



Reducing Risk of Air Embolism Associated with Central Venous Access Devices

Michelle Feil, MSN, RN
Patient Safety Analyst
Pennsylvania Patient Safety Authority

ABSTRACT

Air embolism is a rare but potentially lethal complication of certain medical and surgical procedures. Because air embolism is a preventable hospital-acquired condition that can result in serious harm, it has been labeled a serious reportable event with nonpayment for harm by the Centers for Medicare and Medicaid Services. Between June 2004 and December 2011, the Pennsylvania Patient Safety Authority received 74 reports related to air embolism. The majority of confirmed or suspected air embolisms were attributed to central venous access devices. The widespread use of these devices, along with a high mortality rate attributed to air embolisms related to central venous access devices, warrants special attention. Hospitals can decrease the risk for air embolism by establishing policies and procedures that contain specific air embolism prevention protocols for central venous access device insertion, management, and removal. Other measures to decrease risk include education and competency certification for staff and equipment safety controls. (Pa Patient Saf Advis 2012 Jun;9[2]:58-64.)

INTRODUCTION

Intravascular air embolism is a preventable hospital-acquired condition that can result in serious harm, including death. Intravascular air embolism was labeled a serious reportable event by the National Quality Forum in 2002.¹ In 2006, this list was updated and adopted by the Centers for Medicare and Medicaid Services (CMS) as part of the Inpatient Prospective Payment System, which became effective October 1, 2008, instituting nonpayment to hospitals in situations of patient harm due to occurrence of these serious reportable events.²

Intravascular air embolism occurs when two conditions are met: (1) there is direct connection between a source of air and the vascular system and (2) the pressure gradient favors the entry of this air into the bloodstream. This can occur through active injection of air into the bloodstream or through passive movement of air into the bloodstream when the venous pressure is less than the prevailing atmospheric pressure. Except in cases of trauma and decompression sickness, most air embolisms occur due to medical procedures, including surgical procedures (especially those performed with the patient in the upright position), intravascular catheterization (such as through the use of central venous access devices [CVADs]), radiologic procedures (especially those using automatic contrast media injectors^{3,4}), and the use of air insufflation and positive pressure ventilation.^{5,6}

The sequelae of air embolisms depend on the amount of air entering the bloodstream, the rate at which the air enters, and the route of administration (venous versus arterial). The body can tolerate small amounts of air introduced into the peripheral venous system at slow rates, often without symptoms. Small volumes of air travel to the right side of the heart and into pulmonary vasculature, where the air is dissipated. With larger volumes and rapid infusion of air, pulmonary artery pressures rise, putting strain on

the right side of the heart. In some cases, this can create an air lock in one or more of the pulmonary arteries, obstructing pulmonary circulation and causing complete circulatory collapse. In general, the closer to the heart the air embolism is introduced into the venous system, the smaller the volume of air is required to be symptomatic. Apart from these effects, air embolisms, even when small, can cause tissue ischemia or inflammatory changes within blood vessels, leading to a host of potentially lethal complications (e.g., systemic inflammatory response syndrome, pulmonary edema, myocardial and cerebral ischemia).^{5,6,7}

In contrast to venous air embolism, arterial air embolism is very poorly tolerated, and even a small amount of air can be lethal. Of special concern, 25% of the general population is estimated to have a patent foramen ovale (PFO), an opening between the left and right atria that normally closes at birth and is usually asymptomatic and undetected.⁸ The presence of a PFO in the setting of a venous air embolism is highly dangerous since there exists a pathway by which the venous air embolism can quickly pass into the arterial circulation and enter the cerebral circulation (causing a stroke) or the coronary circulation (causing a myocardial infarction).^{5,6,7}

The widespread use of CVADs, both within the hospital and community settings, warrants special attention due to the risk for air embolism associated with their use. The frequency of venous air embolisms related to CVADs is estimated to range from 1 in 47 to 1 in 3,000.^{6,7} While the frequency of this complication may be low, mortality rates attributed to venous air embolisms associated with CVADs range from 23%⁹ to 50%.¹⁰

AIR EMBOLISM REPORTS IN PENNSYLVANIA

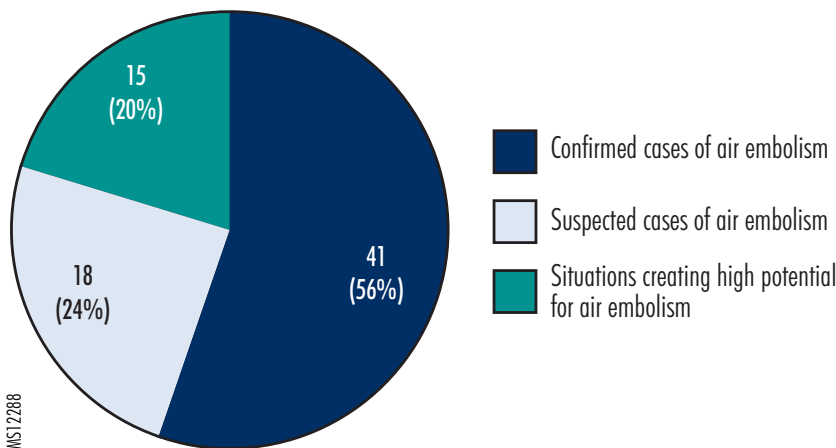
Between June 2004 and December 2011, Pennsylvania acute healthcare facilities reported 74 air embolism events to the Pennsylvania Patient Safety Authority:

41 confirmed events of air embolism, 18 suspected events of air embolism (in which the patient was symptomatic in the presence of known risk factors for air embolism without radiographic confirmation), and 15 events involving conditions in which the patient was placed at high risk of developing an air embolus (see Figure 1). Of the 59 events of confirmed or suspected air embolisms, 25 were reported as Incidents in which no harm was caused to the patient and 34 were reported as Serious Events resulting in harm, including seven cases of permanent harm and six deaths. Twenty-four of the 59 confirmed or suspected air embolism event reports were associated with CVADs; the next most common associated clinical features were surgical procedures, intravascular procedures, and peripheral venous access devices (see Figure 2). Despite the inclusion of air embolism as a serious reportable event for nonpayment by CMS, with presumably increased attention to prevention, air embolism event reports to the Authority have increased over time (see Figure 3). Examples of these reports include the following:

An interventional radiology resident came to the floor and removed the catheter while the patient was sitting semirecumbent in a chair. A gauze dressing, combined with an occlusive dressing, was placed over the access site. Not too long after that, another resident came in to visit the patient and noted [the patient] sitting in the chair, tachypneic and desaturated. The patient was moved to the ICU [intensive care unit] with a possible air embolism.

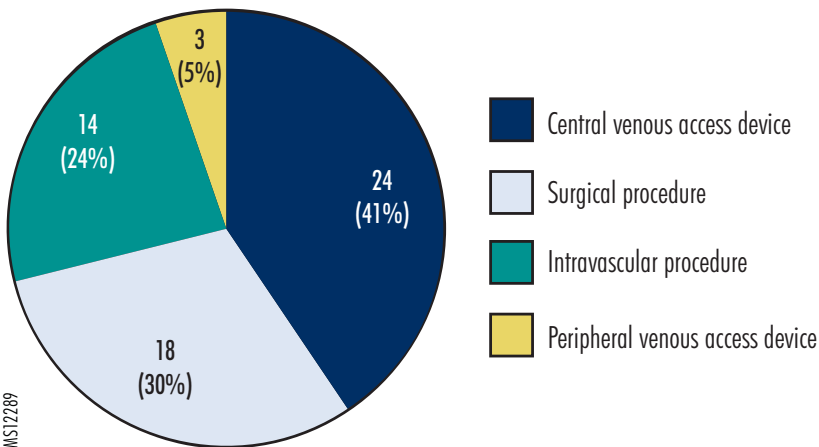
A patient came to interventional radiology for a tunneled catheter placement. During the procedure, the patient got an air embolus. After talking to the physician, [it was determined that] the cause of the embolism came from the catheter as it was being passed into the patient due to the lack of [occlusion (e.g., no

Figure 1. Air Embolism Reports to the Pennsylvania Patient Safety Authority, June 2004 to December 2011



MS12288

Figure 2. Confirmed and Suspected Air Embolism Reports to the Pennsylvania Patient Safety Authority, by Associated Clinical Feature, June 2004 through December 2011



MS12289

caps, not clamped, lumen not covered by thumb]). The staff heard the air sucking in and knew right away. The patient was cared for immediately by being placed on his left side and administering increased oxygen. The patient was transferred back to the ICU with the ICU nurse and physician. The patient was monitored closely and needed no further treatments.

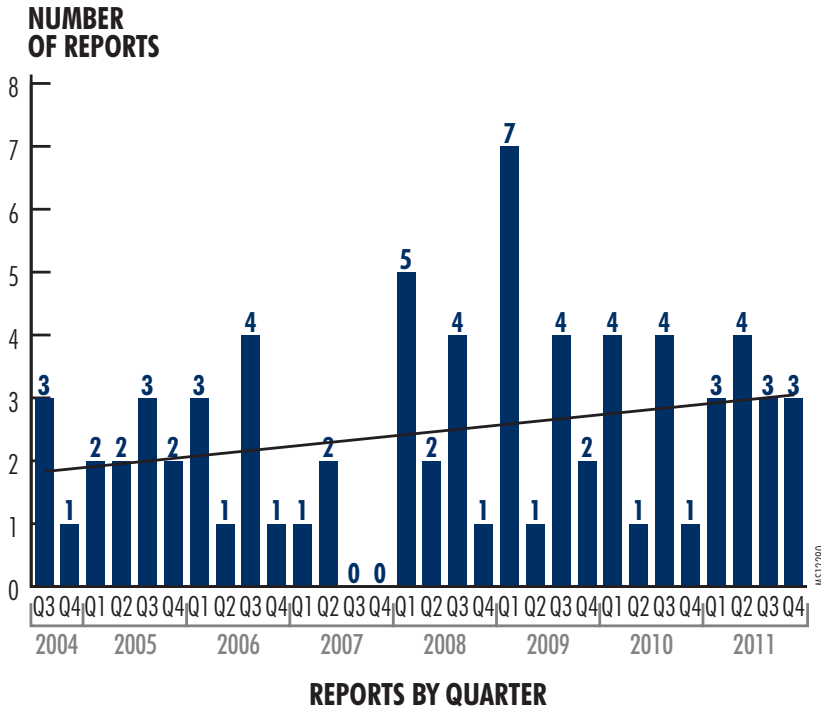
A patient was admitted with a stroke. The physician placed a subcla-

vian central line. A follow-up chest x-ray was obtained. Intravenous fluids were administered through the central line. The patient was taken for a CT [computed tomography] scan of the head. During the CT scan, the physician was made aware by radiology that the central line was in the artery. The CT scan of the head showed intracranial air consistent with an air embolus.

An infant was admitted to the ICU. . . . She acutely developed bradycar-



Figure 3. Air Embolism Reports to the Pennsylvania Patient Safety Authority, by Quarter, June 2004 to December 2011



dia, mottling, and hypotension. She required multiple rounds of medications, including epinephrine, atropine, and sodium bicarbonate, as well as tracheal intubation and cardiac compressions. An echocardiogram performed during the resuscitation showed severely depressed myocardial function, no pericardial effusion, and what appeared to be echo-bright areas of the myocardium consistent with potential air embolus. Following resuscitation, the infant returned to her previous cardiac baseline hemodynamics. The nurse caring for the child subsequently reported that approximately one-half hour before the event, he had changed the IV [intravenous] fluid administration tubing that was infusing into the patient’s umbilical venous catheter. The nurse reported that he had followed the hospital’s nursing procedure for IV tubing change.

The patient’s caregiver disconnected the patient’s IV line from the central line so that the patient could ambulate into the bathroom. After returning to bed, the patient coded. After one minute of cardiopulmonary resuscitation and oxygen bagging, the patient began to respond. The patient was also placed in Trendelenburg and turned for suspected air emboli. The patient was transferred to the ICU for further observation.

The 24 confirmed or suspected reports of air embolisms related to CVADs were further analyzed by the Authority to identify associated factors (See Table).

PREVENTION METHODS

Although uncommon, air embolism can have serious adverse effects on patients and is largely preventable through the application of evidence-based practices.^{1,2} Joint Commission Resources has published a

resource with a summary of updated information and research on air embolisms and their treatment and prevention.¹¹ The Infusion Nurses Society is also a resource for guidelines, policies, and procedures related to CVAD care, including steps to prevent and manage air embolisms.^{12,13}

Insertion of Central Venous Access Devices

- Take steps to increase central venous pressure (CVP). Increasing CVP decreases the pressure gradient that would normally favor movement of air into the bloodstream. CVP is normally lower in all blood vessels located above the level of the heart and during inspiration.
 - Place the patient in the Trendelenburg position with a downward tilt of 10 to 30 degrees during central line placement.^{5,7,11,13}
 - Avoid CVAD insertion during patient inspiration. Instruct the patient to hold his or her breath, and perform a Valsalva maneuver if able.^{5,7,11}
 - Hydrate the patient to correct hypovolemia prior to insertion whenever possible.^{5,7,11,14}
- Ensure all catheters and connections (especially in two-piece systems) are intact and secure.^{5,7,11,13}
- Occlude the catheter and/or needle hub.^{5,7,11,14}
- Ensure that all self-sealing valves are functioning properly.^{7,11}

Care and Maintenance of Central Venous Access Devices

- Ensure that all lumens are capped and/or clamped.^{5,11,14}
- Use Luer-lock connections for needleless IV ports and self-sealing valves.^{11,12,13}
- Use infusion pumps with air-in-line sensors for all continuous infusions.¹¹

Table. Reports to the Pennsylvania Patient Safety Authority of Confirmed or Suspected Air Embolisms Related to Central Venous Access Devices, by Identified Associated Factors, June 2004 through December 2011

CONTRIBUTING FACTORS IDENTIFIED	NUMBER
Insertion	
Venous catheter placed in artery	2
Injection of air	1
Line exchange with head elevated	1
Lines not clamped or capped	1
No Valsalva maneuver	1
Not specified	3
Total	9
Care and Maintenance	
Contrast media injector	1
Other injection of air	1
Line not clamped or capped	1
Line mishandled by unlicensed staff	1
Total	4
Removal by Healthcare Provider	
Head elevated during removal	6
Not specified	3
Total	9
Removal by Patient	1
No Cause Identified in Report	1
Total	24

- Fully prime all infusion tubing, and expel air from syringes prior to any injection or infusion.^{11,12}
- Use an air-eliminating filter on infusion tubing sets whenever appropriate.^{11,13}
- Remove air from infusion bags when infusing fluids using inflatable pressure infusers.¹¹
- Fully prime contrast media injectors, and check for air prior to each injection.¹¹
- Trace lines, double-check all connections, and take all steps necessary to prevent tubing misconnections.^{11,13,15}
- Inspect the insertion site, catheter, and all connections regularly to assess for breaks or openings through which air could enter the system.^{11,14}
- Ensure the integrity of the central line dressing surrounding the insertion site.¹¹
- Use caution when moving or repositioning patients to prevent pulling

on the central line. A break in the closed system, combined with decreased CVP (due to movement to an upright position and deep inspiration), creates a high risk for air embolism.¹¹

- Teach patients and/or caregivers managing infusion therapy how to perform all steps necessary to prevent air embolism.^{11,12,13}

Removal of Central Venous Access Devices

- Place the patient in the Trendelenburg position when possible. If not possible, the supine position is sufficient.^{5,11,14,16,17}
- Position the catheter exit site (e.g., neck, arm) at a height lower than the height of the patient's heart.¹³
- Cover the exit site with gauze and apply gentle pressure while removing the catheter in a slow, constant motion.^{16,17}

- Instruct the patient to hold his or her breath, and perform a Valsalva maneuver as the last portion of the catheter is removed; if unable to do so, time the removal during patient expiration.^{5,11,13,14,16,17}
- Place pressure on the site until hemostasis is achieved. One to five minutes is suggested.^{11,13,16,17}
- Apply a sterile occlusive dressing, such as gauze impregnated with petroleum jelly and covered with a transparent film dressing. Leave dressing in place for at least 24 hours. Change the dressing every 24 hours until the exit site has healed. (Plain gauze dressings have been associated with air passing through a persistent catheter tract into the bloodstream, resulting in air embolisms, as have occlusive dressings left in place for shorter periods of time.)^{11,13,14,16,17}
- Instruct the patient to remain lying flat for 30 minutes after removal of the catheter.^{11,13,16,17}

TREATMENT FOR SUSPECTED AIR EMBOLISM

A high degree of suspicion for air embolism should be maintained when inserting, removing, or otherwise manipulating CVADs. Though often asymptomatic, the following are clinical signs of an air embolism: dyspnea, tachypnea, decreased oxygen saturation, sense of impending doom, anxiety, agitation, change in mental status, chest pain, tachycardia or bradycardia, hypotension, pallor, and light-headedness. If the patient is being monitored by capnography during the insertion, decreased or erratic end tidal carbon dioxide can indicate air embolism. Emergency management includes preventing the further entry of air, placing the patient in a left side-lying position in Trendelenburg, and administering 100% oxygen. This position helps the air embolus to move toward the apex of the right ventricle, away from the



pulmonary artery and right ventricular outflow tract. The administration of oxygen supports the patient with cardiovascular instability or collapse and helps decrease the size of the embolus through its effects on the partial pressures of oxygen and nitrogen within the blood, which causes nitrogen to move from the embolus into the bloodstream.^{5,7,11,16,17}

Withdrawing the air through the CVAD may be beneficial in some cases if it can be done. Hemodynamic support should be provided with inotropic drugs and fluid resuscitation to increase CVP. Cardiopulmonary resuscitation and/or intubation may be necessary. Chest compressions may have the added benefit of helping to break up air emboli and move them away from the right ventricular outflow tract. Once stabilized, hyperbaric oxygen therapy can mitigate further effects of air emboli and decrease their size.^{5,7,11}

RISK REDUCTION STRATEGIES

Beyond the prevention measures taken by individual clinicians, hospitals can take the following measures to reduce the risk of CVAD-related air embolism:

- Establish hospital policies and procedures that contain specific air embolism prevention protocols for CVAD insertion, management, and removal.^{11,12}
- Ensure practitioners inserting and removing CVADs have had adequate training and experience in performing the procedure.^{12,17,18}
- Consider the use of a standardized insertion bundle kit or cart and standardized removal kit.
- Provide all nurses and other clinical staff handling CVADs with ongoing training in proper line care, and assess staff for competence. Reassess competency annually.^{17,18}
- Consider establishing a vascular access nurse team with 100% ownership for placement, daily assessment, and removal of nontunneled short-term central venous access catheters, including peripherally inserted central venous catheter lines.¹⁹
- Do not purchase nonintravenous equipment that can be connected to needleless IV ports.^{11,15}

- Utilize equipment with safety features that are designed to prevent air embolism (e.g., vascular access catheters and caps with self-sealing or one-way valves, infusion pumps with air-in-line detection, infusion tubing with in-line filters).^{11,15}
- Inform nonclinical staff, patients, and family members that they must ask a clinician to assist whenever a central line needs to be disconnected or reconnected.¹¹

CONCLUSION

Air embolism is an infrequent but potentially lethal complication of CVAD utilization. The implementation of specific evidence-based prevention measures, along with risk reduction strategies, can significantly decrease, or eliminate, this Serious Event.

ACKNOWLEDGEMENTS

H.T.M. Ritter III, BA, CBET, CCE, Pennsylvania Patient Safety Authority, contributed to the topic conception and initial literature review and data acquisition for this article. Edward Finley, BS, Pennsylvania Patient Safety Authority, contributed to the data collection and analysis.

NOTES

1. National Quality Forum. Serious reportable events in healthcare—2011 update: a consensus report [online]. 2011 [cited 2012 Mar 8]. Available from Internet: http://www.qualityforum.org/Projects/sz/Serious_Reportable_Events_in_Healthcare_2010/Final_Report.aspx.
2. Centers for Medicare and Medicaid Services. Medicare program; listening session on hospital-acquired conditions in inpatient settings and hospital outpatient healthcare-associated conditions in outpatient settings. *Fed Regist* 2008 Oct 30;73(211):64618-9. Also available: https://www.cms.gov/HospitalAcqCond/Downloads/1422_N_FEDERAL_REGISTER_VERSION_PUB_10_30_08_508.pdf.
3. Venous air emboli and automatic contrast media injectors. PA PSRS Patient Saf Advis [online] 2004 Dec [cited 2012 Mar 8]. Available from Internet: [http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2004/dec1\(4\)/Pages/13.aspx](http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2004/dec1(4)/Pages/13.aspx).

4. A word about air detection devices. PA PSRS Patient Saf Advis [online] 2004 Dec [cited 2012 Mar 8]. Available from Internet: [http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2004/dec1\(4\)/Pages/16.aspx](http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2004/dec1(4)/Pages/16.aspx).
5. O'Dowd LC, Kelley MA. Air embolism [online]. Up to Date 2000 Mar 2 [cited 2012 Mar 8]. Available from Internet: <http://cmbi.bjmu.edu.cn/uptodate/critical%20care/embolic%20disease/air%20embolism.htm>.
6. Natal BL, Doty CI. Venous air embolism [online]. *eMedicine* 2009 Jul 27 [cited 2012 Mar 8]. Available from Internet: <http://emedicine.medscape.com/article/761367-overview>.

7. Mirski MA, Lele AV, Fitzsimmons L, et al. Diagnosis and treatment of vascular air embolism. *Anesthesiology* 2007 Jan;106(1):164-77.
8. Cleveland Clinic. Patent foramen ovale [online]. 2010 Jan [cited 2012 Mar 14]. Available from Internet: <http://my.clevelandclinic.org/heart/disorders/congenital/pfo.aspx>.
9. Heckmann JG, Lang CJ, Kindler K, et al. Neurologic manifestations of cerebral air embolism as a complication of central venous catheterization. *Crit Care Med* 2000 May;28(5):1621-5.
10. Kashuk JL, Penn I. Air embolism after central venous catheterization. *Surg Gynecol Obstet* 1984 Sept;159:249-52.
11. Joint Commission Resources (JCR). *Clinical care improvement strategies: preventing air embolism*. Oak Brook (IL): JCR; 2010 Jul. PDF e-book.

12. Infusion Nurses Society (INS). *Infusion nursing standards of practice*. Hagerstown (MD): INS; 2011.
13. Infusion-related complications. In: Infusion Nurses Society. *Policies and procedures for infusion nursing*, 4th ed. Hagerstown (MD): Lippincott, Williams and Wilkins; 2011:96-123.
14. Brockmeyer J, Simon T, Seery J, et al. Cerebral air embolism following removal of central venous catheter. *Mil Med* 2009 Aug;174(8):878-81.
15. Tubing misconnections: making the connection to patient safety. *Pa Patient Saf Advis* [online] 2010 Jun [cited 2012 Mar 14]. Available from Internet: [http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2010/Jun7\(2\)/Pages/41.aspx](http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2010/Jun7(2)/Pages/41.aspx).
16. Drewett SR. Central venous catheter removal: procedures and rationale. *Br J Nurs* 2000 Dec 8-2001 Jan 10;9(22):2304-15.
17. Ingram P, Sinclair L, Edwards T. The safe removal of central venous catheters. *Nurs Stand* 2006 Aug 16-22;20(49):42-6.
18. McGee DC, Gould MK. Preventing complications of central venous catheterization. *N Engl J Med* 2003 Mar 20;348(12):1123-33.
19. Rosenthal K. Targeting “never events.” *Nurs Manage* 2008 Dec;39(12):35-8.

LEARNING OBJECTIVES

- Recognize risk factors that contribute to air embolism.
- Recall the predominant contributing risk factors for air embolisms related to central venous access devices (CVADs), according to reports submitted to the Pennsylvania Patient Safety Authority.
- Distinguish between circumstances leading to CVAD-related air embolism that create a high risk for harm and those that create a low risk for harm.
- Identify strategies for prevention and treatment of CVAD-related air embolism.

SELF-ASSESSMENT QUESTIONS

The following questions about this article may be useful for internal education and assessment. You may use the following examples or develop your own questions.

1. Which of the following scenarios would *not* increase the risk for air embolus formation?
 - a. Placement of a CVAD in a patient who is hyperventilating and unable to hold his breath
 - b. Stopcock on CVAD left in open position and uncapped after blood sample drawn from the line
 - c. Peripherally inserted central venous catheter (PICC) inserted in a patient with hypertension and fluid overload status
 - d. Pressure applied to catheter exit site for five minutes after removal of central line, then dry sterile gauze dressing applied
2. Which of the following is the contributing risk factor associated with CVAD-related air embolism that is most frequently reported to the Pennsylvania Patient Safety Authority?
 - a. Removal of the central line while the patient’s head is elevated
 - b. Inadvertent placement of the venous catheter in an artery
 - c. Injection of air using contrast media injectors
 - d. Accidental removal of the central line by the patient
3. Complete the following sentence: Air embolism associated with the presence of a patent foramen ovale (PFO) is highly dangerous _____.
 - a. in neonates only
 - b. in 10% of adults who have confirmed PFOs
 - c. only in patients with symptomatic PFOs that have been unable to be closed surgically
 - d. because it allows air to move from the venous system into the arterial circulation, where it can cause a stroke or myocardial infarction
4. Which of the following conditions for CVAD-related air embolism formation carries the highest risk of harm?
 - a. 5 mL syringe of air injected into a peripheral intravenous (IV) line over 10 minutes
 - b. 5 mL of air injected into a CVAD over one minute
 - c. 5 mL of air injected into a CVAD by rapid IV push
 - d. 5 mL of air from unprimed IV tubing infused into a PICC line over five minutes

**SELF-ASSESSMENT QUESTIONS (CONTINUED)**

5. All of the following are risk reduction strategies that a hospital can take to reduce the incidence of CVAD-related air embolism EXCEPT:
 - a. Require training and annual competency evaluation for all nurses and physicians who perform central line removal.
 - b. Mandate an evaluation by biomedical engineering when considering the purchase of any new nonintravenous medical equipment to ensure that it cannot be connected to intravenous lines or needleless IV ports.
 - c. Instruct patients and families to disconnect themselves from their IV lines when ambulating to the bathroom in order to minimize tripping hazards.
 - d. Consider establishing a vascular access nurse team with ownership for central line placement, daily assessment, and removal.

An elderly patient with Alzheimer's disease has been admitted with a urinary tract infection and is being cared for on a medical-telemetry unit where he has been receiving IV antibiotics through a right upper arm double-lumen PICC line. The patient has been placed on constant observation with a sitter at the bedside due to his delirium and wandering behaviors. The patient has a pattern of becoming agitated in the evenings after his wife leaves for the day. At 7 p.m., the sitter calls the nurse into the room because the patient is more agitated than usual and is getting out of bed and pulling on his IV lines. When the nurse assesses the patient, she discovers that the patient has been incontinent and is standing next to the bed yelling, "They are trying to kill me!" He has ripped his infusion tubing, the PICC line dressing is off, and the line is out approximately 10 cm. His heart rate is 110 bpm, with a blood pressure of 88/50 mmHg, respiratory rate of 22 breaths per minute, and pulse oxygenation of 90%.

6. In the above scenario, which combination of assessment findings is MOST suggestive of air embolism?
 - a. Change in mental status, incontinence, and hypoxia
 - b. Tachycardia, hypotension, and agitation
 - c. Tachycardia, dyspnea, incontinence, and multiple potential points of entry for air into the bloodstream
 - d. Tachypnea, tachycardia, hypotension, change in mental status, and multiple potential points of entry for air into the bloodstream
7. Which of the following BEST describes the appropriate immediate actions to be taken in this scenario?
 - a. Notify the rapid response team, speak to the patient in a reassuring manner, and attempt to get the patient to lie down on his left side, putting the bed in the Trendelenburg position and applying 100% oxygen via a nonrebreather mask while waiting for the team to arrive.
 - b. Call security to help get the patient back in bed and apply four-point limb restraints, administer Haldol that has been prescribed as needed for agitation, and place the bed in the Trendelenburg position while applying 100% oxygen.
 - c. Ask the sitter to help reassure the patient while assisting him back to bed in a left side-lying position, putting the bed in the Trendelenburg position and applying 100% oxygen. At the same time, delegate another staff member to notify the rapid response team and the physician responsible for the patient, continue to reassure the patient while applying an occlusive dressing to the PICC insertion site, and clamp all lines.
 - d. Assist the patient back to bed, administer Haldol as ordered for agitation, and call the vascular access nurse to come assess the PICC line.

PENNSYLVANIA PATIENT SAFETY ADVISORY

This article is reprinted from the Pennsylvania Patient Safety Advisory, Vol. 9, No. 2—June 2012. The Advisory is a publication of the Pennsylvania Patient Safety Authority, produced by ECRI Institute and ISMP under contract to the Authority. Copyright 2012 by the Pennsylvania Patient Safety Authority. This publication may be reprinted and distributed without restriction, provided it is printed or distributed in its entirety and without alteration. Individual articles may be reprinted in their entirety and without alteration provided the source is clearly attributed.

This publication is disseminated via e-mail. To subscribe, go to <http://visitor.constantcontact.com/d.jsp?m=1103390819542&p=oi>.

To see other articles or issues of the Advisory, visit our website at <http://www.patientsafetyauthority.org>. Click on “Patient Safety Advisories” in the left-hand menu bar.

THE PENNSYLVANIA PATIENT SAFETY AUTHORITY AND ITS CONTRACTORS



An Independent Agency of the Commonwealth of Pennsylvania

The Pennsylvania Patient Safety Authority is an independent state agency created by Act 13 of 2002, the Medical Care Availability and Reduction of Error (“Mcare”) Act. Consistent with Act 13, ECRI Institute, as contractor for the Authority, is issuing this publication to advise medical facilities of immediate changes that can be instituted to reduce Serious Events and Incidents. For more information about the Pennsylvania Patient Safety Authority, see the Authority’s website at <http://www.patientsafetyauthority.org>.



ECRI Institute, a nonprofit organization, dedicates itself to bringing the discipline of applied scientific research in healthcare to uncover the best approaches to improving patient care. As pioneers in this science for more than 40 years, ECRI Institute marries experience and independence with the objectivity of evidence-based research. More than 5,000 healthcare organizations worldwide rely on ECRI Institute’s expertise in patient safety improvement, risk and quality management, and healthcare processes, devices, procedures and drug technology.



The Institute for Safe Medication Practices (ISMP) is an independent, nonprofit organization dedicated solely to medication error prevention and safe medication use. ISMP provides recommendations for the safe use of medications to the healthcare community including healthcare professionals, government agencies, accrediting organizations, and consumers. ISMP’s efforts are built on a nonpunitive approach and systems-based solutions.



Scan this code with your mobile device’s QR reader to subscribe to receive the Advisory for free.