

Clinical Reports

Detection of iatrogenic cardiac tamponade by transesophageal echocardiography during vena cava filter procedure

Shih-Tai Hsin MD,
Hsiang-Ning Luk MD PhD,
Su-Man Lin MD,
Kwok-Han Chan MD,
Mei-Yung Tsou MD PhD,
Tak-Yu Lee MD

Purpose: To present a patient who developed cardiac tamponade during insertion of an inferior vena cava (IVC) filter. Intraoperative transesophageal echocardiography (TEE) was used as a means to diagnose the cardiac tamponade and to facilitate guiding of pericardiocentesis.

Clinical features: A 45-yr-old man with protein S deficiency complicated by repeated attacks of deep vein thrombosis and pulmonary thromboembolism was scheduled for insertion of an IVC filter. He had history of chronic renal insufficiency, heart failure, and cerebral infarction with mild left hemiparesis. Current medication included diltiazem (30 mg, 1 tab tid), prednisolone (5 mg, 2 tabs qd), and warfarin (2.5 mg daily).

Preoperative transthoracic echocardiography demonstrated bilateral pleural effusions, moderate mitral regurgitation and tricuspid regurgitation, left atrial appendage thrombus and severe generalized hypokinesia of left ventricle. Nuclear medicine examination by ^{99}Tc showed ejection fractions of left ventricle and right ventricle as 20% and 22%, respectively. Under the impression of protein S deficiency with multiple attacks of thromboembolism and failure of anticoagulant therapy, he was arranged for the procedure of vena caval filter insertion. Unfortunately, iatrogenic cardiac tamponade occurred during the course of the procedure with rapid hemodynamic deterioration. Because of the expedient of routine monitoring of cardiac condition with TEE, a prompt diagnosis was made. We successfully improved the patient's hemodynamic status after transthoracic echo-guided pericardiocentesis.

Conclusion: Intraoperative TEE is recommended to be used routinely in patients undergoing vena cava filter procedures. The availability of echocardiographic monitoring in the operation room allows the confirmation of the diagnosis and facilitation pericardiocentesis.

Objectif : Présenter le cas d'un patient qui a subi une tamponnade cardiaque pendant l'insertion d'un filtre dans la veine cave inférieure (VCI). Une échocardiographie transœsophagienne (ETO) peropératoire a servi à diagnostiquer la tamponnade cardiaque et à faciliter le guidage pendant la péricardiocentèse.

Éléments cliniques : Un homme de 45 ans, atteint d'une déficience en protéine S compliquée par des attaques répétées de thrombose veineuse profonde et de thromboembolie pulmonaire, a été admis pour l'insertion prévue d'un filtre dans la VCI. Il avait des antécédents d'insuffisance rénale chronique, de défaillance cardiaque et d'infarctus cérébral marqué par une hémiplégie gauche bénigne. Sa médication comprenait du diltiazem (30 mg, 1 comprimé tid), de la prednisolone (5 mg, 2 comprimés die) et de la warfarine (2,5 mg par jour).

L'ETO préopératoire a mis en évidence des épanchements pleuraux bilatéraux, de la régurgitation mitrale modérée et de la régurgitation tricuspidienne, des thrombus à l'auricule cardiaque gauche et une sévère hypokinésie générale du ventricule gauche. L'examen en médecine nucléaire à l'aide du ^{99}Tc a montré des fractions d'éjection des ventricules gauche et droit de 20 % et de 22 %, respectivement. Face à ce tableau clinique et l'échec du traitement par les anticoagulants, nous avons admis le patient pour l'insertion d'un filtre intraveineux cave. Malheureusement, une tamponnade cardiaque iatrogène, accompagnée d'une rapide détérioration hémodynamique, est survenue pendant l'intervention. Grâce au monitorage de routine de la condition cardiaque avec l'ETO, le diagnostic a été rapidement établi. Nous avons réussi à améliorer l'état hémodynamique du patient après la péricardiocentèse sous échoguidage.

Conclusion : L'ETO peropératoire est recommandée comme mesure de routine chez des patients qui subissent l'insertion de filtre intraveineux cave. L'accessibilité au monitorage échocardiographique dans la salle d'opération facilite le diagnostic et la péricardiocentèse.

From the Department of Anesthesiology, Veterans General Hospital-Taipei, School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC.

Address correspondence to: Dr. Shih-Tai Hsin, Department of Anesthesiology, Veterans General Hospital-Taipei, 201, sec 2, Shih-pai Road, Taipei, Taiwan, ROC. Phone: 886-2- 28757549; Fax: 886-2-28751597; E-mail: sthsin@vghtpe.gov.tw

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PLACING a filter in the inferior vena cava as a barrier to prevent pulmonary thromboembolism has been practiced since the late 1960s. This procedure is used as an adjunct of anticoagulant therapy to prevent emboli in the deep veins from entering the pulmonary system, particularly in those at high risk of venous thromboembolism. However, many complications associated with this procedure, including perforation of vena cava, bleeding or thrombus formation at the site of insertion, malposition or migration of the filter, and post-phlebitic syndrome from chronic venous occlusion have been reported.¹⁻³ Serious complications, such as atrial or ventricle perforation, were rarely reported. We present the perioperative evaluation with TEE and successful management of a patient with iatrogenic cardiac tamponade.

Case report

A 45-yr-old man with protein S deficiency was admitted to our hospital because of multiple episodes of deep vein thrombosis and pulmonary embolism. He had history of chronic renal insufficiency, heart failure, and cerebral infarction with mild left hemiparesis. Current medication included diltiazem (30 mg tid), prednisolone (10 mg qd), and warfarin 2.5 mg daily.

Preoperative transthoracic two-dimensional echocardiography demonstrated bilateral pleural effusions, moderate mitral regurgitation and tricuspid regurgitation, left atrial appendage thrombus and severe generalized hypokinesia of the left ventricle. Nuclear medicine examination by ^{99}Tc shows ejection fractions of left ventricle and right ventricle of 20% and 22%, respectively. Poor wall motion with severe generalized hypokinesia of the left ventricle was also noted. In the presence of protein S deficiency with multiple attacks of thromboembolism and failure of anticoagulant therapy, vena cava filter insertion was arranged.

Intra-operative monitoring items, including electrocardiogram, pulse oximetry, end-tidal capnography and continuous arterial blood pressure measurement, were applied. Anesthesia was induced with $1.5 \text{ mg} \cdot \text{kg}^{-1}$ lidocaine, $5.7 \text{ } \mu\text{g} \cdot \text{kg}^{-1}$ fentanyl, $0.27 \text{ mg} \cdot \text{kg}^{-1}$ etomidate, and $0.54 \text{ mg} \cdot \text{kg}^{-1}$ atracurium *iv* and maintained with isoflurane 1-1.5 % in O_2 100%. The hemodynamic status during induction of general anesthesia was stable and agreeable. After stable anesthesia, a double lumen central venous catheter was placed via the internal jugular vein. Transesophageal echocardiography (TEE, Hewlett-Packard, model 5500, USA) with a multiplane probe was applied as a perioperative monitor.

The surgical procedure started by attempting to introduce the filter guide wire into the inferior vena

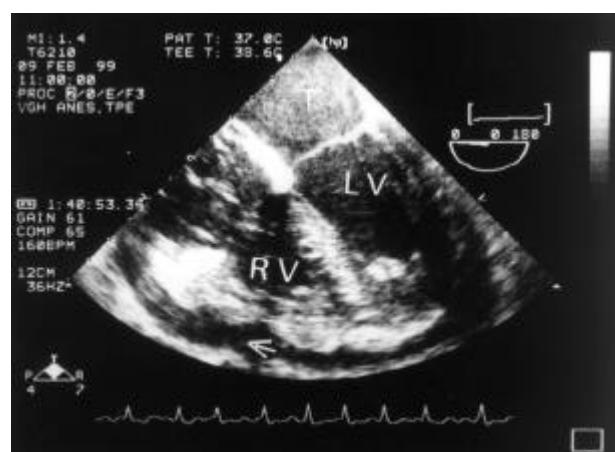


FIGURE 1 Transesophageal echocardiography – four-chamber view. The image shows significant amounts of pericardial effusion. (indicated by arrow) Both ventricles are clearly separated from pericardium by the accumulated fluid. It is noted that the right ventricle is compressed during diastole by the pericardial effusion. It should also be noticed that a huge and well-margin thrombus (designated by T) in the left atrium. LV: left ventricle. RV: right ventricle.

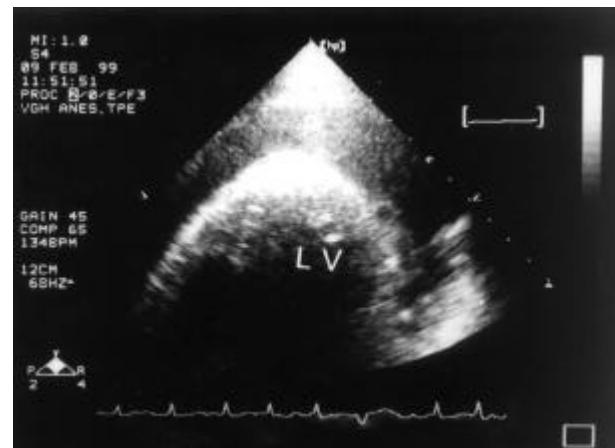


FIGURE 2 Transthoracic echocardiography – apical view of left ventricle. The image shows better picture of large quantity of pericardial fluid that separates the left ventricle and pericardium. LV: left ventricle. P: pericardial effusion.

cava (IVC) via the right external jugular vein. However, it could not be passed through the SVC and the guide wire coiled in the right atrium. At this juncture, atrial fibrillation was noted in the ECG tracing and blood pressure decreased from 105/65 mmHg to 60/35 mmHg with tachycardia (HR: 150/min)



FIGURE 3 TEE – four-chamber view. (obtained during the second time of operation)

The image demonstrates clearly the left atrium and its appendage. In addition, the right atrium, right ventricle and aortic valve are clearly displayed. The previous huge thrombus in the left atrial appendage remains in situ. Interestingly, a novel large thrombus is found in the right atrium (indicated by arrow), probably due to vascular injury in the previous IVC filter indwelling procedure.

despite an intravenous fluid challenge. Repeated doses of ephedrine (40 mg total), continuous intravenous infusion of epinephrine and dopamine were then administrated, but of no avail. Central venous pressure was elevated from 11 cmH₂O to 30 cmH₂O and engorgement of jugular veins was also noted. At this time, the TEE demonstrated compression of right atrium, right ventricular diastolic collapse and pericardial accumulation of fluid, all of which were typical of cardiac tamponade (Figure 1). Emergency pericardiocentesis, guided by TEE and confirmed by transthoracic echocardiography (TTE, Figure 2), was performed immediately. In total, 700 ml blood were drained and the drainage tube was left for continuous but slow drainage. The patient's hemodynamic improved soon after pericardiocentesis and central venous pressure decreased to within normal range. The vena caval filter insertion procedure was called off. Patient was transferred to ICU for further care.

Three weeks later, the patient was rescheduled for thrombectomy of the left atrial appendage (LAA) thrombus and another attempt at vena cava filter insertion. In addition to LAA thrombus, a new thrombus was found in the right atrium (RA) (Figure 3). Both thrombi were removed after sternotomy and atriotomy under cardiopulmonary bypass. The IVC filter was also successfully inserted thereafter via RA to IVC at the

level of L₂₋₃. The perioperative status of the patient was stable and whole procedure was done smoothly.

Discussion

We have demonstrated that intraoperative monitoring with TEE successfully detected the incidental episode of cardiac tamponade and later served to guide pericardiocentesis which saved the patient from lethal outcome.

Deficiency of C or S protein, usually an autosomal dominant disorder, causes identical disease entities characterized by recurrent venous thromboembolism and pulmonary embolism. In addition, few patients with homozygous protein C deficiency have fulminant neonatal intravascular coagulation and require prompt diagnosis and treatment. All these patients had suffered manifest similar clinical symptoms by their early twenties. Heterozygous patients with protein C or S deficiency who develop acute thrombosis should be initially heparinized and then placed on oral anticoagulants.⁴ However, there are two potential problems with the use of coumarin anticoagulants in these patients. First, it lowers the level of the precoagulant factors II, VII, IX, and X, also may reduce the concentration of protein C and S sufficiently to nullify the desired antithrombotic effect. In addition, there are patients with coumarin-induced skin necrosis who are protein C deficient, suggesting that this defect may predispose patients to a rare but serious complication of oral anticoagulants.

The placement of vena caval filter is generally a contemplation for prophylaxis against pulmonary embolism in patients with deep-vein thrombosis or those at high risk for venous thromboembolism, in whom anticoagulant therapy failed or was contraindicated.⁵⁻⁷ An IVC filter may be placed immediately after an episode of large pulmonary embolism in order to forestall a subsequent fatal one. Many complications may also be associated with this procedure. Nevertheless, insertion of the filter is a safe, easy, and effective form of prophylaxis for pulmonary embolism in high-risk patients, although no significant differences in mortality between those who had or had not received vena caval filter.

Cardiac tamponade leads to impaired venous return, insufficient cardiac filling and reduction in stroke volume and cardiac output. Clinical manifestations include narrow pulse pressure, neck vein distention, markedly elevated central venous pressure, which equalizes the ventricular end-diastolic pressures and atrial pressures. Echocardiography is the most effective diagnostic tool due to its sensitive, specific, simple, innocuous and non-invasive nature. A classic transthoracic echocardiographic feature of cardiac tamponade is

diastolic collapse of the RA or RV.⁸ In many cases, however, transthoracic imaging is difficult because of hindrance by mechanical ventilation or competition with the surgical field. TEE can provide adequate visualization, especially of the posterior part of the heart because of the proximity of the transducer to the cardiac structures.⁹ Once the diagnosis of cardiac tamponade is ascertained, emergency pericardiocentesis is not only a simple procedure but also provides a rapid hemodynamic relief. This life-saving procedure could be guided either by TTE or TEE. In this case, intra-operative TEE appears to be superior. Continuous aspiration may help avoid the need of immediate surgical intervention, but definite or radical treatment of pericardial tamponade due to bleeding may require thoracotomy for evacuation of hematoma.¹⁰

In conclusion, this report emphasizes the usefulness of intra-operative transesophageal echocardiography for early detection of pericardial tamponade in patients undergoing vena caval filter insertion procedure and the facilitation of guiding pericardiocentesis.

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