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Case Report

Aspiration of massive free air from a large bore intravenous catheter sheath: A case report

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ABSTRACT

We firstly experienced a rare case demonstrating that massive volume of free air was aspirated from a large bore intravenous catheter sheath of the pulmonary arterial catheter during placement. A 44-year-old male patient underwent the emergency induction of anesthesia for transplantation of liver donated by the brain death subject. After the induction, the central venous and pulmonary artery catheter placement was conducted. The aspiration of venous blood confirmed the intravascular insertion, but massive free air was aspirated when we advanced the sheath proximally. A perforation of subclavian vein and subsequent pneumothorax was strongly suspected. The emergency computed tomography revealed no sign of pneumothorax, pneumomediastinum nor extravasation. The operation was undergone with intensive monitoring and no further adverse complication was observed. The postoperative medical inquiry concluded that the massive free air was not aspirated from extravascular space, for example, thorax or mediastinum through the tip of the sheath, but from the proximal main port of the sheath. When the tip of sheath is occluded by the migration into small vessels, the large negative pressure through side port might easily aspirate the air through the 1-way valve of the main proximal port. Physicians should keep in mind of the structure of the catheter sheath.

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Introduction

Pneumothorax is one of well-known complication during central venous catheterization through an internal jugular vein [1]. Deep puncture of a patient neck causes piercing of thorax and lung. The physician could recognize the penetration by the aspiration of air during pulling of the plunger of the syringe connected to the needle or the catheter. Recently, we experienced a case in which the massive free air could be aspirated through the intravascular large bore catheter sheath. The written informed consent was obtained from the patient.

Case report

A 44-year-old male patient underwent the emergency induction of anesthesia for transplantation of liver donated by the brain death subject. After the induction of anesthesia with propofol, fentanyl and remifentanyl, the trachea was intubated with administrating of rocuronium, and the mechanical ventilation was initiated. For the perioperative drugs administration and cardiovascular monitoring, a central venous catheter and a pulmonary arterial catheter placement were conducted. Ultrasound sonography showed the presence of flap in the right jugular vein suspected as jugular valve, and the left jugular vein was chosen for the catheterization.

With the ultrasound guidance, the 2 guidewires were introduced into the left jugular vein. First, the central venous catheter was placed without any difficulty using Seldinger's methods. Then, the sheath for pulmonary arterial catheter placement was conducted in the same technique (percutaneous sheath introducer kit with integral hemostasis valve/side port for use with 7.5-8 Fr. Catheters, Arrow international, Teleflex Medical, Tokyo, Japan). The sheath and the detachable internal dilator were easily introduced into the vein through the guidewire. Immediately after the removal of the dilator from the sheath, the physician connected the syringe to the side port of the sheath. Although, he pulled the plunger and confirmed intravascular insertion by aspirating of venous blood, the unexpected air was aspirated from the side port of the sheath instead of blood when he advanced the sheath for the appropriate position.

When he pulled out the sheath proximally about 1 cm, the blood was easily aspirated. However, he advanced the sheath deeply into the vein, the air was aspirated, again. The perforation of the sheath into thorax or mediastinum was strongly suspected. The operation was temporally suspended and emergency computed tomography (CT) was taken following the recommendation of Safety Committee of the institute. The CT examination revealed no apparent sign of pneumothorax and pneumomediastinum (Fig. 1). The extravasation of blood was not detected in the image using contrast-enhanced CT (Fig. 2). The reconstructed 3-dimension images suggested the migration of the tip of the sheath into small vessels (Fig. 3).

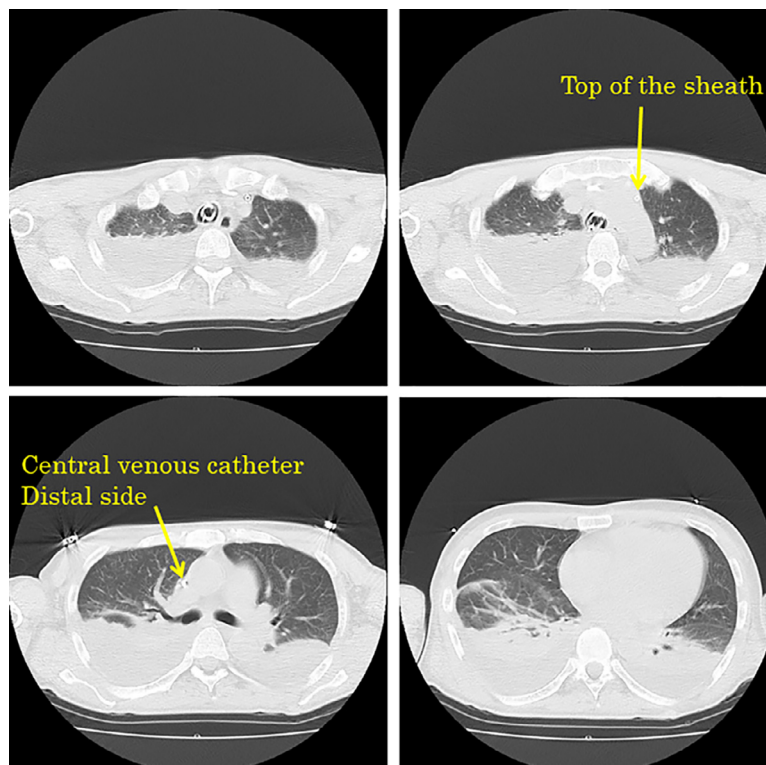


Fig. 1 – The CT image of the patient. There was no air in the thorax and the mediastinum. Pneumothorax and pneumomediastinum was denied.

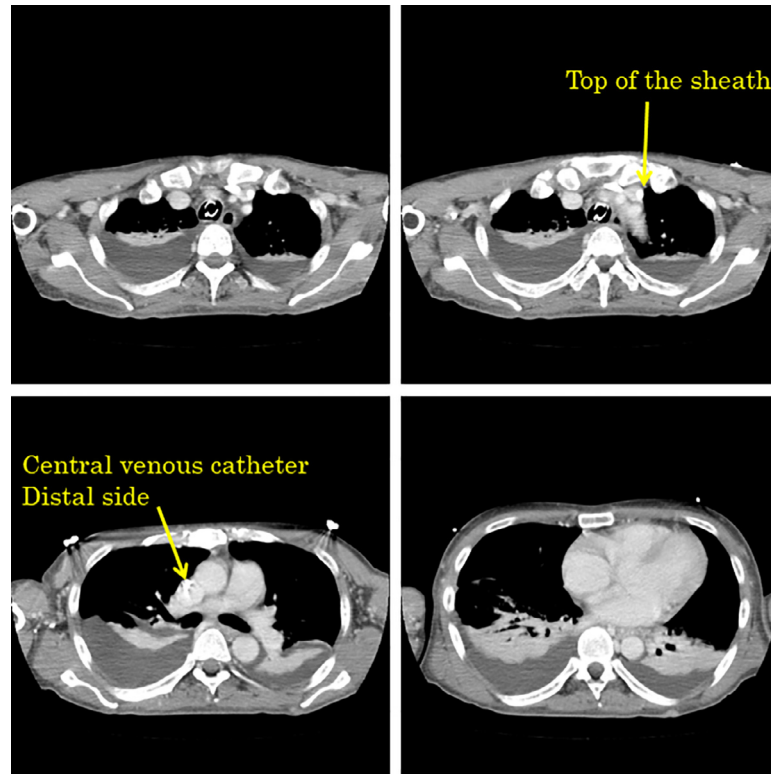


Fig. 2 – The CT image of the patient with contrast enhancement. There was no sign of extravasation of contrast media. The vessel injury was denied.

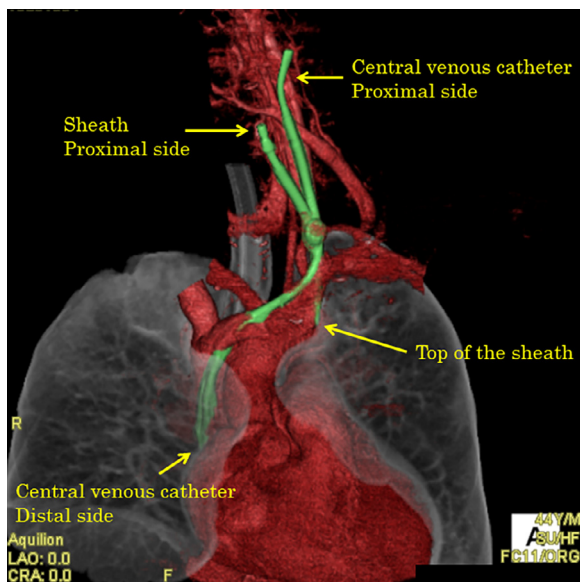


Fig. 3 – The 3-dimensional reconstruction image of CT. The central venous catheter was introduced correctly, whereas, the sheath was migrated into small vessels.

Therefore, we decided to continue the transplantation following to the original plan under intensive monitoring despite of the unsolved incident. The pulmonary artery catheter was

inserted through the right internal jugular vein. The original sheath was not removed until the next day. After the confirmation of no adverse complication, the sheath was removed without any difficulty. No complication was observed during the postoperative period.

Discussion

An aspiration of free air during puncture of a central vein is an absolute evidence of the needle perforation into thorax or mediastinum. Although the CT images demonstrated no abnormality (Figs. 1 and 2), all physicians in charge of the case believed that the free air was aspirated from the thorax or mediastinum [2,3].

On the next day of the incident, the emergent medical inquiry was held in the department of anesthesiology and the detail of the procedure and the progress of the event were reviewed. In the inquiry, the anesthesiologists in charge emphasized that the massive free air could be repeatedly aspirated from the sheath using 20-mL disposable syringe. The origin of massive free air was thoroughly discussed.

Thereafter, we speculated that the air might be aspirated through the main proximal port of the sheath when the tip of sheath was occluded. The tip of sheath had migrated into the left hemiazygous vein or the left intrathoracic vein instead of the innominate vein (Figs. 2 and 3). The migration of the sheath into a small vessel could develop a temporal occlusion

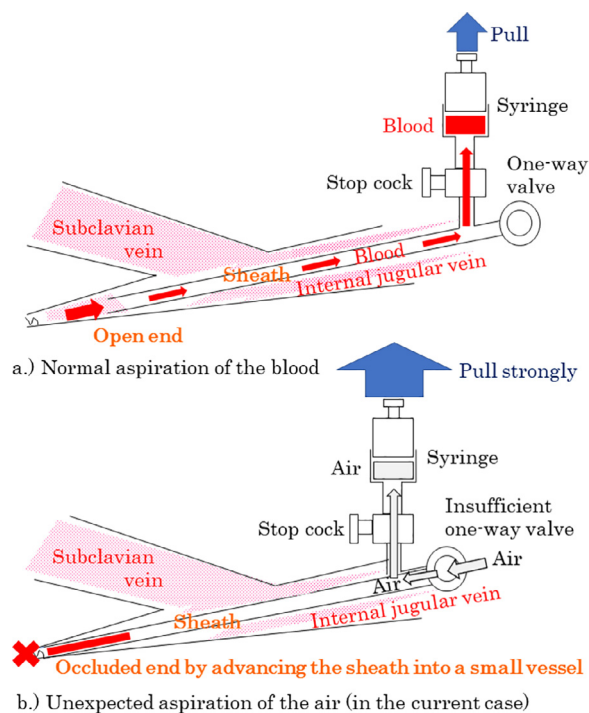


Fig. 4 – The schema of the mechanism of the current incidental aspiration of the blood and the air.

of the tip of the sheath, and concurrent negative pressure from the side port of the sheath could aspirate the air from the main port instead of the blood from the tip (Fig. 4).

We verified our hypothesis using another new sheath. The new sheath without any manipulation allowed only a little air leakage when the tip was occluded. The 1-way valve of the proximal port usually prevents from aspirating air [4,5]. However, after the preparing procedures including the confirmation of connectivity between the sheath and the dilator repeatedly (ie, the operator repeats the maneuver introducing the dilator to the sheath and detaching the dilator from the sheath), the 1-way valve of the proximal port might become loosen and the air could be passed (Fig. 5). This procedure is officially unauthorized by the maker; however, some trainees of anesthesiology had tried to check the connectivity.

Although the sheath of the current case had already discarded and the exact mechanism is uncertain, we concluded that the massive free air aspirated from the sheath was not from thorax or mediastinum but from the proximal port of the sheath. Fortunately, our decision did not abort the important chance of the liver transplantation from the brain death donor and there was no adverse complication in the patient. We recommend that physicians should keep in mind of the

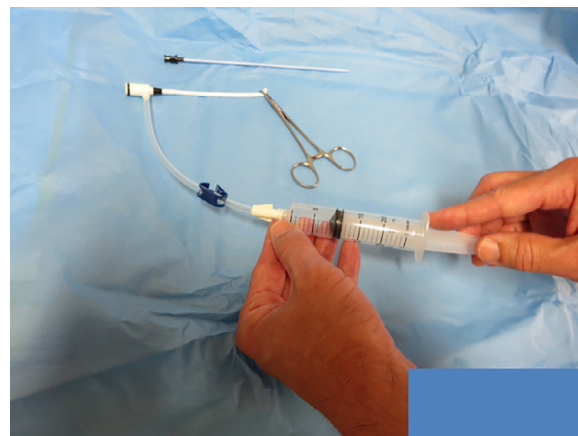


Fig. 5 – The picture demonstrates the view of the laboratory experiment using the new sheath. The tip of sheath was pinched by the forceps and the negative pressure from the side port can aspirate the air.

structure of a catheter sheath and rare possibility of the aspiration of free air through a port.

Author contributions

Takahiro Tamura discussed about the case and wrote the manuscript.

Masashi Takakura modified and revised the manuscript.

Yushi Adachi presented the hypothesis and conducted to report the case.

Maiko Satomoto revised the manuscript.

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