Venous Air Embolism Occurring After Removal of a Central Venous Catheter

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Venous air embolism is a well-known risk of central venous catheter placement in critically ill patients. However, clinicians may not be aware that venous air embolism can also occur after removal of a central venous line. Described in the following two case reports are what are believed to be episodes of air embolism after removal of central lines.

Case 1

A 77-yr-old woman was admitted to St. Luke’s Hospital for repair of an abdominal aortic aneurysm. A balloon-tipped, flow-directed pulmonary artery catheter was inserted using a Cordis sheath in the right internal jugular vein after the induction of general anesthesia. She then underwent uneventful repair of the aneurysm and was transferred out of the surgical intensive care unit on the second postoperative day after an uneventful course in the unit. At the time of transfer the pulmonary artery catheter was removed, but the Cordis sheath was left in place. On the fourth postoperative day the Cordis sheath was removed and a dressing of povidone-iodine ointment and 2 x 2 gauze was placed over the wound with a single strip of adhesive tape. Approximately 15 min after the Cordis sheath was removed, she walked to the bathroom, and within moments of standing she complained of feeling dizzy. When she returned from the bathroom the nurse helping her reported that she suddenly collapsed onto the bed and became unresponsive to verbal queries, although she had her eyes open. On telemetry monitoring she was found to have a sudden increase in heart rate from 85 to 120–130 beats/min, and her blood pressure increased from 120/80 to 190/95 mm Hg. After 2 min the episode resolved. Arterial blood gas tensions while breathing with 4 L/min oxygen flowing through a nasal cannula showed a decrease in \( P_{\text{aO}_2} \) from 80 mm Hg that morning to 42 mm Hg immediately after the episode. A chest radiograph was unchanged from the morning film, revealing only a small area of atelectasis in the left base. A pulmonary ventilation/perfusion scan and pulmonary angiogram were done; they revealed no evidence of pulmonary embolus. The hypoxemia resolved with 50% oxygen by mask, and she was monitored in the intensive care unit overnight. The patient made an uneventful recovery and was discharged home several days later.

Case 2

A 67-yr-old man was admitted to St. Luke’s Hospital for chemotherapy for metastatic squamous cell carcinoma of the larynx. Because the intervals between chemotherapy courses were 2–3 mo, a central venous catheter was placed each time he came in for treatment. On this admission a triple-lumen central venous line was placed in the left internal jugular vein. He completed a 10-day course of chemotherapy without incident, and on the day before discharge the catheter was removed. A dressing of gauze and adhesive tape was placed over the wound after the nurse exerted pressure on the area for 10 min. Immediately after the dressing was applied, the patient sat up in a chair, and within 2 min he complained of feeling dizzy. He was promptly placed back into bed. However, by that time he had suffered a cardiac arrest from which he could not be resuscitated. Permission for an autopsy was not granted.

Discussion

The relationship of both episodes related above to the prior removal of a central venous catheter suggests...
that the direct cause of each event was the entrainment of air through the tract formed by the device. In the first patient, pressure had been applied to the site for 10 min, and there was no bleeding noted when the dressing was applied; but when the patient became unresponsive blood was seen oozing from the site. Myocardial ischemia and infarction were excluded by serial electrocardiograms and by normal serum levels of cardiac enzymes; a neurologic consultant also found no evidence for cerebral vascular insufficiency. Because her symptoms and hypoxemia were compatible with pulmonary thromboembolism, this etiology was pursued, but no evidence for an embolus could be found within 3–4 h of the event. The most likely explanation for the event in light of the fact that other possible etiologies were excluded is air embolism that dissipated by the time the pulmonary angiogram was done. The second patient had no history of cardiac disease and was clearly not in a terminal state, but because he was not being monitored at the time the catheter was removed other causes of sudden cardiac arrest cannot be ruled out. Nevertheless, it is noteworthy that both patients had assumed an upright position after removal of a central venous catheter, and both patients were slightly dehydrated on clinical examination before these reported incidents.

Air embolism occurs when the pressure in a vein open to air decreases below atmospheric pressure. These conditions are met during craniotomy in the sitting position, when the level of the venous channels in the skull and dural sinuses are above the level of the heart. This situation also occurs during insertion of vascular catheters in the large veins of the neck. During the insertion of a noncollapsible catheter, deep inspiration by the patient causes the intrathoracic pressure to decrease below ambient pressure, thus entraining air through the catheter (1). It is possible that this mechanism was responsible for air embolism in these patients because each had a catheter in place long enough for a fibrinous tract to form that could remain open after the removal of the device. Additionally, maneuvers such as coughing or straining that would increase the venous pressure immediately after the removal of a catheter might dislodge freshly formed clot, allowing the tract to reopen on the vascular side. The lack of a dressing impermeable to air would allow air to be entrained through a tract during inspiration, when the venous pressure would fall, particularly in dehydrated patients, if clot from the site had been dislodged.

Indeed, this complication of central venous catheter removal has been reported twice before (2,3). The patients in both reports had episodes similar to those reported here. In both cases the authors point out that the catheters were removed when the patients were in an upright position, and neither patient had an occlusive dressing applied. One patient suffered a cardiac arrest and was left in a permanent vegetative state (3); the other patient developed pulmonary edema secondary to pulmonary air embolism and subsequently recovered (2).

Because the outcome of inadvertent venous air embolism associated with the removal of a central venous catheter can be disastrous, if not fatal, we wish to alert anesthesiologists and other physicians who use these devices to this potential complication. Although measures to prevent air embolism are commonly taken during insertion of a catheter by use of Trendelenburg’s position and having the patient breath-hold during passage of the guidewire, we wish to stress that similar measures should accompany the removal of the catheter. Because of the two cases described here, we have instructed the nurses at our hospital to remove central lines with the patient in the supine position, place an occlusive dressing over the site, and then keep the patient at bed rest for 1 h. With proper attention to detail, venous air embolism should be an entirely avoidable complication of central line placement and removal.

References

