Case report

Seizure Following Removal of Swan Ganz Catheter

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Abstract

Venous air embolism (VAE) is an infrequent incident with fatal consequences during insertion or removal of central venous catheters. It is befalling when air or gas arrives at the vascular system. In this case report, we present a case of a 38-year-old female patient with an air embolism after removal of the Swan Ganz catheter that caused the seizure and cardiac arrest. There is an overview of the causes and ways to prevent VAE in the patient.

Keywords: Venous air embolism (VAE), Swan Ganz Catheter, Central venous catheter (CVC), Chronic Thromboembolic Pulmonary Hypertension (CTEPH)

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Introduction

Venous air embolism (VAE) is an infrequent incident with fatal consequences (1). It befalls when air or gas arrives at the vascular system. VAE occurs for a variety of reasons such as removal of a central venous catheter (CVC) (2), penetrating chest trauma, orthopedic surgery, laparoscopic surgery, neurosurgical, and head and neck procedures (3, 4). The arrival of the air into the vessels may happen in all of these cases; which is often due to the formation of a negative pressure especially when the site of the procedure is above the heart (2).

Case Report

A 38-year-old lady with a history of shortness of breath was admitted as a case of Chronic Thromboembolic Pulmonary Hypertension (CTEPH) for pulmonary Endarterectomy. According to echocardiography, the Ejection fraction of the left ventricle was 50%, while PAP (systolic pressure) was 60mmHg, there was severe right ventricular (RV) enlargement and moderate RV dysfunction. The other findings were Severe Tricuspid regurgitation and lack of any Patent Foramen Ovale (PFO) Prior to surgery, catheter insertion was needed to re-evaluate the patient's cardio-

pulmonary parameters (PAP, PVR, etc.). For this purpose, a Swan Ganz catheter had been inserted via the right internal jugular vein (IJV). After measuring the desired indexes and stabilizing the patient's condition for surgery by the following next weeks, the inserted catheter was removed.

About a few seconds later the patient suffered from a tonic-clonic seizure that was followed by bradycardia, hypotension, and cardiac arrest. Cardiopulmonary Resuscitation (CPR) was accomplished after 30 minutes. The patient was taken to the Intensive Care Unit (ICU) while the level of Glasgow Coma Scale (GCS) was 4, intubated, and received high doses of epinephrine and norepinephrine. A brain CT scan (Figure 1) showed no abnormality, however supportive treatment for this disorder was initiated. With all the actions taken, the level of GCS did not improve during the following days. For this reason, and also instability in hemodynamics it was not possible to wean her from the ventilator so a tracheostomy was done on the 5th day. GCS level increased gradually as well as the hemodynamic parameters. On the 8th day, all the inotropes were tapered off and she was weaned from ventilator on 11th day. By fixing the problems of alertness and hemodynamics, the patient left ICU on the 15th day; while he was discharged from the hospital on the 20th day after the recovery and normalization of the general conditions.

Discussion

The increasing use of large bore sheaths for pulmonary artery catheters can sometimes increase the risk of air, entrapment during their insertion and removal and when embolism is created, we may feature more severe conditions (5). In addition, implementation, incidental disconnection or removal of a catheter may cause a cerebral air embolism; which occurs in the arterial vascular bed as a result of paradoxical embolism through an intra-cardiac or intrapulmonary right-to-left shunt. In a more precise statement, the ingress of air into systemic veins causes venous air embolism, whilst its entrance into the, pulmonary artery and the

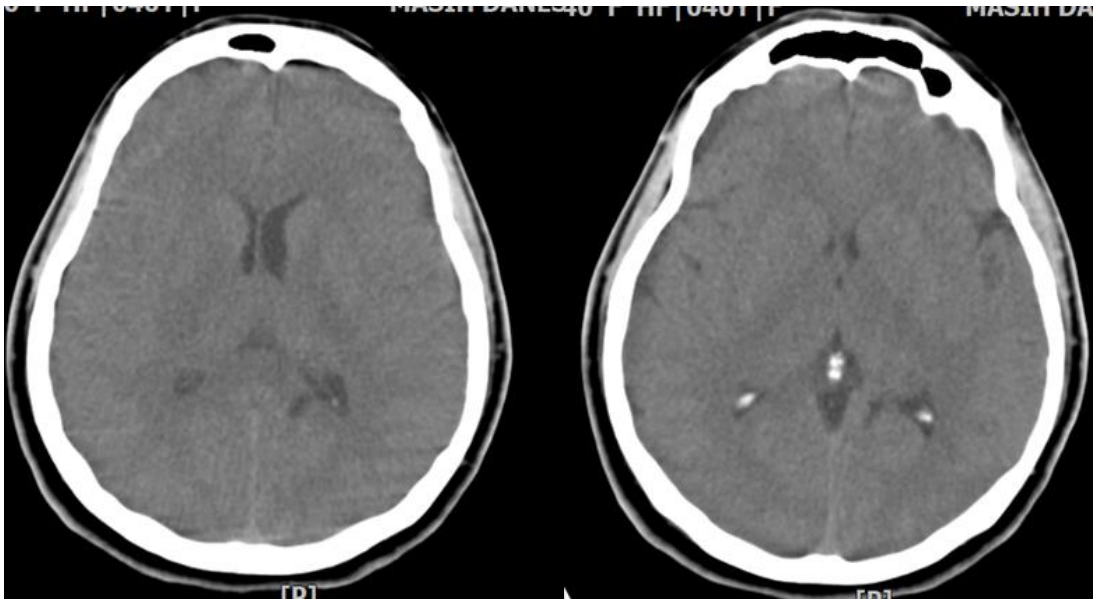

Figure 1. A view of the patient's brain CT scan; no significant abnormal pattern

Table 1: Pathways of VAE migration and their clinical sequelae.

Main routes	Sub-routes	Clinical sequelae
Retrograde ascension to the cerebral venous system	-	Mental status changes Loss of consciousness Seizure Focal neurological deficits Cerebral edema
Blood circulation	**Paradoxical embolism**	Cardiac ischemia and infarction Arrhythmia Acute heart failure Systemic hypotension Mental status changes Loss of consciousness Seizure Focal neurological deficits Cerebral edema
	Pulmonary artery	Acute right ventricular failure Pulmonary arterial hypertension Respiratory failure Pulmonary edema Systemic hypotension

pulmonary veins and at last systemic arteries results in arterial air embolism (6, 7) In general, air emboli in the venous system can go through two paths: toward the heart and retrograde ascension to the Superior Vena cava and cerebral venous system. The air emboli going to the heart may enter the systemic circulation under two different conditions (pulmonary artery or paradoxical embolism) (Table 1) (8). The precise fatal volume of air is unknown; however, it is proposed that air arrival at 20 ml/s will produce symptoms whereas 75-100 ml/s may be lethal.

Regardless of the type of risk or embolism pathway in patients under the Swan Ganz catheter, most symptoms of embolism have been reported during the catheter insertion (9). Of course, in cases such as reports by Brockmeyer et al. and Keegan et al., there have been reports of an embolism at the time of catheters removal.

The Swan Ganz Catheter of this patient was removed while was in a sitting position and the dressing of the site of the catheter was not water sealed. So, with deep breathing and saponification of air, it was entered the venous system and because of sitting position, the bubbles were migrated upward to the cerebral venous system and were entrapped, so prevent venous drainage and subsequent increase in intracranial pressure which caused the tonic-clonic seizure. As the patient had a high Pulmonary artery pressure (PAP), even a small decrease of the partial pressure of Oxygen may cause more increase in PAP and then subsequent Right ventricular failure, and this vicious cycle at last caused cardiac arrest. Paradoxical air emboli were not possible, because there was no PFO. A brain CT scan performed two times immediately and after 48 hours showed no abnormality in the brain tissue, while if there were arterial emboli,

brain edema could be seen in CT scan. Arterial blood gas analysis at first showed severe hypoxemia, while after intubation and circulatory support became normal. There was no change in the rhythm of the patient and no ECG change after successful CPR.

It should be noticed that in arterial emboli due to the upward position of the Right coronary artery (RCA) orifice most of the air emboli is on that vessel, so nearly usually is associated with arrhythmia disturbances, while in this patient after improvement of hypoxia the heart rate became normal. Meanwhile, due to the position of the patient and severe high Pulmonary arterial hypertension and severe TR, the probability that the air emboli migrate toward the SVC is more than pulmonary circulation. EEG and MRI were not available in our center and so not performed. The main purpose of this report is to emphasize the fact that removing the central venous catheters can cause VAE and all healthcare staff should be aware of it. This condition was followed by the fact that the removal of the catheter was done in a position where the patient was sitting and breathing spontaneously. It is also noticed in our report that, although the patient was in good condition, she suffered from a seizure that is not so common complication after catheter removal. This can be due to the climb of the air (due to lower density than liquids) to the brain.

In this way, the adoption of conditions such as putting the patient on the bed while the head is lower than the heart level during the removal of the catheter can be helpful. Asking the patient to hold breathing at the moment of removal and also putting a water-sealed dressing on the site of insertion immediately after catheter withdrawal, is necessary and should be done.

Conclusion

The withdrawal of central venous catheters can sometimes be accompanied by air embolism and irreversible abnormalities such as seizure and brain hypoxia. Therefore, attention to this subject and the implementation of precautionary measures in all the same cases, especially in the case of thicker catheters, is mandatory.

Acknowledgment

None.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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