PERICARDIAL DISEASE

ECHO BOARD REVIEW

QUESTION 1

A 72-year-old woman presents with a 6-month history of progressive pedal edema and exertional dyspnea. Her medical history includes coronary disease and hypertension.

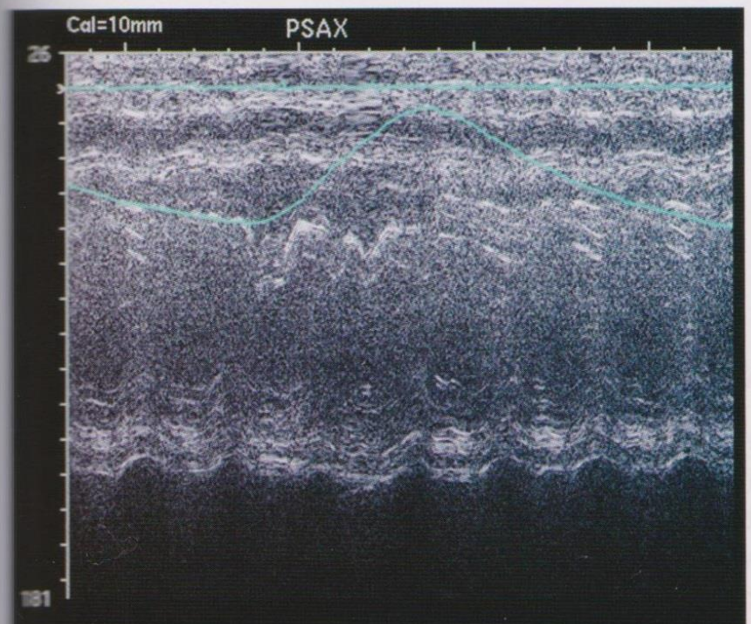

Figure 10–24.

The image provided (Figure 10–24) is most consistent with:

A. Cardiac tamponade
B. Primary pulmonary hypertension
C. Pericardial constriction
D. Dilated cardiomyopathy

ANSWER 1: C

This is an M-mode tracing taken from the parasternal long-axis view. The RV is closer to the transducer and the interventricular septum is seen between the ventricles. Superimposed on the M-mode tracing is a tracing from a respirometer in green. During inspiration, the respirometer shows an upward deflection. Coincident with inspiration, there is septal shifting with a transient increase in RV size and a concordant decrease in LV size. The opposite occurs during expiration. Respiratory-dependent septal shifting is consistent with a fixed external obstruction to ventricular filling, as occurs in pericardial constriction. Pericardial constriction is typically a consequence of cyclic or chronic pericardial inflammation and is most commonly seen in inflammatory conditions or postcardiac surgical procedures. This patient is not in cardiac tamponade; there is no significant pericardial fluid between the right ventricular free wall and the transducer and fluid is not seen posterior to the heart. In primary pulmonary hypertension, the right ventricle is enlarged with flattened septal motion in systole and diastole due to RV pressure overload. With dilated cardiomyopathy the LV is enlarged with decreased systolic endocardial motion of the septum and posterior wall. In this case, the LV at end-diastole is normal at about 5 cm and the end-systolic dimension is 3.5 cm for a fractional shortening of 30%, which is normal.

QUESTION 2

A 55-year-old woman presents with a 3-month history of progressive pedal edema and exertional dyspnea. She has no significant past medical history.

Data from her transthoracic echocardiogram area is as follows:

LV end-diastolic volume	100 mL
LV posterior wall thickness	1.2 cm
LV ejection fraction	59%
LA indexed volume	45 mL/m^2
Mitral valve E wave velocity	1.7 m/s
Tissue Doppler E′ velocity	0.05 m/s
IVC diameter	2.0 cm
Tricuspid regurgitant jet velocity	3.6 m/s

You conclude that the data are most consistent with:

A. Pericardial constriction
B. Dilated cardiomyopathy
C. Restrictive cardiomyopathy
D. Chronic obstructive pulmonary disease

ANSWER 2: C

This is a patient with restrictive cardiomyopathy. Patients with restrictive cardiomyopathy have relatively normal systolic function with significant diastolic dysfunction, often in the setting of increased LV wall thickness. This study shows decreased ventricular compliance and severely elevated LV filling pressure as reflected in the elevated E wave velocity of 1.7 m/s and a severely elevated E/E′ of 34. The elevated LV filling pressure is also reflected in the severely elevated indexed LA volume (normal < 30 ml/m^2) and pulmonary hypertension, with only mildly increased central venous pressure. LV chamber size (indexed LV volume) is normal, with preserved systolic function and mild hypertrophy of the chamber walls, also characteristic of restrictive cardiomyopathy. For pericardial constriction, elevation in RV filling pressure is more pronounced than the increase in LV filling pressure, evidenced by dilation of the IVC, which is not seen in this case. Also, in constriction, myocardial tissue Doppler would be normal (normal E′ velocity), with only mildly increased pulmonary pressures. This patient does not have a dilated cardiomyopathy; LV volume would be increased, with a decreased ejection fraction. Chronic obstructive pulmonary disease is not associated with LV diastolic dysfunction, and the severity of pulmonary hypertension is greater than expected for this diagnosis.

QUESTION 3

A 54-year-old woman with acute myeloid leukemia presents with dyspnea.

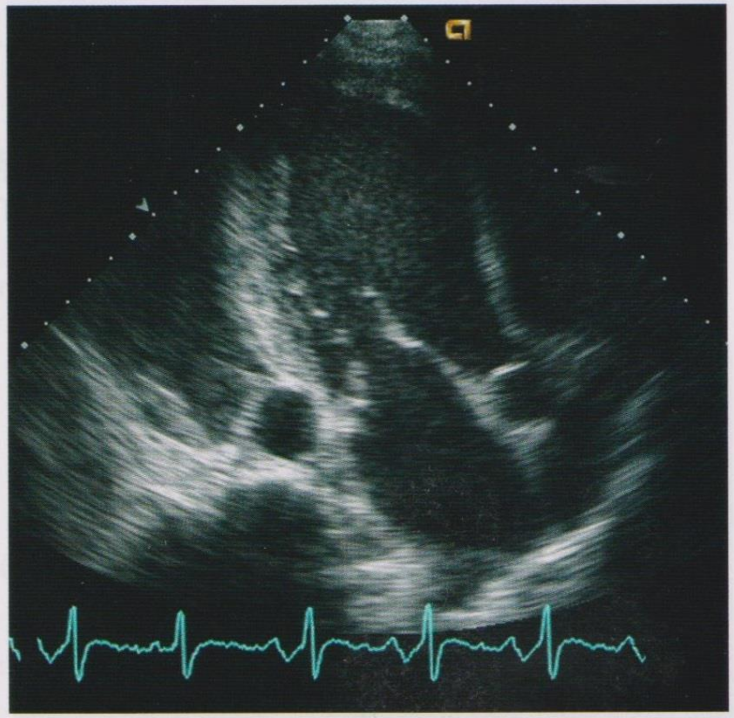

Figure 10–25.

Based on (Figure 10–25), the next best step in patient management is:

A. Pericardiocentesis
B. Thoracentesis
C. Ligation of the persistent left superior vena cava
D. Pericardial stripping

ANSWER 3: B

This patient has a large left-sided pleural effusion. The image presented is an apical long-axis view of the heart. The LV is closest to the transducer. Posterior to the heart, there is an echolucent space consistent with fluid. The circular structure is the descending thoracic aorta seen in cross section. Tracking posterior to the descending thoracic aorta is a large pleural effusion. A pleural and pericardial effusion can be differentiated by the tissue planes that bound the fluid collection. Fluid that tracks anterior to the descending aorta is pericardial. In this example, there is a trivial pericardial stripe seen just along the epicardial border, which is normal thickness. The descending aorta might be mistaken for a dilated coronary sinus, as seen in patients with a persistent left superior vena cava. However, the coronary sinus is not well seen on this image; it typically is closer to the atrioventricular groove and slightly superior to the descending aorta in this view. A persistent left superior vena cava is a normal variant and does not cause symptoms or require intervention. Pericardial stripping refers to surgical removal of a thickened pericardial when pericardial constriction is present.

QUESTION 4

This 43-year-old man has a history of Hodgkin's lymphoma, initially diagnosed at age 18 years when he presented with fatigue and large pericardial and pleural effusions. At that time he was aggressively treated with chemotherapy and mantle radiation. He now presents with several months of progressive exertional dyspnea. This hepatic vein flow tracing is obtained (Figure 10–26).

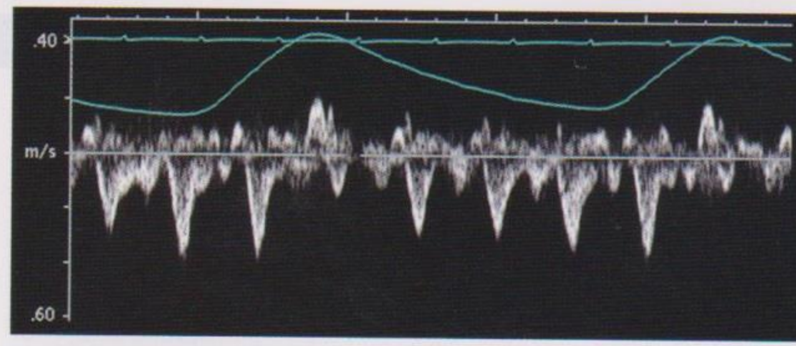

Figure 10–26.

The patient's current symptoms are most likely due to:

A. Prior chemotherapy
B. Recurrent pericardial effusion
C. Prior mantle field radiation
D. Recurrent pleural effusion

ANSWER 4: C

This is a patient with pericardial constriction. The hepatic vein tracing shows the ECG, respirometer (inspiration is an upward deflection), and Doppler tracing, with care taken using 2D imaging to ensure that the Doppler angle did not change with respiration. The pulsed Doppler tracing from the hepatic vein shows a prominent RA filling curve in diastole with blunted filling in systole, typical of the "square root sign" of ventricular filling pressures with constriction. Filling increases on the first beat after inspiration and then declines dramatically (and in fact reverses on the first beat) with expiration. Late pericardial constriction is a relatively common complication in patients with Hodgkin's lymphoma who received mantle field (upper torso) radiation treatment in the 1980s and 1990s. Other late adverse effects of radiation therapy include diastolic ventricular dysfunction and accelerated valve calcification and coronary atherosclerosis. Pericardial constriction is less common with more contemporary treatments for Hodgkin's lymphoma, in which chemotherapy and more focused treatment fields are utilized.

Other respiratory-dependent changes in pericardial constriction that would be seen by echocardiography include reciprocal changes in Doppler inflows, increased on inspiration across the right valves and decreased on inspiration across the left valves, and an inspiratory increase in IVRT duration. Right heart catheterization would show equalization of intracardiac and pulmonary artery diastolic pressures. Anthracycline chemotherapy is cardiotoxic, and the potential cumulative effect of treatment is a dilated cardiomyopathy. In patients with severe ventricular dysfunction and volume overload, the IVC may be dilated, but anterograde flow in the hepatic vein would be normal. If there were significant concurrent tricuspid annular dilation and tricuspid regurgitation, hepatic vein systolic flow reversal might be seen but would not be dependent on the respiratory cycle. A pleural effusion would not affect RA Doppler inflow unless tamponade physiology was present.

QUESTION 5

A 64-year-old female patient with end-stage renal disease presents with dyspnea and a blood pressure of 90/60 mm Hg. A TTE is ordered (Figure 10–27).

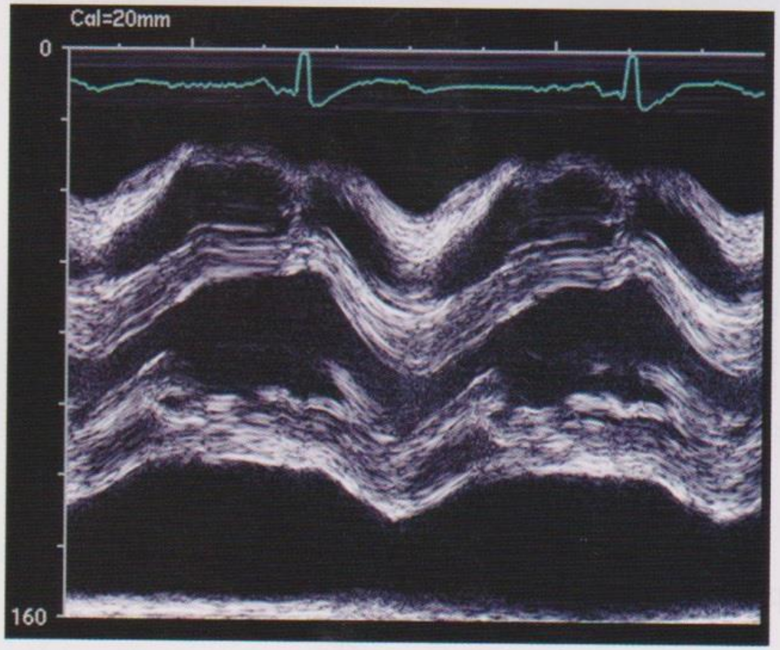

Figure 10–27.

Based on the image provided, what is your next step in the management of this patient?

A. Respirometer
B. Right heart catheterization
C. Cardiac CT
D. Pericardiocentesis

ANSWER 5: D

This image shows an M-mode tracing taken from the parasternal short-axis view in a patient with a large pericardial effusion. There is a circumferential pericardial effusion, evidenced by an echolucent space between the transducer and the heart and a large echolucent space posterior to the heart, between the heart and pericardium, which is seen in the very far field. This patient has evidence of hemodynamic significance, with a small LV chamber size at the level of the mitral leaflet tips and a small RV chamber size (referenced to the side marks, the RV chamber size is approximately 1 cm in diameter in diastole). Additionally, there is late diastolic invagination of the RV free wall, a small posterior deflection, just at the onset of the QRS, which is also supportive of a hemodynamically significant effusion. With symptoms, hypotension and a large pericardial effusion, prompt pericardiocentesis is appropriate. Additional diagnostic information, such as intracardiac pressures or respiratory variation in tricuspid or mitral inflow, is not needed. Cardiac CT would also diagnose a pericardial effusion but is not needed with a diagnostic echocardiogram, and CT is less useful for determining the hemodynamic significance of an effusion. In a patient with suspected pericardial constriction, cardiac CT would aid in visualizing the pericardium and in measuring pericardial thickness.

QUESTION 6

The following pulsed Doppler tracing was recorded across the mitral valve (Figure 10–28).

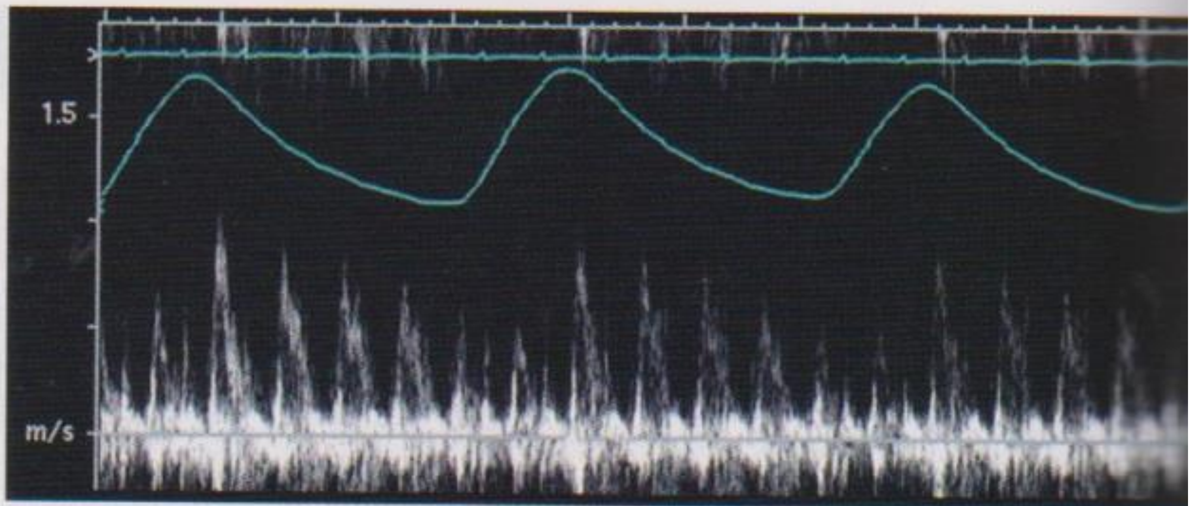

Figure 10–28.

The most likely diagnosis for this patient is:

A. Normal respiratory variation
B. Pericardial constriction
C. Myocardial restriction
D. Chronic obstructive pulmonary disease

ANSWER 6: B

This is a pulsed Doppler sample taken across the mitral valve in a patient with pericardial constriction. On the first beat after inspiration (upward deflection on green respirometer curve), there is a significant (>20%) decrease in the mitral E wave velocity and

with expiration there is a higher mitral E wave velocity. These findings are consistent with impaired LV filling during inspiration and increased LV filling during expiration. The proposed mechanism for these changes is that the negative intrathoracic pressure with normal inspiration allows increased RV inflow. Because total heart volume is limited due to pericardial constriction, the increase in RV size results in a decrease in LV size and a reduction in LV filling with inspiration. The opposite changes occur during expiration, and these changes exceed the normal degree of variation in RV and LV inflow with respiration. These exaggerated reciprocal variations in respiratory flow are also seen in pericardial tamponade. With exaggerated respiratory effort, as can occur with chronic obstructive pulmonary disease, respiratory variation in inflow to the thinner-walled RV is commonly seen, but without external cardiac constraint, reciprocal changes in LV filling are not seen. In myocardial restriction, there is no external constraint on the heart and, although diastolic LV function is abnormal, reciprocal respiratory changes in ventricular filling are not seen.

QUESTION 7

A 55-year-old woman with a history of viral cardio-myopathy with severe biventricular systolic dysfunction underwent placement of biventricular surgical ventricular assist devices. Cardiac output has decreased and you are asked to review an echocardiogram (Figure 10–29).

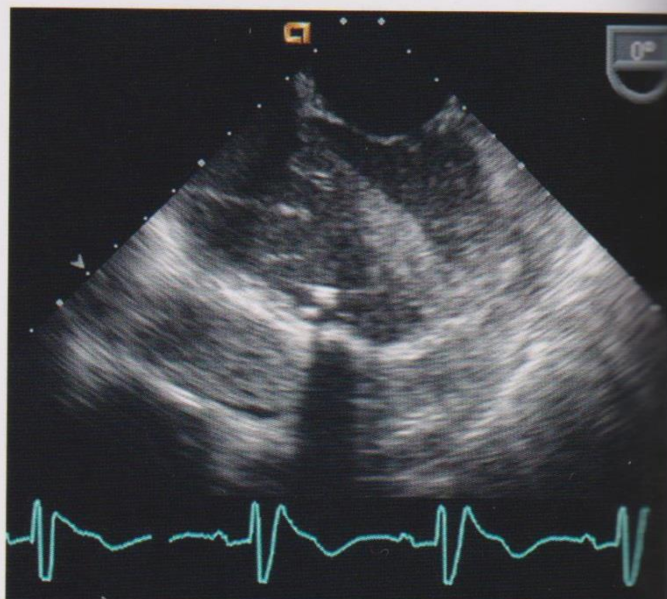

Figure 10–29.

Based on the image provided, the next best step in patient management is:

A. Reposition inflow cannula
B. Intravenous (IV) fluid administration
C. Hematoma evacuation
D. Cannula thrombus removal

ANSWER 7: C

This TEE 4-chamber view shows a large hematoma in the pericardial space, adjacent to the inflow cannula from the RV apex, identified by the bright echoes with dense distal shadowing. There is a 3-cm-thick echodense space around the heart with a thin pericardial stripe seen in the far field. The pericardial hematoma surrounds both ventricles and is the most likely cause of decreased cardiac output, either by compression of the inflow cannula or frank tamponade physiology. Thus, surgical evacuation of the hematoma was appropriate and resulted in marked clinical improvement in this patient. With an LV assist device, the LV chamber is usually small due to "unloading" by flow into the device. However, if the ventricular assist device flow rate is set too high, the LV chamber can collapse or the inflow cannula can abut the septum, resulting in impaired inflow into the device. In this case, the LV appears small and underfilled but the RV appears dilated, suggesting that a high flow rate is not the problem. Administration of IV fluid is unlikely to be helpful given the dilated RV seen on this image; total intravascular volume does not appear reduced. In the absence of a ventricular assist device, fluid administration partially alleviates tamponade physiology while awaiting pericardiocentesis; however, with a ventricular assist device, a further increase in RV diastolic pressure is unlikely to be helpful. The inflow cannula itself is not well seen and it would be difficult to diagnose an obstructive thrombus within the device on echocardiographic imaging due to image artifact from prosthetic material, although Doppler interrogation of cannula flow

QUESTION 8

A 78-year-old man presents with exertional dyspnea 6 years after coronary artery bypass grafting. Coronary angiography documents occlusion of one of his four bypass grafts. A TTE (Figure 10–30) is ordered and compared with a study he had done 5 years earlier.

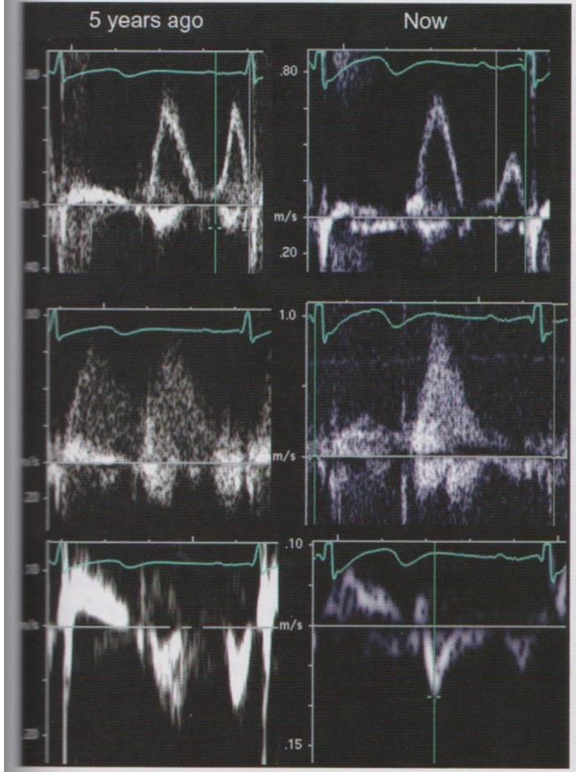

Figure 10–30.

Of the following options, what additional finding would most likely be present?

A. IVRT respiratory variation
B. Indexed LA volume 43 cm^3
C. LV dP/dt 800 mm Hg/s
D. IVC diameter 1.5 cm

ANSWER 8: A

This patient has Doppler evidence of pericardial constriction, likely a consequence of his prior bypass grafting surgery. In addition to the findings shown, respiratory variation in LV/RV inflow and the IVRT would be present. In pericardial constriction, myocardial function is normal, with normal LV relaxation and ventricular compliance, but diastolic filling of the ventricle is constrained externally by the rigid pericardium. The early component of diastolic filling, E wave, is normal, but the late atrial contribution, A wave velocity, is minimal because of elevated LV end-diastolic pressure. Therefore, the E/A ratio (*top*) is increased in this patient compared with his baseline study. On the pulmonary venous tracing (*middle*), higher LV filling pressure leads to blunting of the systolic component of LA filling compared with baseline. However, because myocardial function is normal, the E/E′ ratio remains in the normal range, with a baseline E/E′ of 0.65/1.1 = 6 and a follow-up E/E′ of 0.65/0.08 = 8, both of which are in the normal range and within measurement variability of each other. In constriction, the thickened pericardium encases the entire heart, and biventricular size is normal or only mildly increased; an indexed LA volume of 43 cm^3 is severely increased and would be more typical of restrictive cardiomyopathy. The LV *dP/dt* is normal (>1000 mm Hg/s) with pericardial constriction because LV systolic function is normal. Also, in constriction, return of blood is restricted, with severely increased central venous pressure, and the IVC would be dilated and plethoric, not normal caliber.

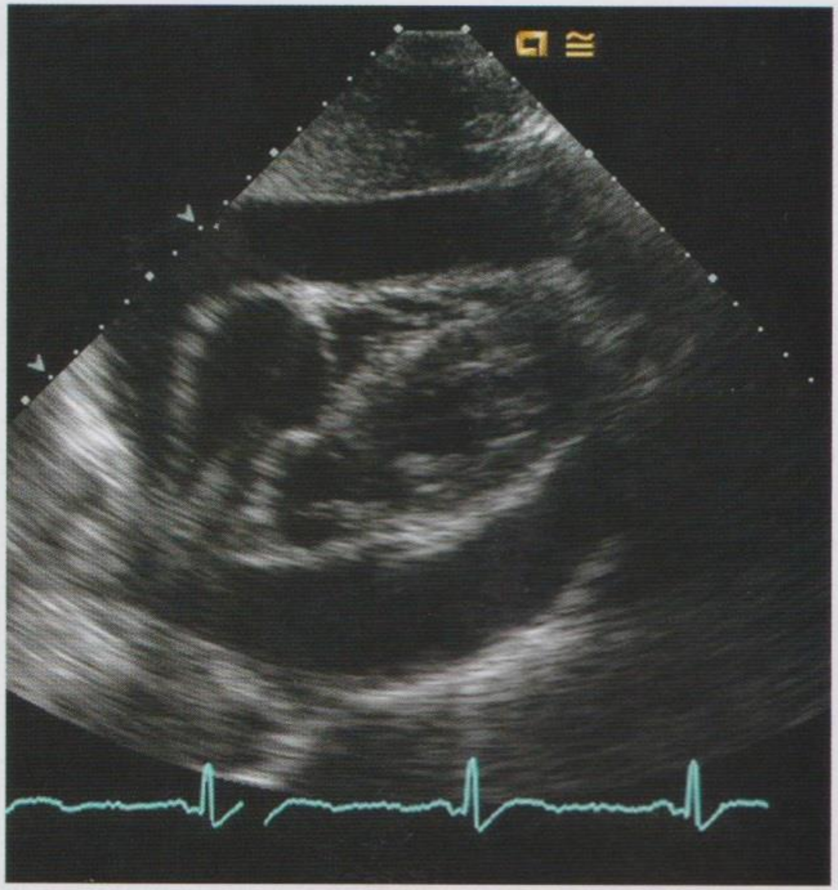

Figure 10–31.

Which of the following clinical conditions would most hinder further echocardiographic evaluation?

A. Pulmonary hypertension
B. Pleural effusion
C. Cardiac amyloidosis
D. Abdominal ascites

ANSWER 9: A

This subcostal 4-chamber view shows a large pericardial effusion. Both RV and LV chamber size are small and there is a large echolucent space anterior and posterior to the heart. The posterior fluid is seen between the posterior LV wall and the pericardium (seen in the very far field). Symptoms of a pericardial effusion typically include chest discomfort and dyspnea, but a slowly accumulating effusion may also be asymptomatic, as in this example. In a patient with a large pericardial effusion, cardiac tamponade is a clinical diagnosis based on evidence of hemodynamic compromise including tachycardia, hypotension, and a pulsus paradoxus. In addition, echo-Doppler findings suggesting tamponade physiology can be helpful in clinical decision making. Echocardiographic findings of hemodynamic significance include respiratory-dependent variation in ventricular inflow; with an increase in RV inflow on inspiration and a reciprocal decrease in LV inflow with inspiration. As a consequence, there are also concordant reciprocal changes in ventricular volumes with the respiratory cycle. Significant pulmonary hypertension increases intracavitary RV pressure, preventing RV compression, and thus may obscure classic echocardiographic features of tamponade. Cardiac amyloidosis is associated with restrictive LV filling on the transmitral Doppler tracing, with a high E/A ratio and low tissue myocardial velocity. However, amyloidosis does not cause respiratory-dependent variation in RV and LV filling and septal shifting is not present. Extracardiac fluid collections such as pleural effusion or abdominal ascites do not exert external circumferential pressure on the heart and therefore do not generate echocardiographic findings consistent with cardiac tamponade.

QUESTION 10

The following pulsed Doppler tracing was recorded across the tricuspid valve (Figure 10–32).

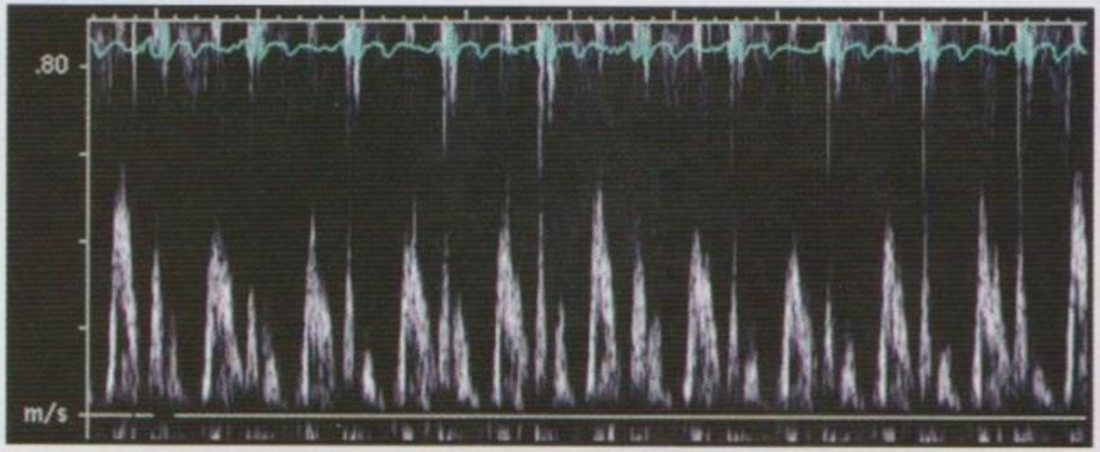

Figure 10–32.

The most likely diagnosis for this patient is:

A. Normal respiratory variation
B. Pericardial tamponade
C. Positive pressure ventilation
D. Pericardial constriction

ANSWER 10: A

This is a pulsed Doppler sample taken across the tricuspid valve in a patient with a normal heart. Although a respirometer tracing is not shown, the degree of change in inflow velocity is within normal limits. With inspiration, negative intrathoracic pressure increases and there is an increase in RV inflow (tricuspid E wave velocity) up to 25% variation. With pericardial tamponade or constriction, reciprocal respiratory variation in ventricular inflow is greater than 25% between the first beat after inspiration and the first beat after expiration. Positive pressure ventilation eliminates the negative intrathoracic pressure of inspiration and normal respiratory variation in inflow is not seen.

QUESTION 1

In the parasternal long axis view shown in Figure 10–24, identify the structures labeled A through E.

A. ____________________
B. ____________________
C. ____________________
D. ____________________
E. ____________________

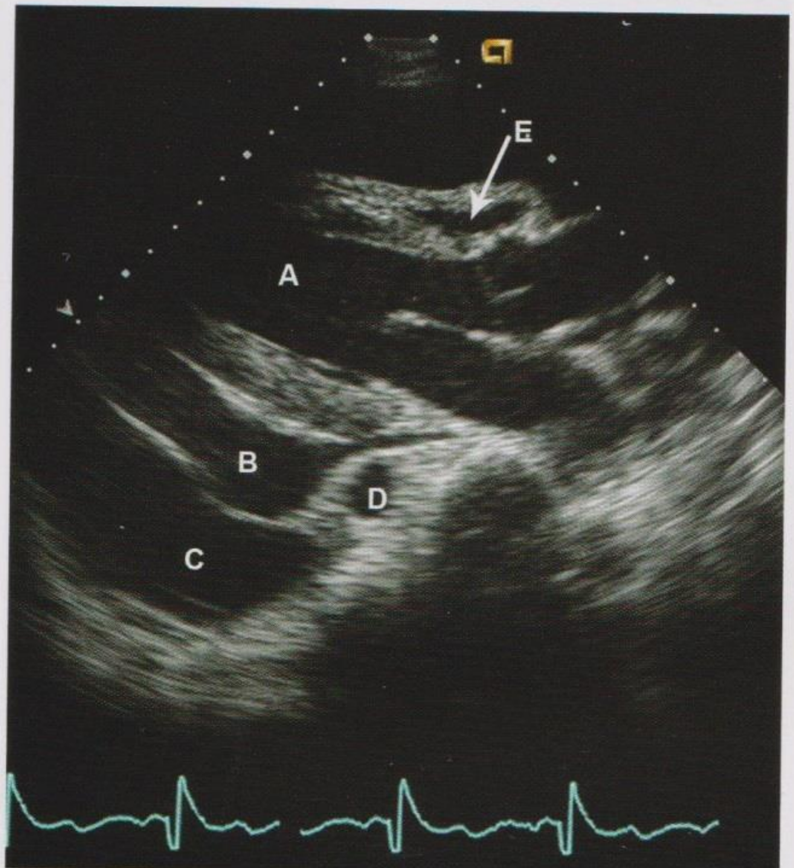

Figure 10–24

ANSWER 1

A. Left ventricle
B. Pericardial effusion
C. Pleural effusion
D. Descending thoracic aorta
E. Right ventricle (compressed consistent with tamponade physiology)

QUESTION 2

A 34-year-old man with lymphoma presents with a 3-week history of decreased exercise tolerance. Physical examination shows a diaphoretic man with a blood pressure of 90/60 mm Hg, pulse of 120 beats per minute (bpm), and respiratory rate of 24 per minute. His lungs are clear, and heart sounds are distant. A handheld bedside echocardiogram shows a large circumferential pericardial effusion.

The most appropriate next step is:

A. Evaluate for RA systolic and RV diastolic collapse.
B. Record Doppler left and right ventricular filling velocities with a respiration tracing.
C. Insert a Swan-Ganz (right heart) catheter.
D. Perform pericardiocentesis.
E. Call cardiac surgery.

ANSWER 2: D

This patient has a large pericardial effusion and is hypotensive, so the most appropriate next step is pericardiocentesis to relieve tamponade physiology. The effusion is not loculated, so percutaneous drainage is reasonable; cardiac surgery would be called only if the effusion was loculated or if recurrent effusions suggested the need for a pericardial window. Further echocardiographic evaluation for signs of tamponade physiology is not needed because the diagnosis is evident on physical examination–the finding of a large effusion is enough to proceed with therapy. Further diagnostic evaluation would unnecessarily prolong the time to treatment. A right heart catheter is helpful for monitoring right and left heart filling pressures and to measure cardiac output but would not add useful information in this case.

QUESTION 3

In a 56-year-old woman with breast cancer and a moderate-sized pericardial effusion, inflow velocities across the tricuspid (Fig. 10–25*A*) and mitral (Fig. 10–25*B*) valves were recorded along with a respirometer showing inspiration as an upward deflection of the tracing. These tracings show:

A. Normal respiratory variation in inflows
B. Reduced RV filling with inspiration
C. Tamponade physiology
D. Electrical alternans
E. Pulsus paradoxus

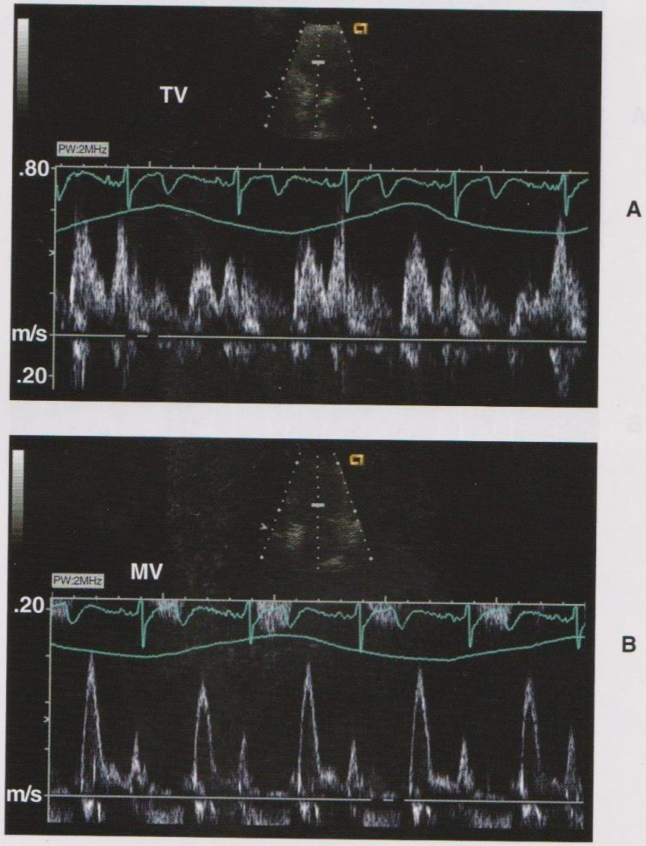

Figure 10–25

ANSWER 3: A

The tricuspid valve tracing is noisy. However, the lowest E velocity (second beat) is about 0.35 m/s and increases with inspiration (note the third and fourth beats) to about 0.45 m/s. Although this increase in flow velocity is greater than 20%, right-sided filling normally increases with inspiration. The transmitral velocity shows an E velocity of about 1.4 m/s with inspiration (second and fifth beats) with an apparent slight increase in velocity to 1.5 m/s at end expiration. If tamponade were present, the expected finding is a decrease in transmitral velocity by at least 20% with inspiration. Normally, there is little change in mitral inflow velocity with respiration; the apparent slight variation on this tracing might reflect slight changes in the intercept angle between the Doppler beam and inflow velocity as the heart position moves in the chest with respiration and the sonographer maintains a steady transducer position.

Electrical alternans may be seen with very large pericardial effusions where the heart "swings" from side to side on alternate beats, resulting in a decrease in the amplitude of the QRS on the ECG on every other beat. Pulsus paradoxus refers to the physical examination findings of an inspiratory fall in systolic blood pressure of at least 20 mm Hg, appreciated on auscultation of the blood pressure or palpation of a peripheral pulse.

QUESTION 4

Echocardiography is requested in a 52-year-old man with dyspnea and a long history of asthma. There is a small pericardial effusion, and the LV and RV inflow patterns are recorded with a respirometer. The tracings for this patient, shown in Figures 10–26*A* and *B*, are most consistent with:

A. Normal respiratory variation in inflows
B. Reduced RV filling with inspiration
C. Tamponade physiology
D. Respiratory distress
E. Restrictive cardiomyopathy

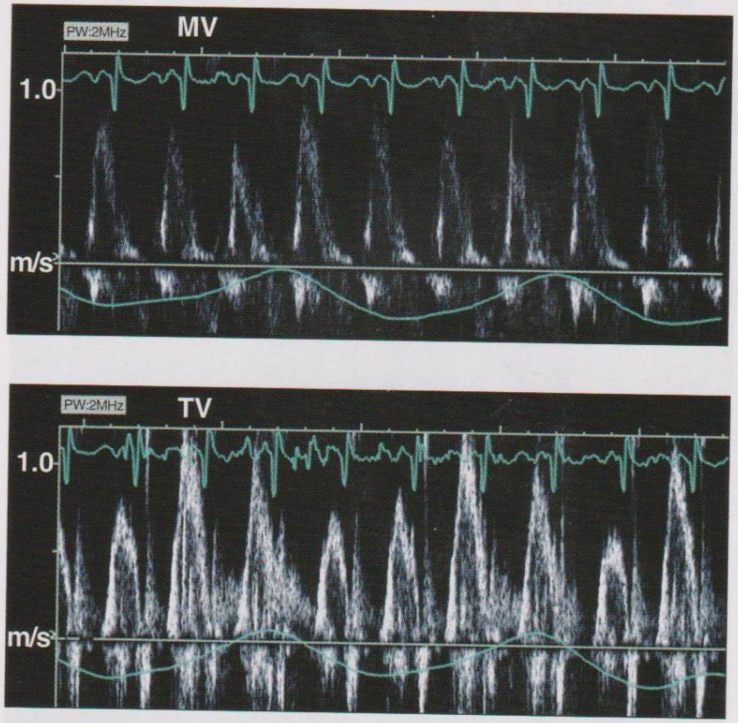

Figure 10–26

ANSWER 4: D

The patient is tachycardic, with a heart rate of about 130 bpm resulting in fusion of the E and A velocities on both tracings. The RV inflow shows a marked increase in velocity, from 0.6 to 1.1 m/s with inspiration, suggesting a marked increase in RV diastolic filling with the negative intrathoracic pressure of inspiration. There are several possible underlying causes for this observation. With cardiac tamponade, the negative intrathoracic pressure of inspiration allows rapid right heart filling, but the fixed total cardiac volume results in a reciprocal decrease in LV diastolic filling with inspiration. In the LV inflow tracing, flow decreases with inspiration but only from about 0.7 to 0.6 cm/s (less than 20%). In addition, tamponade is very unlikely with a small effusion. Thus these tracings are most consistent with exaggerated variation in right-sided filling due to respiratory distress with a greater negative intrathoracic pressure compared with normal quiet respiration. Respiratory variation in patients with restrictive cardiomyopathy tends to be similar to normal.

QUESTION 5

The M-mode tracing in Figure 10–27 shows:

A. Pericardial constriction
B. Cardiac tamponade
C. Aortic regurgitation
D. Pericardial effusion
E. Hypertrophic cardiomyopathy

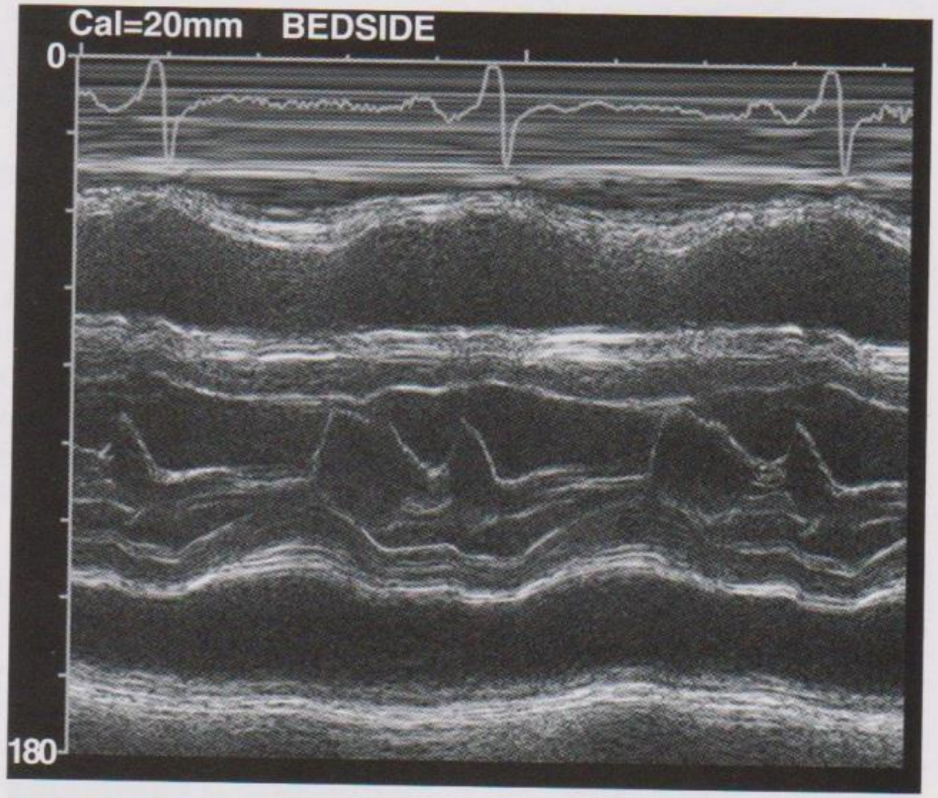

Figure 10–27

ANSWER 5: D

This M-mode tracing at the mitral valve level shows a pericardial effusion both anterior to the right ventricle and, more prominently, posterior to the left ventricle. The flat motion of the posterior pericardium with the normal motion of the posterior wall epicardium are diagnostic. With constriction, multiple parallel echodense signals would be seen in the pericardial region. There are no signs of tamponade physiology; the inward motion of the RV free wall in systole is caused by normal RV contraction. Aortic regurgitation would result in high frequency fluttering of the anterior mitral valve leaflet, and hypertrophic cardiomyopathy would be associated with increased diastolic thickness of the ventricular septum.

QUESTION 6

A 34-year-old woman presents with decreased exercise tolerance and increased abdominal girth over the last year. Her past medical history is remarkable for radiation therapy for Hodgkin's disease 16 years ago. Physical examination shows a blood pressure of 124/74 mm Hg, with a decline in systolic blood pressure to 110 mm Hg with inspiration. Heart rate is 92 bpm, respiratory rate is 20 per minute, and her jugular venous pressure is more than 20 cm H_2O. There is a grade 2/6 holosystolic murmur at the apex, but no gallops are appreciated. Her lungs are clear, but her abdomen is distended with a fluid wave and there is 3+ ankle edema. Echocardiography shows a small left ventricle with normal systolic function, but image quality is poor. The left ventricular inflow pattern shows an E velocity of 1.4 m/s and an A velocity of 0.6 m/s. Tissue Doppler signals are poor quality, and pulmonary vein flow cannot be recorded. There is about a 16% decline in LV inflow velocities with respiration.

The most useful next step is:

A. Coronary angiography
B. TEE
C. Endomyocardial biopsy
D. Right heart catheterization
E. Chest CT

ANSWER 6: E

The clinical history (prior radiation therapy), physical examination (ascites, elevated right-sided filling pressures), and the echocardiographic findings suggest constrictive pericarditis. The most useful test at this point is a chest CT to evaluate the thickness of the pericardium. If pericardial thickening and constriction are present, surgical pericardiectomy is beneficial. Patients with prior radiation are at risk for accelerated coronary disease; however, her symptoms do not suggest this diagnosis, so coronary angiography should not be the first diagnostic step. TEE would provide better visualization of chamber anatomy and function and would allow recording of pulmonary vein inflow. However, TEE is not accurate for assessment of pericardial thickening. Endomyocardial biopsy may show myocardial fibrosis in patients with prior mediastinal radiation but has a low yield when the differential diagnosis is pericardial constriction versus restrictive cardiomyopathy. Right heart catheterization alone would confirm elevated right-sided filling pressures, but a combined right and left heart catheterization is needed when constriction is suspected to demonstrate the equalization of intracardiac diastolic pressures.

QUESTION 7

In the apical view shown in Figure 10–28, an echo lucent space (*arrow*) is seen lateral to the left ventricle. Which of the following views would be most helpful in determining whether this is a pleural or pericardial effusion?

A. Parasternal long axis
B. Subcostal four-chamber
C. Apical two-chamber
D. Left sub-scapular
E. Suprasternal

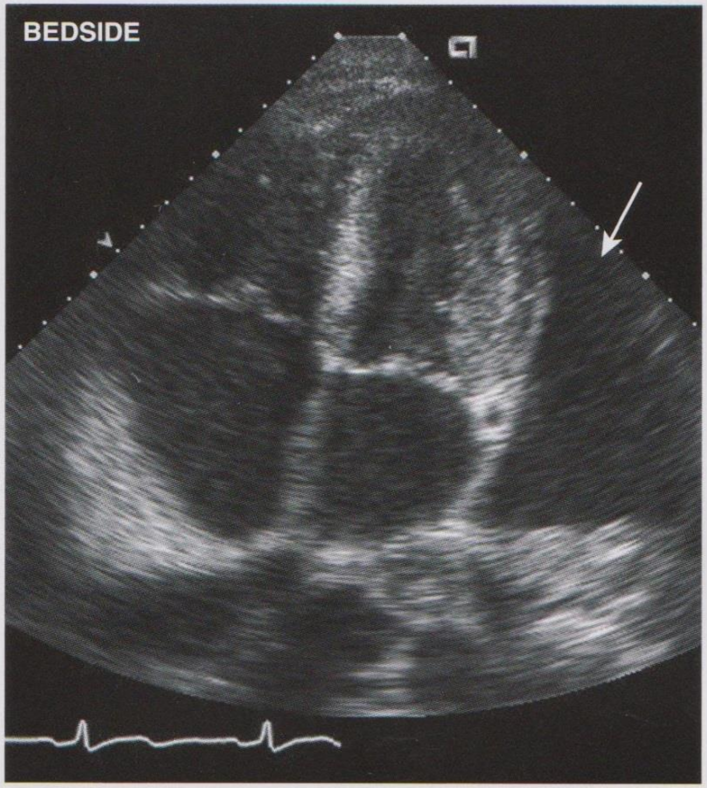

Figure 10–28

ANSWER 7: A

The parasternal long axis view is most likely to be helpful, because it will show whether the fluid tracks anteriorly (pericardial) or posteriorly (pleural) to the descending thoracic aorta. Identification of a small amount of pericardial fluid with parallel lines indicating the parietal and visceral pericardium also may be seen. The subcostal view might show pericardial fluid anterior to the right ventricle but would not help with identification of the fluid lateral to the left ventricle. The pericardial and pleural spaces are not easily seen in the apical two-chamber view. Obtaining views from the posterior left chest, using the left pleural effusion as an acoustic window, may be used for cardiac visualization when other views are inadequate but is only feasible with large pleural fluid collections. The pericardial space is not easily seen from the suprasternal notch.

QUESTION 8

A 68-year-old woman presents with a 2-month history of increasing dyspnea on exertion and decreased exercise tolerance. Her past medical history is remarkable for rheumatoid arthritis, hypertension treated with a diuretic, and coronary bypass grafting surgery 10 years ago. Physical examination shows equal blood pressures in both arms at 138/86 mm Hg, with systolic blood pressure falling to 116 mm Hg during inspiration. Heart rate is 88 bpm, respiratory rate is 14 per minute, jugular venous pressure is 18 cm H_2O, and lungs are clear. There are no murmurs, gallops, or rubs.

Echocardiography shows an LV dimension of 50 mm at end-diastole and 32 mm at end-systole with a diastolic wall thickness of 10 mm and an ejection fraction of 56%. There is no significant pericardial effusion. Estimated pulmonary systolic pressure is 32 mm Hg. The transmitral E velocity is 1.2 m/s with a deceleration time of 100 ms and an A velocity of 0.4 m/s. Tissue Doppler at the medial mitral annulus shows E_M is greater than A_M, and pulmonary venous flow shows a predominance of diastolic inflow. The transmitral E velocity falls from 1.2 m/s to 0.9 m/s with inspiration, and the transtricuspid E velocity increases from 0.8 to 1.2 m/s with inspiration.

The most likely diagnosis is:

A. Pericardial tamponade
B. Constrictive pericarditis
C. Restrictive cardiomyopathy
D. Dilated cardiomyopathy
E. Hypertensive heart disease

ANSWER 8: B

The diastolic filling parameters in this patient are consistent with any of these five possible diagnoses. However, the echocardiographic findings are most suggestive of constrictive pericarditis because there is a greater than 20% inspiratory increase in RV filling concurrent with a reciprocal respiratory decrease in LV filling. The more than 20 mm Hg fall in systolic blood pressure with inspiration (pulsus paradoxus) and the elevated jugular venous pressure also are consistent with this diagnosis. In this patient with rheumatoid arthritis and previous coronary surgery, constrictive pericarditis may be the end-stage result of repeated episodes of inflammatory pericarditis, or it may be due to her previous surgical procedure.

Similar clinical and Doppler findings are seen with pericardial tamponade, but there was no significant pericardial effusion in this case. Restrictive cardiomyopathy also might show a similar pattern of diastolic dysfunction but would also be characterized by increased LV wall thickness, elevated pulmonary pressures, and lack of respiratory variation in right and left ventricular filling. With a dilated cardiomyopathy, the ventricular dimensions would be larger and the ejection fraction would be lower. Hypertensive heart disease is defined as concentric ventricular hypertrophy caused by hypertension, often with early diastolic and late systolic dysfunction. The normal wall thickness in this patient and the respiratory variation in filling patterns argue against this diagnosis.