

Case
Report

Intraoperative localization and monitoring of migrating foreign body using transesophageal echocardiography

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ABSTRACT

Radiological imaging is often used for the preoperative localization of foreign body following blast injury, but their utility in case of migration during intra-operative period is limited. Transesophageal echocardiography (TEE) has been used for intra-operative localization and removal of intra-cardiac foreign body; however, reports for localization of extracardiac migrating foreign body are few. Preoperative radiological imaging, in a victim of factory blast-injury, suggested foreign body in the posterior mediastinum. However, the intra-operative TEE showed it in the left atrium, which later migrated into the left ventricle necessitating a change in surgical approach for its removal.

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INTRODUCTION

Foreign bodies emanating from detonations often cause severe lacerations in their path when transiting through tissues. Specific localization of these foreign bodies is necessary to avoid unnecessary and inappropriate incisions during surgical removal. The preoperative localization of these foreign bodies is often done using radiological imaging. However, intra-operatively most operative suites still lack real-time computed tomographic or magnetic resonance imagers. Intra-operative echocardiography has been previously shown to help in localization and removal of intra-cardiac foreign bodies.^[1,2] We report a high impact industrial blast victim whose preoperative radiological imaging suggested a foreign body in the posterior mediastinum. The foreign body removal was tried via extended right posterolateral thoracotomy; however, the foreign body could not be located in the area identified preoperatively. Intra-operative

transesophageal echocardiography (TEE) examination was performed, which showed the foreign body in the posterior wall of the left atrium (LA), which subsequently migrated to the left ventricle (LV) during handling necessitating a change in surgical approach for its removal.

CASE REPORT

Written informed consent was obtained from the patient for publication of this case report and the accompanying images. A 38-year-old male was referred to our institute 1-week after sustaining an injury in a factory blast with complaints of right sided chest pain and difficulty in breathing since 4 days. There was no history of loss of consciousness, convulsion, dysphasia, hematemesis or bleeding from the ear, nose or throat. On examination, the patient was conscious and oriented, the hemodynamic parameters were stable and a chest tube drain was present *in situ*. Auscultation of the chest revealed

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decreased air entry in right lower axillary region. A chest radiograph revealed a partial opacification of the right hemithorax with an intercostal chest tube drain *in situ* [Figure 1]. Contrast enhanced computerized tomography (CT) from the referral hospital showed a 1.6×1.4 cm metallic foreign body in the right paravertebral region superior to the entry of the inferior vena cava into the right atrium (RA), with a surrounding hemothorax [Figure 2]. CT angiography demonstrated a metallic foreign body on the right side of the posterior mediastinum posterior to the LA, abutting the right inferior pulmonary vein at its entry into the LA. There was no evidence of contrast leak or extravasation. All cardiac chambers, main pulmonary artery and its branches appeared normal.

Surgical removal of the foreign body via an extended right posterolateral thoracotomy was planned. A peripheral vein, left radial artery, and right internal jugular vein were cannulated under local anesthesia. General anesthesia was induced using fentanyl and titrated dose of propofol. Vecuronium was used to facilitate endotracheal intubation with a 37F left sided double lumen tube (DLT). The patient was positioned in left semi lateral position, and the position of DLT was confirmed using a fiberoptic bronchoscope. Thoracotomy resulted in the evacuation of a hemothorax. However, persistent efforts of the surgeon to locate the foreign body based on preoperative radiological imaging remained unsuccessful. An adult TEE probe (X7-2t attached to iEE33 Matrix™ Echocardiography system, Philips, Andover, MA, US) was placed after ruling out clinical overt features of esophageal injury. While surgeon was manipulating the posterior mediastinum, TEE showed the foreign body in the LA near the posterior wall in modified mid esophageal-2 chamber view [Figure 3]. The surgeon was informed of the location of foreign body and then he could feel it near the left inferior pulmonary vein. It was decided to operate and remove the foreign body with the help of cardiopulmonary bypass. However, while preparing the groin for instituting CPB through the femoral route, TEE showed migration of the foreign body into the LV [Figure 4]. Ventricular fibrillation was induced using a fibrillator immediately after instituting CPB. Diastolic arrest of the heart was achieved using potassium based antegrade cardioplegia. The foreign body was removed from LV through interatrial septum (IAS) and the lacerated posterior wall of the LA was repaired. Total CPB and aortic clamp time were 123 and 73 min respectively.

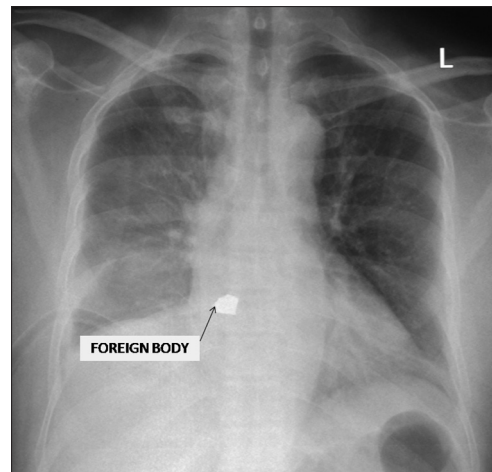


Figure 1: Chest X-ray posteroanterior view showing foreign body marked with arrow

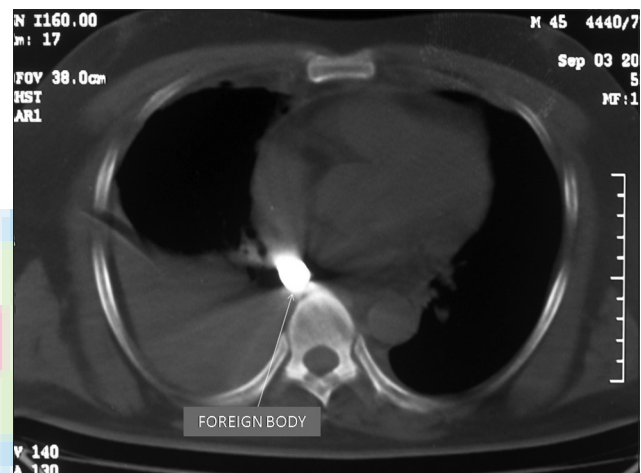


Figure 2: Chest computerized tomography scan showing foreign body (arrow marked) in the posterior mediastinum

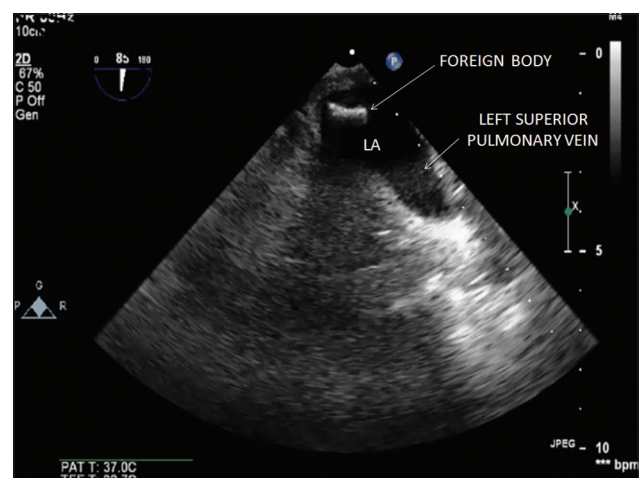


Figure 3: Transesophageal echocardiographic modified midesophageal two chamber view showing foreign body inside the left atrial wall

The patient was weaned off CPB using $0.05 \mu\text{g/kg/min}$ of adrenaline and shifted to Intensive Care Unit (ICU)

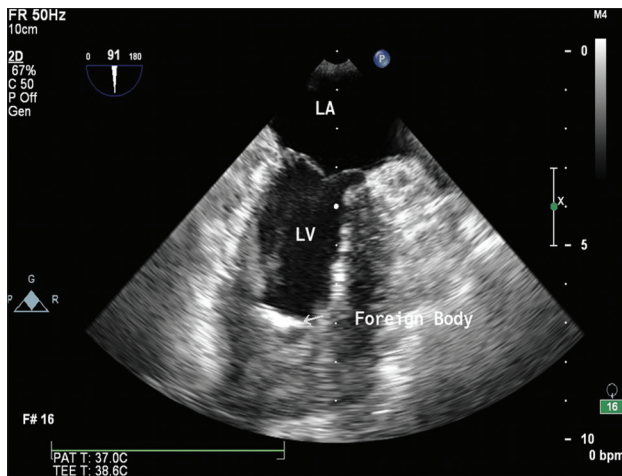


Figure 4: Transesophageal echocardiographic midesophageal two chamber view showing foreign body inside the left ventricular cavity

at the end of surgical procedure for elective mechanical ventilation. Surgical findings included 3 mm skin wound on right chest wall, 1 × 1 cm laceration on anterior pericardium, a wound on RA just above right coronary artery with lacerated IAS and posterior wall of LA besides clots in the right thorax and posterior pericardium. During surgery, the patient received 3 units of packed red blood cells to compensate for blood loss and two units each of platelet concentrate and fresh frozen plasma administered empirically to prevent bleeding. The patient was weaned from mechanical ventilation after 36 h and he was discharged from ICU on 3rd postoperative day. One week later, he required wound debridement but the subsequent hospital stay was uneventful and he was discharged from hospital on day 15.

DISCUSSION

Blast injury can cause penetrating trauma to the chest by a variety of foreign bodies.^[3] Surgical removal of the foreign body is decided on a case by case basis depending on ongoing symptoms, including bleeding from damaged vessels, proximity to major coronary artery, cardiac rhythm disturbances and risk of thrombosis or embolization. A small, smooth, asymptomatic, noncontaminated foreign body embedded deep in the myocardium may not require surgical removal.^[4,5]

Preoperative localization of the foreign body is crucial for its surgical removal. Plain radiographs easily demonstrate presence of metallic fragments inside the body but usually need a second orthogonal view for more accurate localization. CT scan has superior

spatial resolution for demonstrating the course of the penetrating object and the resulting injuries. Fluoroscopy may help in the intra-operative localization, but it does not provide continuous monitoring for migration and is also associated with radiation hazards. Moreover, fluoroscopy is usually not available in surgical operating rooms, and the same was not available in our OR. Echocardiography has been used in penetrating chest trauma to determine whether cardiac involvement is present.^[1] Even a small metallic fragment within the myocardium can be detected equally well by transthoracic or transesophageal approaches. However, visualization of foreign body in close proximity of highly reflecting structure like pericardium or calcified valve becomes difficult on echocardiography.^[6] Due to the closer proximity of transducer, TEE is preferable over TTE for detecting foreign bodies located within posterior structures of the heart (LA and LV), and if the precordial window is limited. It is specifically useful in detecting myocardial injuries, traumatic shunts, and aortic dissections.^[7] Intra-operative TEE examination is a class II indication for localizing foreign bodies.^[8] In the 2010 practice guidelines for perioperative TEE, both consultants and American Society of Anesthesiologists members agree that TEE should be used in case of major abdominal or thoracic trauma; however, its level of evidence is not specified.^[9] Epicardial echocardiography is another useful tool to locate the foreign body as it provides high-quality images but position of epicardial probe on the anterior surface limits access to posterior and apical cardiac structures. Since TEE provides noninvasive, uninterrupted, continuous monitoring of myocardial function and better visualization of posterior structure, it is preferred over epicardial echo. In the index case preoperative echocardiogram was not considered as CT angiography showed the foreign body in the posterior mediastinum without any cardiac involvement. Absence of hemodynamic instability and tamponade like features also suggested against cardiac involvement. Hemothorax raised the suspicion of lung injury and was the basis to choose a right posterolateral thoracotomy. When the routine surgical inspection of the anatomy did not reveal the location of the foreign body, we chose to insert a TEE probe which showed the foreign body embedded in the LA. Decision to institute CPB to limit distal embolization was taken immediately, but before CPB could be instituted the foreign body migrated from LA to LV possibly through mitral valve as there was no other lacerated area for its migration. Therefore, the heart was fibrillated soon after establishing CPB to prevent further embolization.

Based on surgical finding, the possible route of the projectile in the index case was entry through right chest wall (skin wound)-pericardium (laceration over anterior pericardium) to the RA (wound on RA) then to the LA through IAS (lacerated IAS) and finally piercing the posterior wall of LA to be impacted in the posterior mediastinum. Although uncommon absence of tamponade could be due to elasticity of RA, impaction of foreign body in posterior wall of LA and pericardium and/or drainage of blood to right pleural cavity through pericardial laceration. Perioperative TEE was instrumental in changing the surgical plan and preventing embolization into the arterial tree.

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