An Evaluation of Acute Cardiac Tamponade by Transesophageal Echocardiography

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A 63-yr-old man with femoral venous thrombosis presented to the interventional radiology suite for prophylactic placement of an inferior vena cava (IVC) filter from the right internal jugular approach. During the procedure, he became hypotensive and developed pulseless electrical activity. Cardiopulmonary resuscitation, fluids, vasopressors and, ultimately, femoro-femoral veno-arterial cardiopulmonary bypass assistance were required to resuscitate the patient. Pulmonary embolism and coronary artery occlusion were excluded using angiographic methods. Transthoracic echocardiography (TTE) revealed a large pericardial effusion suggesting a cardiac rupture. TTE-guided pericardiocentesis was performed, but his hemodynamics were not substantially improved and TTE images were suboptimal. To more thoroughly evaluate cardiac tamponade, transesophageal echocardiography (TEE) was performed, demonstrating a large pericardial echo-free space containing large echodense masses that were suspected to be hemorrhagic effusion and pericardial thrombus, respectively. (Figs. 1A–C; please see video clips available at www.anesthesia-analgesia.org). The large pericardial effusion and pericardial thrombus compressed the right atrium and right ventricle, worsening the patient’s hemodynamics. Severe global hypokinesis was believed to be secondary to the ischemic effects related to his cardiac arrest. The patient was taken to the operating room, where a large hematoma was evacuated from the pericardium and a laceration of the right ventricle was repaired. The patient was uneventfully weaned from cardiopulmonary bypass and recovered without any neurological sequelae.

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Figure 1. Transesophageal echocardiography. A: Anteflexed midesophageal 4-chamber view shows pericardial effusion and thrombus compressing the right atrium (RA) and right ventricle (RV). B: Midesophageal bicaval view shows displaced right atrial wall and undulating fibrinous strands in a large amount of pericardial effusion. C: Transgastric short-axis view shows large pericardial effusion and thrombus in the right-side pericardial cavity. LA, left atrium; LV, left ventricle; Ao, aortic artery.
Cardiac tamponade is a clinical diagnosis based on signs (e.g., jugular venous distension, tachycardia, pulsus paradoxus, and hypotension) and symptoms (e.g., chest discomfort, tachypnea, exertional dyspnea, and episodes of unconsciousness). Echocardiography can readily demonstrate the pathophysiology underlying these clinical findings and may prove valuable in confirming this diagnosis.\(^1\) First, two-dimensional echocardiography identifies morphological features, in addition to pericardial effusion. Right atrial collapse is a specific finding if it lasts more than one-third of the cardiac cycle (from late diastole to early systole), whereas right ventricular collapse during early diastole and left atrial collapse are more highly specific but low sensitivity findings.\(^2\)

Posttraumatic pericardial effusion may result in deposition of clot, which may loculate and exert pressure on one or more of the cardiac chambers. These changes are more likely to occur when respective chamber pressures temporarily decrease to less than the pericardial pressure. Furthermore, paradoxical septal motion with respiration, dilated IVC and hepatic veins with lack of inspiratory collapse, and a “swinging” heart can be observed. In the present case, increased left ventricle diastolic wall thickness in cardiac tamponade was seen, representing the characteristic feature of “pseudohypertrophy”\(^2\); (please see video clip available at www.anesthesia-analgesia.org). Second, Doppler echocardiographic findings of cardiac tamponade are based on alterations of intrathoracic and intracardiac pressures that occur during respiration, and reflect clinical severity. In patients with cardiac tamponade, significant pericardial effusion blunts the transmission of intrathoracic pressure. During spontaneous inspiration, intrathoracic pressure and pulmonary capillary wedge pressure decrease, whereas intracardiac pressure remains unchanged. A decrease in pressure gradient thus results in diminished diastolic pulmonary venous and transmitial valve Doppler flow velocities during spontaneous inspiration, subsequently facilitating right ventricular filling by enhanced ventricular interdependence (e.g., increased tricuspid valve flow and hepatic venous flow toward the IVC). Opposite changes are observed on spontaneous expiration. These respiratory changes in Doppler flow velocities are reversed if the patient is receiving positive pressure ventilation. In this case, findings of pronounced fluctuation in tricuspid and transmitial flow, paradoxical septal motion with respiration and dilated IVC and hepatic veins were not observed, mainly because the patient was under cardiopulmonary bypass.

Acute traumatic pericardial effusion can impair cardiac performance and induce cardiac tamponade with even 50 mL of localized pericardial fluid, whereas circumferential chronic pericardial effusion generally has low pressure without the symptoms of cardiac tamponade or echocardiographic findings mentioned above.\(^3\) Briefly, the rate of fluid accumulation relative to pericardial stretch and efficacy of compensatory neurohormonal mechanisms has an impact on the symptoms of cardiac tamponade. Patients with pericardial effusion along with no characteristic hemodynamic and echocardiographic findings are thus not diagnosed with cardiac tamponade. In this regard, patients with constrictive pericarditis have cardiac tamponade-like hemodynamics and Doppler echocardiographic findings.

A previous report documented that cardiac tamponade as a complication of catheter-based procedures is rescued by urgent pericardiocentesis alone in 82% of cases, whereas large pericardial thrombus and sustained massive pericardial effusion, despite extended pericardiocentesis, necessitate surgical intervention.\(^4\) TEE has the advantage of being able to diagnose intrapericardial clot and loculated pericardial effusion compared to TTE. TEE should thus be considered when TTE does not offer adequate information about the presence of pericardial effusion or evaluation of hemodynamic impact. The present case demonstrates the efficacy of TEE in evaluating iatrogenic cardiac tamponade.

REFERENCES