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Difficult pulmonary artery catheterization caused by an interluminal leak

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Introduction

Pulmonary artery (PA) catheterization is known to be occasionally difficult [1]. Malfunction of a PA catheter is rare [2] and is usually obvious when present. Here, we describe failed PA catheterization caused by an interluminal leak that was not readily detected by bedside checking.

Case report

A 72-year-old woman was scheduled for aortic valve replacement. After the induction of anesthesia, the insertion of a PA catheter (model 746H8F CCO/SvO_2/VIP catheter; Baxter Edwards, Irvine, CA, USA) was attempted via the right internal jugular vein. A brief inspection of the catheter, as recommended by the manufacturer, did not indicate any damage. The catheter was threaded into the vein about 20 cm, and then advanced further with the balloon inflated with 1.5 ml of air. A typical right atrial and then right ventricular pressure tracing was observed. However, the catheter would not float into the PA. With further advancement of the catheter, ventricular dysrhythmia occurred, and the catheter was withdrawn to the right atrium with the balloon deflated. At that time, we noticed that the volume of air returned to the syringe was about 0.5 ml, which was less than the volume initially used for inflation. A rupture of the balloon was suspected, and the catheter was withdrawn from the introducer. The balloon was inflated in a cup of saline and carefully examined. No bubble appeared. Without apparent evidence of a rupture, we tried to insert the same catheter with the patient in different positions [3], but the results were the same. A loss of air in the balloon was noticed again. To check for possible leaks once again, we kept the balloon inflated with air in saline for a few minutes, but no deflation was observed. Little loss of air was evident when the air returned to the syringe at deflation. After a few more attempts, we opened another package containing a PA catheter, and this catheter floated into the PA without delay. The operation proceeded uneventfully and the patient was discharged from the hospital without complication.

The catheter that failed to enter the PA was sent to the manufacturer's laboratory. Tests at the laboratory revealed an interluminal leak between the balloon inflation lumen and the thermistor lumen. The leak was found at the yellow triangular part of the catheter, where multiple lumens divide separately (Fig. 1; *A*).

Discussion

We have reported here a case of difficult PA catheterization caused by a structural defect of the catheter. It has been reported that an erroneous pressure reading was caused by an interluminal communication between the balloon lumen and the PA lumen of a catheter [2]. However, an interluminal leak causing difficult PA catheter placement has not been reported previously.

The first sign that alerted us to catheter malfunction was a loss of air from the balloon. However, we could not detect the leak by bedside checking. Even when we kept the balloon inflated in saline for a few minutes, we were unable to detect the leak. We first reasoned that the leak was evident only when the balloon was pressurized under right ventricular pressure. However, the actual pressure in the balloon inflated with 1.5 ml of air

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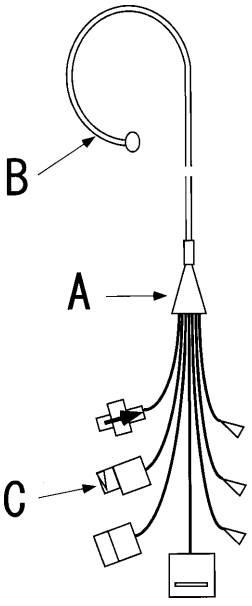

Fig. 1. Schematic presentation of pulmonary artery catheter. *A* The triangular part, where an interluminal leak between the balloon lumen and the thermistor lumen was found; *B* the thermistor, which is located 4 cm from the tip of the catheter; *C* the thermistor connector

was 220–250 mmHg, as reported previously [4], when we measured it with three of the same model catheters. Thus, the difference between atmospheric and right ventricular pressure cannot solely explain the deflation of the balloon in the patient. Probably, the combination of the leak and the prolonged manipulation of the catheter in the patient resulted in deflation of the balloon and failed catheterization.

This case illustrates the difficulty of detecting a minor interluminal leak. A rupture of the balloon can be detected easily by bubbling when the balloon is inflated in saline. However, to detect an interluminal leak, one may have to submerge the entire catheter in saline with the balloon inflated. According to the manufacturer, the proximal part of the thermistor lumen (Fig. 1; *C*) is open to the air, whereas the distal end (Fig. 1; *B*) is tightly sealed. Therefore, if we had examined the catheter in this way for a prolonged period, we would have detected bubbles from the proximal part of the thermistor lumen (Fig. 1; *C*). However, such a process is time-consuming, and it may not be practical to check all the catheters in this way. Furthermore, the manufacturer discourages the procedure of submerging the catheter in saline, because this may result in leakage of fluid into the thermistor lumen, and the development of an electrical short circuit. The alternative is to abandon the catheter when a loss of air in the balloon is observed in vivo, even if the tests ex vivo look all right.

An interluminal leak may cause intravenous air if the air used for balloon inflation leaks into a lumen that communicates with the patient's bloodstream, such as the catheter tip lumen and the injection lumens. In our patient, the catheter leak was into the thermistor lumen, whose distal end was air-tight. Thus, the air that leaked into the lumen would have been dispelled from the proximal end of the catheter. Our patient did not suffer clinical sequelae of pulmonary or systemic air embolism.

A few reports have described defects in PA catheters that could have resulted in complications if they had not been noticed [5, 6]. The manufacturers of the catheter that we used commented that they checked for luminal leaks before shipping the catheters, and that interluminal leaks were rare. They also said that they were trying to improve their product line, and their checking system further to eliminate any defective catheters.

In summary, we have reported here an interluminal leak in a catheter that caused difficult PA catheterization. We advise that mechanical defects in a PA catheter should be noted as a possible cause of difficult catheterization. When the balloon of a PA catheter is deflated in vivo, the volume of air returning to the syringe should be carefully checked so as to detect possible leaks.

References

1. Baraka A, Nawfal M, Dahdah S (1991) Difficult pulmonary artery catheterization in the patient with tricuspid regurgitation. Anesthesiology 74:393
2. Mark JB, Spillane R (1994) Interluminal communication in a pulmonary artery catheter causing artifactual pressure measurement. Anesth Analg 78:1184–1186
3. Keusch DJ, Winters S, Thys DM (1989) The patient's position influences the incidence of dysrhythmias during pulmonary artery catheterizaion. Anesthesiology 70:582–584
4. Hardy JF, Taillefer J (1983) Inflating characteristics of Swan-Ganz catheter balloons: clinical considerations. Anesth Analg 62:363–364
5. Erb JM, Ramsay JG (1998) Is your pulmonary artery catheter shedding? Anesthesiology 89:543–544
6. Fitch JC, Fand XE, Dewar ML (1998) Preinsertion pulmonary artery catheter flushing. Anesthesiology 88:1690–1691