip itself had no



Figure 1: Chest image on day 4 in the intensive care unit. Plain radiography of the chest is used to assess the position of the catheter tip after insertion of the central venous catheter via the right subclavian vein approach. The catheter tip is correctly located slightly caudal from the tracheal bifurcation.

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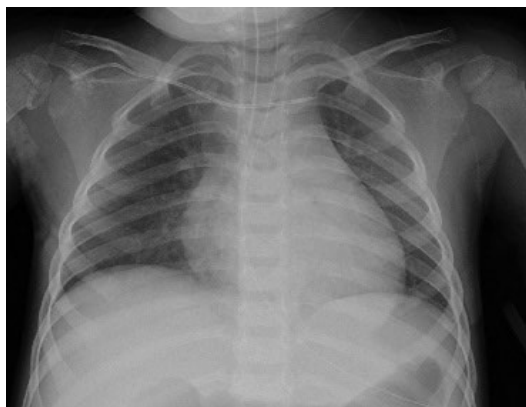


Figure 2: Chest image on day 11 in the intensive care unit. Plain radiography showing that the central venous catheter that was placed via the right subclavian vein approach continued horizontally to the left side of the patient's body trunk, and the tip migrated into the left subclavian vein. There are no significant differences in the length of the catheter inside the patient's body, lung field radiolucency, or heart shadow compared with those in Figure 1.

impact on infusion management and drug administration, so the patient was placed under observation. The patient was discharged from the ICU on day 75 with no complications from the central venous catheterization.

Discussion

Several cases have been previously reported in which catheter tips have migrated after CVCs were correctly placed in their target positions. Ahuja et al. reported that a chest radiograph showed that a CVC tip that was initially placed towards the right atrium from the right subclavian vein had migrated to the left internal jugular vein 5 days after intervention in a 25-year-old woman diagnosed with choriocarcinoma with hemangiomas in the liver, who had a complication with respiratory failure.⁵⁾ The present case is similar to that report; however, it is the first reported case of migration to the left subclavian vein in a pediatric patient.

The catheter tip migration in the present case could have been caused by the regular thoracic movement from the artificial ventilation.⁵⁾ With the subclavian vein approach, catheter fixation is believed to be superior to that with the internal jugular vein approach. However, considering the mobility of the shoulder joint, it is possible that the catheter could shift position during seizure-like body movements involving involuntary movements and instability of intrathoracic pressure, whether or not the person is receiving artificial ventilation or sedation.

It is also possible that the central venous catheter position may have shifted due to the "jet effect" that occurs

during drug injection.⁶⁾ This is a phenomenon wherein pressure during drug injection via a catheter causes the catheter tip to move. After intubation and exchange of the CVC, the patient in the present case received continuous infusion of fentanyl (5–15 $\mu\text{g/hr}$), midazolam (2.4–7.2 mg/hr), and dexmedetomidine (8–12 $\mu\text{g/hr}$) intravenously, and 2–6 mg of midazolam was additionally injected for sedation several times daily until the migration of the tip was recognized. However, the "jet effect" may not have played a role in the catheter movement, because the size of the catheter was small, and the frequency of the bolus injection had decreased from seven times to once by the time the CVC tip migration occurred.

In a pediatric patient, it is best to avoid frequent repeated plain radiography to check the catheter position in order to prevent overexposure to radiation. It is possible that position checks can be more easily and less invasively performed with ultrasonography; however, ultrasonography is associated with more technical problems and issues of precision than is plain radiography.⁷⁾ Further studies exploring these challenges should be conducted.

Conclusion

We report the case of a patient with anti-NMDA receptor encephalitis in whom a CVC tip was placed in the correct position in the SVC via the right subclavian vein approach. The catheter tip migrated, however, to the left subclavian vein a few days later. It is possible for the initial catheter tip location to shift over time in central venous catheterization, particularly in patients controlled by artificial ventilation due to the variable intrathoracic pressure. We conclude that appropriate follow-up using chest radiography or ultrasonography is therefore required whenever complications associated with catheter placement are suspected.

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