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Case Reports

A Transesophageal Cardiovascular Intervention

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Abstract

Endoscopic ultrasonography-guided transesophageal pericardiocentesis was performed for a posteriorly located effusion not amenable to transthoracic drainage in a 58-year-old woman with a history of recurrent breast adenocarcinoma who presented with dyspnea. The patient had a pericardial effusion that resulted in cardiac tamponade. Transthoracic pericardiocentesis was unsuitable because of the posterior location of the effusion. Pericardiocentesis via the transesophageal route was performed. The pericardial sac was punctured with a 19-gauge needle, and 245 mL of pericardial fluid were aspirated, resulting in the resolution of the tamponade physiology. Endoscopic ultrasonography-guided transesophageal drainage is a novel and promising therapeutic option for posteriorly located pericardial effusions.

Keywords: Cardiac tamponade; echocardiography; endosonography; pericardiocentesis

Case Report

Presentation and Physical Examination

A 58-year-old woman presented with a 2-week history of progressive dyspnea. On admission, she was dyspneic at rest. Her blood pressure was 105/65 mm Hg, and her heart rate was 104/min. Oxygen saturation was 99% with 3 L supplementary oxygen. A computed tomography (CT) scan performed on admission revealed a large pericardial effusion (Fig. 1A, Fig. 1B). A transthoracic echocardiogram confirmed a posteriorly located effusion with diastolic collapse of the right atrium and ventricle (Fig. 2A, Fig. 2B). The maximum size of the effusion was 2.96 cm. Transthoracic pericardiocentesis was considered unsuitable in view of the posterior location of the effusion; imaging at subxiphoid, parasternal, and apical windows failed to identify favorable pathways that could have reached the effusion without injuring other structures. Computed tomography–guided and fluoroscopy-guided approaches were considered but decided against for the same reason. The cardiothoracic surgery team declined a request for pericardial fenestration in view of the history of pleurodesis, previous thoracic instrumentation, and the overall poor prognosis. A decision was made to perform pericardiocentesis via the transesophageal route using endoscopic ultrasonography (EUS).

Medical History

The patient had undergone a wide local excision and axillary clearance followed by radiation therapy and chemotherapy for a left-sided adenocarcinoma of the breast 6 years before presentation. A recurrence of cancer was diagnosed 2 years before presentation, for which the patient underwent further chemotherapy. Fourteen months before admission, she underwent bilateral video-assisted pleurodesis for recurrent bilateral pleural effusions.

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Technique

The patient underwent procedural sedation with 2.5 mg intravenous midazolam and 50 μg intravenous fentanyl; she breathed spontaneously throughout the procedure. The patient received supplemental oxygen through a face mask; endotracheal intubation was not performed. Blood pressure was monitored using an arterial line, and heart rate and rhythm were monitored using a cardiac monitor. No inotropes or vasopressors were administered throughout the procedure. The pericardial effusion was identified, and the pericardial sac was punctured with a 19-gauge fine needle (Cook Medical) (Fig. 3A). The needle was advanced into the pericardial effusion (Fig. 3B), and a total of 245 mL hemorrhagic pericardial fluid was aspirated. There were no immediate or late complications. The patient reported significant symptomatic improvement with no recurrence of tamponade symptoms. The tachycardia resolved, and blood pressure increased to approximately 146/90 mm Hg at the end of the procedure. Transthoracic echocardiography performed immediately after the procedure confirmed a significant reduction in the size of the pericardial effusion (maximum size measured = 1.9 cm) and an absence of diastolic right atrial or ventricular collapse (Fig. 4A, Fig. 4B). The patient was discharged 3 days after the procedure.

Key Points

- Endoscopic ultrasonography is an up-and-coming modality in gastroenterology with increasing cardiovascular applications (biopsy of intracardiac masses, direct pulmonary artery embolism thrombolysis, pericardiocentesis, and pleural effusion drainage).
- Transesophageal pericardiocentesis can be performed when conventional transthoracic drainage is not feasible because of posteriorly located or loculated effusions.
- The proximity of the esophagus and mediastinal structures could provide an inlet for EUS-guided procedures in the future (possibly including direct left atrial pressure measurements, pericardial drain insertions, and intracardiac interventions).

Abbreviations and Acronyms

CT	computed tomography
EUS	endoscopic ultrasonography

Outcome and Follow-Up

An outpatient CT scan performed 6 days after the procedure confirmed the significant reduction in the size of the pericardial effusion (Fig. 5A, Fig. 5B). The patient died 6 months after the procedure from pneumonia.

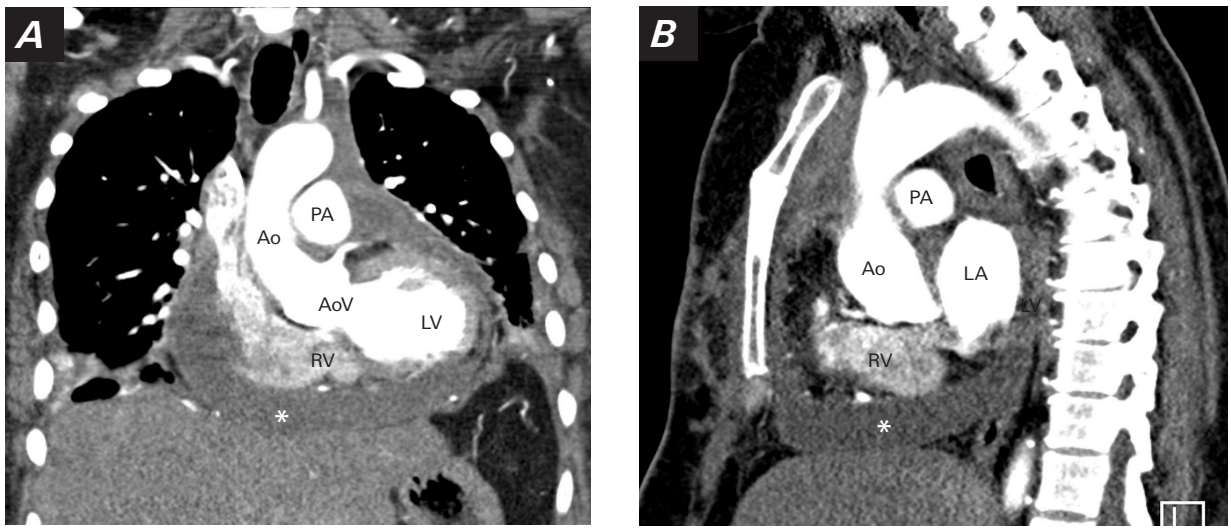

Fig. 1 Computed tomogram before pericardiocentesis in **A**) coronal and **B**) sagittal planes. The asterisk indicates the pericardial effusion.

Ao, ascending aorta; AoV, aortic valve plane; LA, left atrium; LV, left ventricle; PA, pulmonary artery; RV, right ventricle.

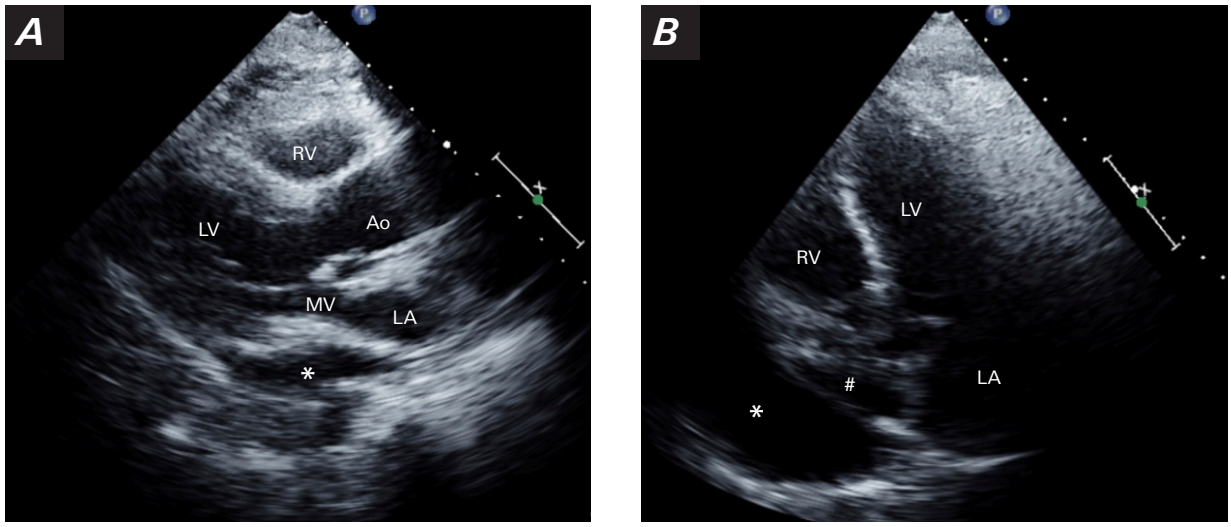

Fig. 2 Transthoracic echocardiogram before pericardiocentesis in **A**) parasternal long axis and **B**) modified apical 4-chamber views. The pound sign indicates a partially collapsed right atrium; the asterisk indicates the pericardial effusion.

Ao, ascending aorta; LA, left atrium; LV, left ventricle; MV, mitral valve; RV, right ventricle.
Supplemental motion image is available for Figure 2A and Figure 2B.

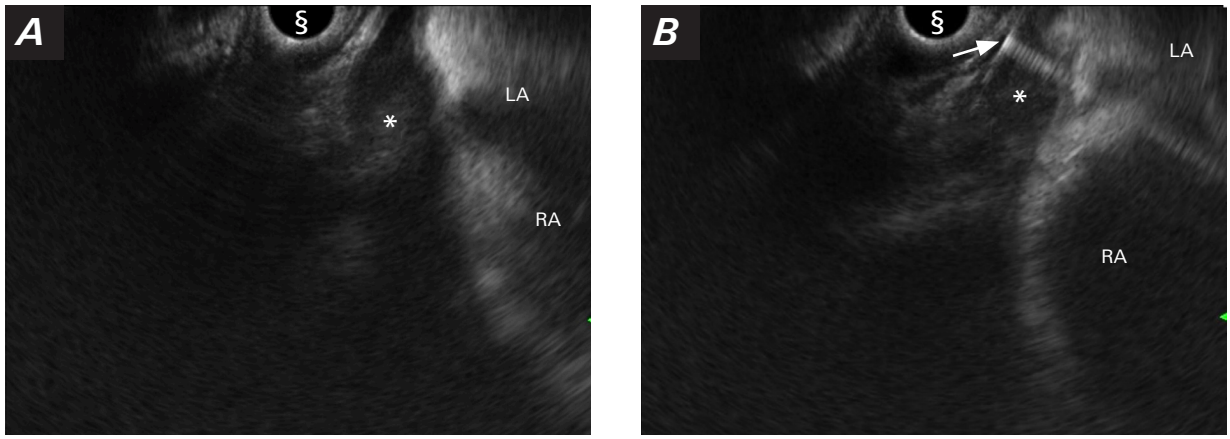

Fig. 3 A) Endoscopic ultrasonograph (EUS). The § indicates the EUS scope; the asterisk indicates the pericardial effusion. **B**) The aspiration needle (arrow) is seen within the pericardial effusion (asterisk).

LA, left atrium; RA, right atrium.

Discussion

Pericardial fluid accumulation can result in cardiac tamponade. The total fluid amount and its rate of accumulation in relation to pericardial stretch and compensatory mechanisms determine the severity of clinical symptoms, ranging from minimal to circulatory collapse.[1] Established or impending cardiac tamponade is usually treated urgently by transthoracic pericardiocentesis guided by echocardiography and, less commonly, by CT or fluoroscopy.[2] Complications from emergency transthoracic needle pericardiocentesis are not uncommon and can themselves be life-threatening. Liver parenchymal and bile ducts injuries, intra-abdominal viscus perforations, lung injuries, dissections of coronary arteries, infections, and placements of pericardial drains within ventricles have been described at a rate of approximately 1.2%.[3-5] Furthermore, transthoracic needle pericardiocentesis can be extremely difficult in special situations, including patients with (1) small

but rapidly accumulating effusions, (2) severe obesity that prevents effective transthoracic ultrasonography and necessitates puncture through deep tissue layers, (3) chest wall or abdominal deformities or anatomical variations, or (4) posteriorly located effusions.[6,7] Open surgical drainage can be considered when needle pericardiocentesis is difficult.[1]

Endoscopic ultrasonography is a rapidly evolving modality in the field of gastroenterology. The scopes used for EUS are similar to regular endoscopes but with the added component of an ultrasound transducer.[8] Curvilinear EUS scopes scan in a plane parallel to the axis of the scope and have additional working channels for instrumentation, allowing image-guided procedures such as needle aspirations, cauterizations, and tissue sampling.[9] Real-time visualization of device and needle advancement while performing a procedure is possible (Fig. 3B). The original indication for EUS was to perform fine-needle aspirations of difficult-to-access lesions, such as tumors in the pancreas, and to locally

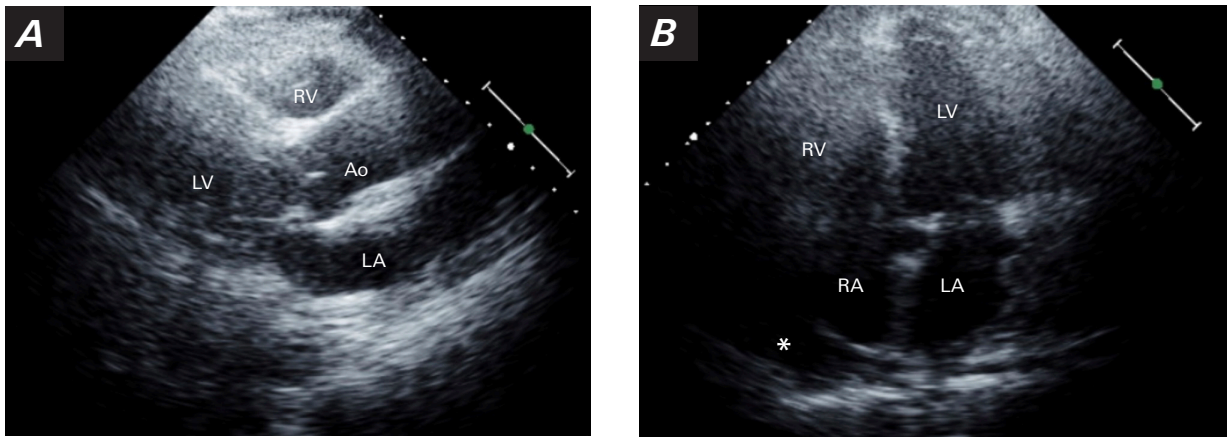

Fig. 4 Transthoracic echocardiogram after pericardiocentesis in **A**) parasternal long axis and **B**) modified apical 4-chamber views with reduced effusion (asterisk).

Ao, ascending aorta; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle.
Supplemental motion image is available for Figure 4A and Figure 4B.

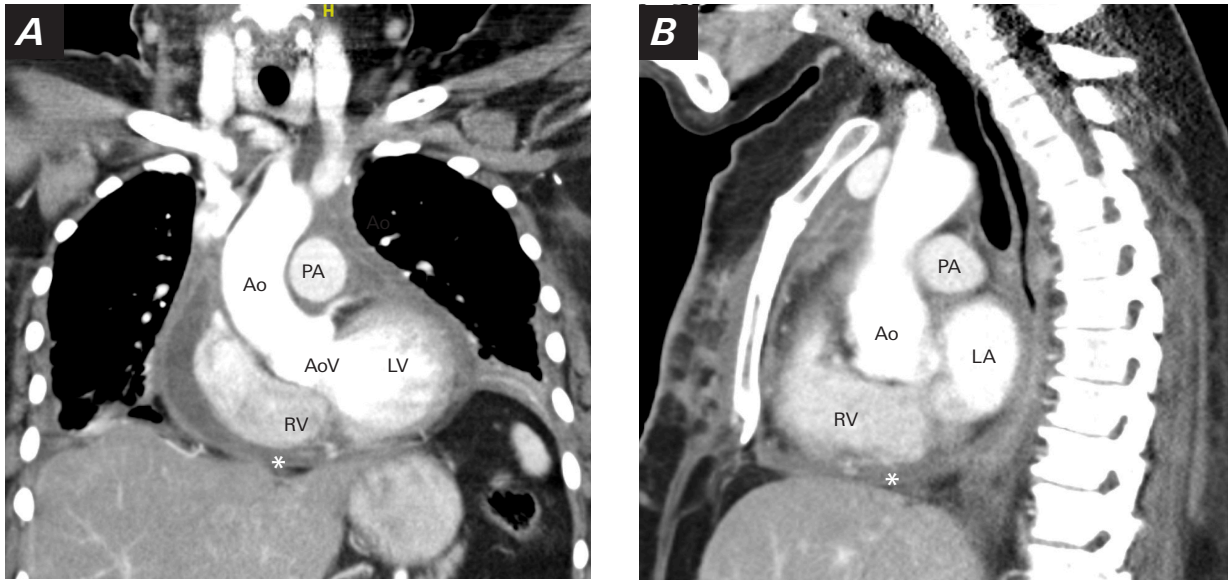

Fig. 5 Computed tomogram after pericardiocentesis with reduced effusion (asterisk) in **A**) coronal and **B**) sagittal planes.

Ao, ascending aorta; AoV, aortic valve plane; LA, left atrium; LV, left ventricle; PA, pulmonary artery; RV, right ventricle.

stage tumors of the gastrointestinal tract.[10] The list of indications has rapidly expanded to include drainage procedures (peripancreatic collections and biliary drainage), injections (celiac plexus neurolysis and bleeding control), targeted destruction of lesions (fiducial placement for radiation therapy and alcohol ablation), guidance of transluminal endoscopic surgery, and vascular intervention (vascular coil insertion and vascular access).[11-13] Risks and complications of EUS include perforation, sedation-related problems (anaphylactic reaction to anesthetic drugs, respiratory depression with cardiovascular collapse, and aspiration pneumonia), and bleeding from iatrogenic vascular injuries. Puncture or biopsy-related infections are rare. Contraindications for EUS are generally similar to those for all standard upper gastrointestinal endoscopic procedures—namely, significant hemodynamic instability and patients at high risk of respiratory arrest or aspiration pneumonia. Relative contraindications include bleeding tendency and sepsis.

In terms of cardiology, transesophageal EUS has been shown to offer excellent and consistent visualization of the heart and its surrounding structures, similar to a transesophageal echocardiogram.[14] Endoscopic ultrasonography–guided, transesophageal drainage of pericardial effusions is a novel concept in the world of cardiology; therefore, no guidelines exist. Although conventional transthoracic pericardiocentesis guided by real-time echocardiography is the standard of care for cardiac tamponade, there can be occasions when transthoracic drainage is not feasible because of technical or anatomical factors. Posteriorly located or loculated effusions frequently pose a clinical dilemma, as transthoracic pericardiocentesis might not be feasible at all or would come with a high risk of injury to noncardiac structures, such as the liver or lungs.

There have been several reports of successful EUS-guided pericardiocentesis procedures.[15,16] The main reason it was carried out, as in the case discussed here, was when the location of the pericardial fluid (typically posterior) made a transthoracic approach, whether echocardiographic or CT guided, difficult. The decision of whether to opt for an EUS-guided or transthoracic approach requires balancing the procedural risks of EUS against the likelihood of injury to noncardiac structures from an unfavorable transthoracic approach. The concept of draining effusions through the esophageal wall may appear intimidating to a nongastroenterologist, but it is technically relatively simple: The scope is positioned straight in the midesophagus and can be rotated to visualize the pericardial sac, which is readily identifiable, particularly in the presence of an effusion, with the separation of the 2 pericardial layers by anechoic fluid. A needle can be carefully advanced under real-time visualization through the esophageal wall and into the space between the 2 pericardial layers. Significant myocardial injury is unlikely because of the real-time visualization and the small needle. Furthermore, the safety of EUS-guided punctures has been explored widely in other anatomical locations, and transvascular biopsies (with the biopsy needle traversing structures such as the aorta, pulmonary arteries, or portal vein) have been shown to be relatively safe.[17,18]

One of the main limitations of the procedure is the need for sedation and possibly endotracheal intubation. Although the patient described here had hypotension and tachycardia, she was still sufficiently stable to tolerate the EUS-guided procedure. In the setting of an extremely unstable or rapidly deteriorating patient, the need for sedation, intubation, hemodynamic support, and transfer to an endoscopy suite would likely preclude the option of EUS-guided drainage. In the authors' opinion, EUS-guided pericardiocentesis is most appropriate for patients who are not extremely unstable with otherwise difficult-to-reach effusions.

The proximity of the esophagus and mediastinal structures could provide an inlet for EUS-guided diagnostic and therapeutic procedures to the heart in the future. Procedures that appear feasible through a transesophageal approach include pericardial drain insertion for extended drainage via a transesophageal or transnasal route, biopsy of pericardial and myocardial tumors, or thrombolysis of pulmonary emboli through direct puncture of the pulmonary arteries. Direct measurements of left atrial pressures appear feasible, similar to portal vein pressure measurements, which are already a reality.[19,20] Supplementary Table I provides an overview of all published reports of EUS-guided cardiovascular procedures.

In conclusion, this article describes a case of an EUS-guided transesophageal drainage of a posteriorly located pericardial effusion. Endoscopic ultrasonography may prove to be a promising procedure in cardiac interventions.

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