Unrecognized tamponade diagnosed pre-induction by focused echocardiography

Une échocardiographie ciblée permet de diagnostiquer une tamponnade non reconnue avant l'induction

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Abstract

Purpose We report a case of unrecognized cardiac tamponade diagnosed pre-induction by focused transthoracic echocardiography (TTE). The value of focused perioperative TTE, the anesthetic implications of Churg-Strauss syndrome, and the diagnosis of cardiac tamponade are discussed.

Clinical features A 58-yr-old man with a history of severe asymptomatic aortic stenosis presented for elective endoscopic sinus surgery for intractable nasal polyps with recurrent sinusitis. His cardiologist and cardiac surgeon had recommended proceeding with surgery, as aortic valve replacement was not indicated because he was asymptomatic. Prior to induction, a focused TTE was performed by anesthesia in order to document the degree of aortic stenosis, baseline ventricular function, and baseline volume status. This provided a baseline for

comparison in case the patient's hemodynamic status should deteriorate intraoperatively. Unexpectedly, the TTE examination revealed cardiac tamponade. After confirmation of the diagnosis by cardiology, urgent pericardiocentesis was performed. A diagnosis of Churg-Strauss syndrome was ultimately made, and the patient was treated with high-dose prednisone therapy.

Conclusion Focused TTE has significant clinical utility for the diagnosis and assessment of hemodynamically significant cardiac conditions, particularly in the complex patient where clinical examination is challenging and echocardiographic findings can have immediate management implications.

Résumé

Objectif Nous rapportons un cas de tamponnade cardiaque non reconnue diagnostiquée avant l'induction grâce à une échocardiographie transthoracique (ÉTT) ciblée. Nous discutons de l'utilité de l'ÉTT périopératoire ciblée, des implications anesthésiques du syndrome de Churg-Strauss et du diagnostic de tamponnade cardiaque.

Éléments cliniques Un homme de 58 ans présentant des antécédents de sténose aortique asymptomatique grave s'est présenté pour une chirurgie endoscopique des sinus non urgente en raison de polypes nasaux réfractaires provoquant des sinusites à répétition. Son cardiologue et son chirurgien cardiaque avaient recommandé d'aller de l'avant avec la chirurgie; en effet, le remplacement de la valve aortique n'était pas indiqué, le patient étant asymptomatique. Avant l'induction, une ÉTT ciblée a été réalisée par l'anesthésiologiste afin d'évaluer le degré de sténose aortique, la fonction ventriculaire de base, et la volémie de base. Ces données constituaient des valeurs de base à utiliser à titre de comparaison au cas où le statut hémodynamique du patient venait à se dégrader pendant

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l'opération. Contre toute attente, l'examen d'ÉTT a révélé une tamponnade cardiaque. Après confirmation du diagnostic par le cardiologue, une ponction péricardique d'urgence a été réalisée. Finalement, un diagnostic de syndrome de Churg-Strauss a été posé, et le patient a reçu un traitement de prednisone à forte dose.

Conclusion *L'ÉTT ciblée possède une importante utilité clinique pour le diagnostic et l'évaluation de maladies cardiaques significatives d'un point de vue hémodynamique, particulièrement chez les patients présentant des antécédents complexes, chez lesquels l'examen clinique est difficile et pour lesquels des résultats échocardiographiques peuvent avoir des implications immédiates au niveau de la prise en charge.*

Focused transthoracic echocardiography (TTE) is a powerful tool for assessment and diagnosis of hemodynamically significant cardiac conditions. Recent expanding interest in TTE within non-traditional specialties, such as critical care medicine, anesthesiology, and emergency medicine, along with improved portability of devices has increased the use of this technology in acute care medicine.^{1,2} Recognition of this expansion has prompted joint consensus statements by the American Society of Echocardiography, the American College of Emergency Physicians, and the American College of Chest Physicians (ACCP) regarding the competency of acute care physicians in the use of ultrasonography assessment.^{3,4} Several protocols with memorable acronyms have been proposed, including FoCUS, FATE, BLEEP, HEART, and others, as summarized in a recent review.^{2,5,6} All rely on pattern recognition and a “goal-focused” approach to allow the sonographer to answer a discrete clinical question to guide hemodynamic management.⁶ In the case described here, a focused TTE examination performed preoperatively resulted in the unexpected diagnosis of cardiac tamponade. Its utility as an extension of the clinical exam is emphasized, particularly when a significant diagnosis may be difficult to make on clinical grounds alone. The manifestations and anesthetic implications of Churg-Strauss syndrome are discussed, and the implications of cardiac tamponade are outlined.

Case

Consent for disclosure was obtained from the patient. A 58-yr-old man with a history of severe aortic stenosis (AS), hypertension, and asthma presented for elective endoscopic sinus surgery for intractable nasal polyps with recurrent sinusitis. Throughout the patient's work-up for surgery, he

remained asymptomatic from his valvular lesion, and he denied symptoms of angina, syncope, pre-syncope, dyspnea, or significant functional limitation. His medications included ramipril, atorvastatin, salbutamol, and ipratropium. A preoperative echocardiogram performed five months before surgery revealed severe calcific AS, with an aortic valve area of 0.8 cm²; peak and mean gradients of 104 and 65 mmHg, respectively; jet maximum velocity 5.1 msec; and a hypertrophied left ventricle (LV) with preserved function (LV ejection fraction 74%). Notably, no pericardial effusion was present. In consultation with a cardiac surgeon and cardiologist, it was recommended that the patient proceed with his sinus surgery, as his asymptomatic status did not warrant aortic valve replacement at that time.⁷

On the day of surgery, the patient's history was reviewed and he reported no changes in his health other than recent unintentional weight loss. The patient's vital signs were unchanged from those documented in the pre-surgical screening clinic, except for an elevated heart rate (heart rate 106 beats·min⁻¹ vs 83 beats·min⁻¹ in clinic, sinus rhythm, blood pressure 111/79 mmHg, oxygen saturation 98% on room air). Physical examination revealed a precordial murmur consistent with the diagnosis of severe AS. His lung fields were clear to auscultation, and there were no signs of congestive heart failure. His electrocardiogram (ECG) showed voltage criteria for LV hypertrophy.

A preoperative focused TTE exam (FoCUS) was performed to record the patient's baseline LV function and volume status. This provided a baseline for comparison in the event of hemodynamic compromise as well as for educational purposes to examine the degree of stenosis of his aortic valve. The components of a FoCUS examination include assessment of the LV function, right ventricular (RV) function, pericardial space, and volume status.² Unexpectedly, a large pericardial effusion was detected (Fig. 1, video 1) along with systolic collapse of the right atrium (RA) (Fig. 2, video 2), diastolic collapse of the RV, and a dilated inferior vena cava (IVC) with no respiratory variation in size. These findings were consistent with significant compensated cardiac tamponade despite the patient's normal blood pressure.⁸ Surgery was aborted, and the patient was transferred to the coronary care unit for urgent assessment by cardiology. Formal echocardiography confirmed the diagnosis of cardiac tamponade, and the cardiology department performed ultrasound-guided needle pericardiocentesis shortly thereafter for 360 mL of serosanguinous fluid.

Upon further inquiry, the patient admitted to a three-month history of increasing dyspnea, 20 pound weight loss, skin rash, and refractory cough, which he had not disclosed preoperatively because he did not consider these symptoms of particular significance to his upcoming surgery. Analysis

Fig. 1 Subcostal short-axis view of the left ventricle (LV) and right ventricle (RV) showing pericardial effusion (PE)

Fig. 2 Apical four-chamber view of right atrial (RA) systolic collapse (arrow) with the presence of pericardial effusion. LV = left ventricle; LA = left atrium; RV = right ventricle

of the drained pericardial fluid and subsequent bronchoscopy biopsies revealed eosinophilic infiltrates. This result, together with evidence of subendocardial vasculitis found on cardiac magnetic resonance imaging and a rapid response to corticosteroid therapy, signified a diagnosis of Churg-Strauss syndrome. The patient was discharged from hospital several days later. Incidentally, the patient's nasal polyposis regressed on high-dose prednisone therapy, and he no longer required endoscopic sinus surgery.

Discussion

This patient's clinical presentation represents a rare manifestation of an uncommon disease. Churg-Strauss syndrome is a rare systemic vasculitis associated with late-onset asthma, chronic sinusitis, hypereosinophilia, and non-

specific vasculitic symptoms, such as fever, weight loss, rash, and neuropathy.^{9,10} Multiple organ system dysfunction may be present and may manifest with pulmonary (e.g., infiltrate, pleural effusion, hemorrhage), integumentary (e.g., purpura, maculopapular rash, ulcer), neurologic (e.g., stroke, polyneuropathy, mononeuritis multiplex), gastrointestinal (e.g., abdominal pain, diarrhea), renal (e.g., glomerulonephritis, renal insufficiency), or cardiac (e.g., ischemic cardiomyopathy, myocarditis, pericarditis, pericardial effusion) complications.¹¹ Although pericardial effusion is an established manifestation of Churg-Strauss syndrome, progression to cardiac tamponade is rare.^{9,10,12}

Establishing the diagnosis of cardiac tamponade by history or physical examination in a patient with pre-existing cardiac disease presents significant challenges, as signs or symptoms may be attributed to coexisting disease. Dyspnea is the most sensitive symptom of tamponade (87–88% sensitivity),¹³ but it is non-specific in a patient with coexisting cardiac or respiratory disease. Had dyspnea been elicited preoperatively in this patient, it could easily have been attributed to either his asthma or his AS. Other symptoms reported in tamponade (fever, cough, chest pain, lethargy, palpitations) have < 25% sensitivity; this patient's cough could easily have been attributed to his asthma.¹³ Classically described physical findings in Beck's triad for acute tamponade (decreased arterial blood pressure, muffled heart sounds, and jugular venous distention) are not reliably present when effusions develop over time.^{13–15} Medical patients with baseline hypertension may paradoxically present with elevated blood pressure with tamponade, and the finding of muffled heart sounds is only 28% sensitive in cardiac tamponade.¹³ In this patient, arterial blood pressure was within the normal range, and the precordial exam was made more difficult due to his loud systolic murmur of AS. Only the third component of the triad, jugular venous distention, is a sensitive physical finding in the setting of cardiac tamponade (76% sensitivity), and in retrospect, was present in this patient.¹³ Tachycardia, another sensitive sign for cardiac tamponade (77% sensitivity), was also present in this patient, though it is nonspecific.¹³ Finally, the most sensitive and specific sign, pulsus paradoxus (98% and 83% respectively),¹⁶ is not routinely assessed preoperatively unless cardiac tamponade is already suspected.

Furthermore, routine investigations are not likely to provide diagnostic certainty in cardiac tamponade. A chest *x-ray* may be non-contributory early in the condition, as alterations in cardiac silhouette are not observed until at least 200 mL of fluid accumulates, though, overall, cardiomegaly on chest *x-ray* is 89% sensitive.^{13,15} This patient did not have enlargement of his cardiac silhouette on preoperative chest *x-ray*. The presence of electrical alternans on ECG, though specific for a large pericardial effusion, has low sensitivity and was not present in this case.^{13,15}

Table Echocardiographic findings of hemodynamically significant cardiac tamponade in the presence of a moderate to large pericardial effusion

Criteria	Echocardiographic Sign	Diagnostic Utility
RA Collapse	RA inversion during ventricular systole while atrium is relaxed	Early sign, greater specificity when persists for 1/3 of cardiac cycle
RV Collapse	Diastolic compression of the RVOT	Follows RA collapse, high specificity, low sensitivity
Reciprocal Doppler flow with respiration	Augmented mitral and tricuspid inflow and decreased pulmonary vein outflow with inspiration	Leads to clinical finding of pulsus paradoxus
IVC Plethora	Dilated IVC with loss of inspiratory collapse	High sensitivity, low specificity

RA = right atrium; RV = right ventricle; RVOT = right ventricular outflow tract; IVC = inferior vena cava

Given the diagnostic challenges presented above, cardiac tamponade was not suspected prior to the performance of focused bedside TTE. This case clearly illustrates the clinical utility of this “point-of-care” diagnostic modality as an aid to the clinical exam. The traditional indication for a FoCUS exam is for the rapid detection of clinically suspected hemodynamically significant cardiac conditions, such as pericardial effusion causing tamponade, LV failure, RV failure, or severe hypovolemia.^{2,4} This can prove especially valuable in the setting of emergency surgery, where the time to acquire formal diagnostic echocardiography is limited, and yet, echocardiography findings frequently have immediate management implications. In this patient, the FoCUS examination was not performed to evaluate current hemodynamic compromise; rather, it was performed as an aid to repeat intraoperative examination in case compromise should occur. The goal of the examination was for serial assessment of LV function and volume status in this high-risk patient undergoing non-cardiac surgery. The availability within the anesthesiology department and their expertise in performing focused TTE were essential for the incidental diagnosis of tamponade and the initiation of treatment.

Adequate training in the acquisition and interpretation of focused TTE is essential for appropriate and effective use of this technology. Its successful use has been shown in many settings. Anesthesiologists with cardiac training are able to obtain interpretable images for focused TTE in as many as 98% of perioperative patients.¹⁷ Images for a complete exam can be acquired in a short time frame [10.5 (4.2) min],¹⁸ and the process does not lead to a delay in surgery.¹⁸ With appropriate training, these images can be interpreted with a high degree of correlation with expert assessment.^{17,19–21} Additionally, the technical skills needed for basic image acquisition can be successfully taught to trainees in anesthesiology using both simulation and curriculum implementation.^{22–24} The knowledge base necessary for interpretation is based on pattern recognition and “goal-focused” assessment. For example, the particular echocardiographic features a cardiologist considers in a formal assessment of cardiac tamponade include systolic RA

compression; diastolic RV collapse; augmented respiratory variation in tricuspid and mitral flow velocities; and a dilated IVC (Table).⁸ In the focused TTE assessment for tamponade, the ACCP requires recognition of the following components for competence in critical care echocardiography: pericardial effusion; RA or RV collapse; and a dilated IVC.⁴ In this way, the key patterns and goals for hemodynamically significant conditions are identified by a focused TTE exam despite the limited scope of the sonographer’s knowledge. Furthermore, the information is readily available at the patient’s bedside and can be used immediately by the treating physician to guide patient management.²⁵

In this complex cardiac patient presenting for endoscopic sinus surgery, history, physical exam, and traditional investigations alone did not establish the diagnosis of cardiac tamponade. A focused bedside TTE performed by the anesthesiologist just prior to induction of anesthesia prevented potentially disastrous hemodynamic compromise had cardiac tamponade gone unrecognized. Furthermore, this timely diagnosis allowed for prompt management of this life-threatening state. The exact role that focused bedside TTE will play in the future of perioperative patient care remains to be seen. Nevertheless, this case clearly illustrates the incredible potential of this “point-of-care” diagnostic modality to improve the anesthesiologist’s diagnosis and management of important cardiac conditions.

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