

Life-Threatening Pulmonary Air Embolism Following Right Jugular Venous Catheter Removal Successfully Managed With Hyperbaric Oxygen: An Unusual Case Report

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Life-Threatening Pulmonary Air Embolism Following Right Jugular Venous Catheter Removal Successfully Managed With Hyperbaric Oxygen: An Unusual Case Report

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Key Clinical Message:

Central venous catheter removal is perceived by most physicians as a simple bed side procedure not paying attention to a possible serious and life-threatening complication like pulmonary air embolism and the risk of which is increased by removing the catheter in a sitting position. This paper raises physicians' awareness on the proper technique on how to remove central venous catheters.

Introduction:

Pulmonary air embolism is an uncommon type of pulmonary embolism and is mainly due to medical or surgical procedures [1]. Pulmonary air embolism can occur due to direct entry of air into the vasculature [2] or due to an increase in the pressure gradient between the atmosphere and the vasculature which most commonly occurs in the setting of neurosurgical operations where patients are operated on in a sitting position [2,3]. Central venous catheter insertion or removal related pulmonary air embolism is an under-diagnosed iatrogenic morbidity and can pose significant morbidity and mortality [4,6]. The outcome associated with air embolism is related to the rapidity of air entry to the vasculature, the amount of air entered, and the volume. In dogs, for example, it was estimated that the fatal dose of air when injected rapidly was 7.5 ml/kg [2] but, in humans, it is not yet known but a volume of 100-300 ml can be lethal [2,7]. The diagnosis needs a clinical

suspicion and transthoracic echocardiography is usually the first test to be done, though can miss mild cases in which case transesophageal echocardiography can be diagnostic [8]. Management of patients with air embolism begins with stabilizing the airway, breathing, and circulation while simultaneously diagnostics are getting done. The most definitive treatment is the removal of air bubbles from the right ventricle through a pulmonary venous catheter or the use of hyperbaric oxygen which reduces the volume of air by inducing systemic hyperoxia displacing the nitrogen from the air bubbles into the blood and reducing its sizes thereby minimizing the obstructive effect of the air in the vasculature [9,10].

The mortality rate has been decreasing with the more frequent use of hyperbaric Oxygen to manage these patients as well as for the long-term complications [5]. We present a 27 years old pleasant male who was admitted for a suspected demyelinating disease and received pulse steroid and followed by 7 sessions of plasma exchange through a right central venous catheter and after removal of the catheter the patient developed sudden severe difficulty breathing with hypoxia, air embolism was suspected and bedside echocardiography demonstrated numerous air bubbles in the left ventricle and left atrium due to right to left shunt, probably a patent foramen ovale. The patient was then shifted to the intensive care unit and received hyperbaric oxygen and showed significant improvement without any neurological or cardiac sequelae.

Case History/Examination:

We present a 27 years old medically free gentleman who was admitted because of 4 days history of gradually worsening vision in both eyes reaching to the point that he could not see his mobile phone screen. He gave no further complaints, no limb weakness, no speech or swallowing deficits, and he had good control over his urine and defecation. He did not mention any numbness and never experienced this before. His work up in the hospital revealed bilateral optic neuritis and his brain MRI showed demyelinating lesions suggestive of multiple sclerosis. He was commenced on pulse steroids for 5 days without improvement and the decision was to start him on plasma exchange where he received 7 sessions through a right jugular venous line. He finished 7 sessions of plasma exchange with only slight improvement in his vision. On the day of discharge, his jugular venous line was removed by his assigned physician in sitting position after which , he immediately developed difficulty breathing and became hypoxic and his O₂ saturation dropped to 70% , he was immediately commenced on high flow nasal canula, intensive care team attended the case on the scene.

Methods:

The patient was suspected to have pulmonary air embolism due to the sudden deterioration from a stable clinical condition following the removal of his right jugular venous catheter. A CXR was ordered bedside and showed congested lungs (Figure-02) and bed side echocardiography showed air bubbles in the left side of the heart and the diagnosis of air pulmonary embolism was confirmed (Figure-1). He was fully conscious throughout the event. He was put in the left lateral decubitus position with head down and was shifted to the intensive care unit. In the ICU, he was kept on high flow nasal canula and hyperbaric oxygen therapy was arranged for him after 4 hours. After receiving hyperbaric oxygen, he showed dramatic improvement and stayed for observation in the ICU for a few days then shifted back to the medical floor and was discharged safely home.

Figure-01 (Echocardiography with Apical four chamber view of the heart showing multiple air bubbles in the left ventricle and left atrium (yellow arrows))

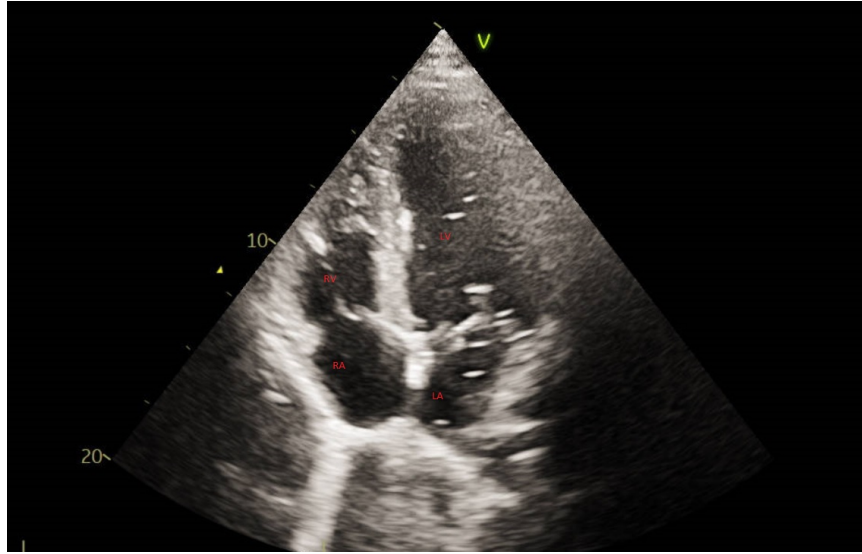
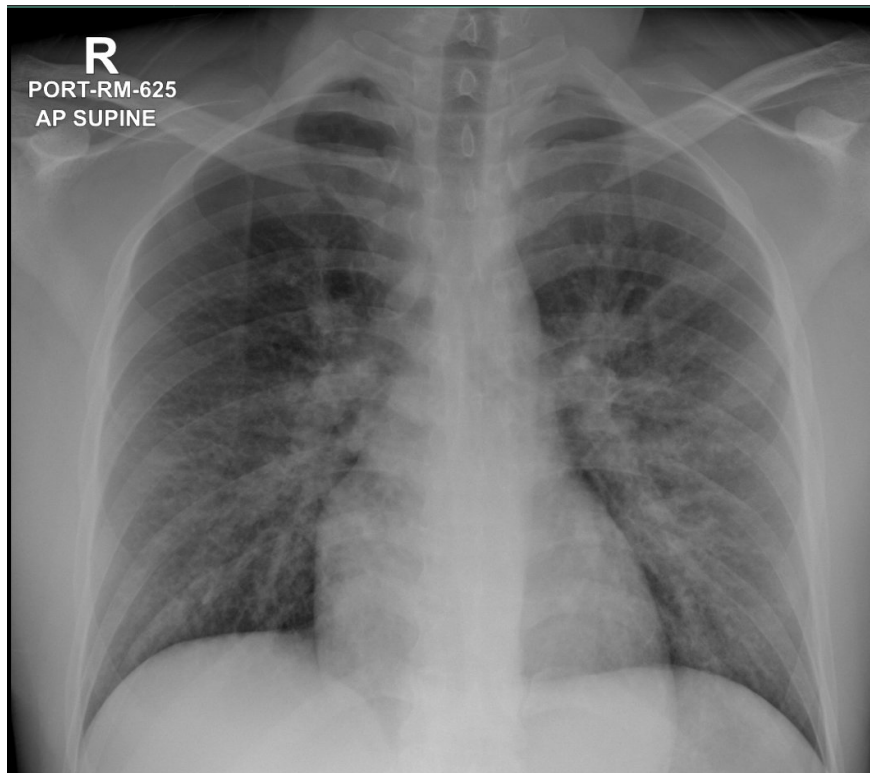


Figure-2 (Anterio-posterior chest x-ray in supine position showing bilateral perihilar infiltrate suggestive of pulmonary congestion)



Conclusion:

The patient's diagnosis was reached quickly as the physician had a high index of suspicion for pulmonary air embolism as a serious and potentially life-threatening sequel of central venous catheter removal , especially,

following catheter removal in a sitting position and the management was timely and effective with hyperbaric oxygen and resulted in a fast recovery and patient's discharge.

Discussion:

Pulmonary air embolism is a serious medical emergency with significant clinical outcome that can result in death. It represents one of the deadly complications of central venous line insertion and removal [6]. The patient once suspected of having venous air embolism should be placed in the left lateral decubitus position with head down or Trendelenburg position to allow air bubbles to stay in the upper most part of the right ventricle which avoids further movement of the air bubbles into the pulmonary trunk and hence causing less embolization [11,12]. Further management should include providing supplemental oxygen to increase the partial blood oxygen pressure and decrease the partial blood nitrogen pressure which will cause the nitrogen to diffuse from the air bubbles which has a high nitrogen pressure into the blood where it has a low pressure and thereby decreasing the air bubble size [13]. Treatment with hyperbaric oxygen has been known to drop the mortality rate for severe cases particularly if used within 3 hours of onset of air embolism [9,15,16]. Preventive measures to be taken when inserting or removing a central venous line has been known for proper positioning of the patient in the Trendelenburg position especially for jugular and subclavian venous lines or supine for femoral lines, in addition to taking care of the patient volume status, and instructing the patient to do Valsalva maneuver or exhale during removal of the line [14]. In this paper, we are describing a case of suspected multiple sclerosis who presented with bilateral optic neuritis and was initially managed with pulsed steroids with no improvement then shifted to plasma exchange through a right jugular venous catheter through which he received 7 sessions of plasma exchange and upon removal of the jugular venous catheter in the sitting position he immediately developed shortness of breath with severe hypoxia and was found to have air bubbles in the left side of his heart due to a patent foramen ovale. He also developed acute respiratory distress syndrome and was shifted to the intensive care unit on high flow nasal canula. Within six hours of the event, he was started on hyperbaric oxygen and showed significant improvement. With extensive literature review on Pubmed, multiple cases were reported on the development of air embolism particularly causing cerebral air embolism through paradoxical air embolism following the removal of central venous catheters [17-20]. Cases of pulmonary air embolism have also been reported following venous catheterization or removal [21-23]. Physician awareness of this potentially lethal complication of central venous catheterization or removal has been reported to be inadequate in a study done by Ely et.al. where it was found that around 42% of the 140 physicians who were surveyed did not show concern for air embolism when inserting a central venous line, although, 91% chose the Trendelenburg position during insertion, only 26% of the physicians reported concern for air embolism during central venous line removal, and around 13.9% of the physicians admitted elevating the head of the bed during central venous line removal which can potentially increase the risk of air embolism [24].

The main purpose of this paper is to emphasize on the importance of taking preventive measures to prevent air embolism when inserting or removing a central venous line and to increase the awareness among physicians to keep a high index of suspicion for such a serious complication. This paper also discusses the importance of commencing hyperbaric oxygen therapy in severe cases as it has shown effectiveness in reducing the size of air embolism and related morbidity. To conclude, Pulmonary air embolism related to central venous catheters insertion or removal, although uncommon, has been reported in the literature and physicians should keep in mind certain preventive measures when dealing with central venous catheters to prevent such a serious complication.

Authors Contribution:

Haidar Barjas: Literature Review and Manuscript writing

Wisam Al Wassiti: Manuscript writing

Rasha Abduljabbar: Manuscript writing

Naghm Sadik: Manuscript revision

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None declared by the study authors.

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All information related to this case is included in this article.

Ethical Approval:

This paper was approved by the Medical Research Council and the has the following MRC Number: 04-24-348

Consent Statement:

Written informed consent was obtained from the patient to publish this report.

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