

5 Role of Echocardiography in Emergency Room

Abstract

- Echocardiography (Echo) in the emergency room has emerged as an important non-invasive tool for improving the efficiency in the diagnosis of serious conditions in the medical emergency department.
- Echo has an important role to play in patients presenting with (a) chest pain syndrome, (b) hypotension, (c) unexplained dyspnea, (d) palpitation, (e) recurrent syncope, (f) possible etiology of embolus in patients with cerebral or peripheral embolism, (g) chest trauma (one must not hesitate in seeking the assistance of such a test whenever required).
- Apart from diagnostic utilities, echo is extremely useful in a situation requiring pericardial fluid aspiration particularly in patients with cardiac tamponade. Insertion of pacemaker lead is another important therapeutic use of echocardiography.

Emergency room is the first contact department for critically ill patients. The emergency room physician faces significant clinical challenges on a regular basis. One of the particular clinical challenges is cardiovascular emergency. An early diagnosis and appropriate therapeutic approach is life saving in the golden hour. A focused good clinical history and a precise clinical examination is the initial approach. Various simple investigation tools like electrocardiogram, X-ray, ultrasonogram, echocardiogram, serum biomarkers are very much available and useful in emergency room. In this modern era of medicine these applications has become an extension of physical examination and can provide timely information to arrive at diagnosis.

2D echo along with doppler echo is a diagnostic modality that can provide detailed information about a patient's cardiovascular system. Specifically, it can provide structural, functional, hemodynamic and blood flow information. Additionally, it can do this in a short period of time at the patient's bedside and is a non-invasive test. Portable machines have made the procedure handy and ideal for patient evaluation in the emergency room.

The Emergency Room Physician frequently encounters patients with complaints like

- Acute chest pain
- Acute breathlessness
- Stroke
- Syncope
- Palpitations
- Hypotension and shock
- Chest trauma

ROLE OF ECHO IN ACUTE CHEST PAIN SYNDROME¹

Chest pain accounts for about 8% of all emergency room visits. The major life threatening cardiovascular Emergencies presenting as chest pain are :

- a. Acute coronary syndrome
- b. Aortic dissection
- c. Pulmonary embolism

ACUTE CORONARY SYNDROME (ACS)

ACS encompasses a spectrum of illness ranging from unstable angina, Non ST elevation MI, ST elevation MI and sudden death. Echocardiogram plays a vital role in the management of patients presenting with ACS.¹

Role of ECHO in ACS

1. Triage of patients in suspected ACS
2. Infarct size estimation
3. Assessment of ventricular function
4. Evaluation of complications
5. Assessment of reperfusion
6. Identification of location/severity of disease in patients with ongoing ischemia.

1. *Triage of patients with suspected ACS:* The diagnosis of ACS is considered in patients who present with typical chest pain and chest pain equivalents (shoulder, jaw, epigastric or back pain) as well as any acute cardiac symptoms like dyspnea, syncope or palpitations. Furthermore atypical presentation may be observed with weakness or confusion or cerebrovascular accidents in Elderly or Diabetics.

The approach to patients with diagnostic ECG abnormalities is well defined. Cardiac biomarkers play an important role in the evaluation of patients with suspected ACS with non-diagnostic ECG. However biomarkers often require serial measurement over 6 to 8 hours. In this scenario of suspected ACS with non diagnostic ECG, echocardiography plays a vital role to triage the patients for further management. Regional wall motion abnormality (RWMA) (Fig. 1) appears to be the first following ischemia before ECG changes or pain. Echocardiogram at rest has an excellent sensitivity of 93% and a good specificity of 66% in diagnosing coronary artery disease.

Myocardial ischemia and infarction result in regional disturbance of ventricular contraction. Normal systolic contraction consists of both myocardial thickening and inward motion of the endocardium. Immediately after the onset of ischemia, myocardial thickening ceases and depending on the severity of ischemia the wall becomes hypokinetic, or akinetic or dyskinetic. If blood flow is not restored in time myocardial necrosis occurs and the wall motion abnormality becomes fixed. Both systolic and diastolic dysfunction also occur after acute reduction in coronary flow.

A positive Echo should meet any of the following criteria (Fig. 1).

- i. Abnormal wall motion of 2 or more contiguous segments
- ii. Abnormal wall motion of one segment visible in 2 different views.
- iii. Global hypokinesis with an estimated ejection fraction of less than 40%.

Patients with positive echo are admitted to coronary care units and managed according to ACS protocol. Patients who had negative echo undergo graded exercise ECG testing before discharge.

2. *Infarct size estimation:* Size of infarct is estimated by the extent of regional wall motion abnormality. Quantification of wall motion abnormality is done using wall motion score index. This involves applying a numerical score 1 to 5 to each of the analyzed segment based on whether they are normal, hypokinetic, akinetic, dyskinetic or aneurysmal. The total score is then divided by the number of segments evaluated to create score index. Higher scores represent progressively greater degree of ventricular dysfunction.

3. *Assessment of Ventricular function:* Echocardiogram helps to assess the systolic and diastolic dysfunction using various techniques like ejection fraction, time velocity integral, left ventricular dp/dt, etc.

In clinical practice determination of systolic function using ejection fraction is very simple method. This can be done quickly in Emergency room. This ejection fraction guides the clinician in the management of ACS and anticipate the complications. Greater the left ventricular dysfunction as assessed by low ejection fraction, the greater the complications like heart failure, arrhythmias and death.

A Doppler assessment at the mitral valve indicates the diastolic function. Doppler pattern becomes abnormal early in the course of ischemia or infarction. The greater the degree of diastolic dysfunction the worse is the prognosis.

4. *Evaluation of complications of myocardial infarction:* Acute myocardial infarction (AMI)² can present with one of various complications. Two dimensional echocardiography is very helpful in diagnosing complication of AMI.²

Complications detected by Echo

- Pericardial effusion
- Infarct expansion
- Thrombus formation
- Myocardial rupture – Free wall, ventricular septal defect, papillary muscle.
- Right ventricular infarct.

5. *Assessment of reperfusion:* Thrombolysis is still the commonest mode of establishing reperfusion of infarct artery in our country even in this interventional era. After thrombolysis the most important step is to assess whether it is successful in establishing the reperfusion or not. Apart from ECG, ST resolution and cardiac biomarker echocardiogram tells us about the reperfusion. After successful reperfusion the wall motion abnormality resolves. Typically this recovery occurs within 12-72 hours if blood flow is restored early.

Myocardial contrast echocardiography wherein microbubbles are injected intravenously allows for noninvasive assessment of myocardial perfusion at the bedside.³

6. *Identification of location of disease:* The wall motion abnormality assessed by 2D – Echo helps to predict the location of the culprit coronary artery. The left ventricle is conventionally divided into 17 segments for echocardiographic analysis. Each segment is supplied by a particular coronary artery. Hence by evaluating the segments involved in the wall motion abnormality the culprit artery can be predicted with reasonable accuracy.

ECHO IN AORTIC DISSECTION⁷ (FIG. 2)

Acute aortic dissection is a potentially catastrophic illness which presents as acute severe chest pain. A high index of clinical suspicion is needed for the diagnosis.

Consider aortic dissection when there are following associations:

- Chest pain that is migratory and radiating to back.
- Chest pain with severe abdominal or back pain.
- Chest pain with neurologic symptoms
- Chest pain with signs of vascular compromise.
- Chest pain with murmur of aortic regurgitation.

Echocardiogram is well suited for initial evaluation of suspected aortic dissection because of its ready availability at bedside.³

Aortic dissection is diagnosed by the presence of an undulating intimal flap within the aortic lumen that separates the true and false channels. This flap should be identified in more than one view and should have motion independent of that of the aortic walls.

Transesophageal echocardiogram (TEE)³ offers an excellent sensitivity (98%) when compared to transthoracic echo (73%) in evaluating aortic dissection.

Echo in Acute Breathlessness

Acute onset of dyspnea can be due to various causes.

- i. Cardiovascular
 - Left heart failure
 - Pulmonary embolism
 - Pericardial tamponade
 - High altitude
- ii. Pulmonary
 - Pneumothorax
 - Pneumonia
 - Foreign body
 - Bronchial asthma
- iii. Metabolic
 - Diabetic ketoacidosis
 - Uremia
 - Salicylate poisoning

Acute dyspnea is a life threatening emergency where simple investigatory tools like chest X-ray and echocardiogram clinches the correct diagnosis. When acute dyspnea is encountered in emergency room never forget to order an echocardiogram and chest X-ray both of which are helpful in diagnosing cardiovascular and pulmonary causes of dyspnea.

Left Heart Failure

Left heart failure may be due to a variety of Structural abnormalities.

- i. Cardiac valves – valvular heart disease, e.g.-Mitral Stenosis (Fig. 3)
- ii. Myocardium – cardiomyopathies, hypertension
- iii. Pericardium – constrictive pericarditis, tamponade
- iv. Coronary arteries – acute myocardial infarction
- v. Aorta – proximal aortic dissection
- vi. Cardiac tumours – myxoma

Mitral stenosis is the commonest valvular heart disease presenting as left heart failure.

Echocardiogram helps in assessing severity of the stenosis⁴ (Fig. 3).

- a. Increased velocity of the E and A waves across mitral valve.
- b. Increase in time taken for peak velocity to decrease to half of its initial value (pressure half time)
- c. Persistent pressure gradient across mitral valve at end diastole.

Severe MS is said to be present if

- a. MVA 1cm^2 (2D Echo)
- b. Pressure half time > 220 milli seconds
- c. Mean pressure gradient across mitral valve > 10 mm Hg

Morphology of the valve can be studied using echo and if the valve is suitable for balloon mitral valvotomy (BMV) it can be performed in resistant cases of left heart failure as an emergency procedure.

Acute aortic regurgitation secondary to aortic dissection, trauma, infective endocarditis may also present with severe dyspnea apart from the causes already discussed.

Hypertensive emergency can present with sudden onset of severe breathlessness due to acute left heart failure. Longstanding hypertension results in myocardial hypertrophy leading to impaired LV filling and elevation of Pulmonary venous pressures. Further acute rise in blood pressure produces pulmonary edema. Echocardiographic evaluation frequently reveals diastolic dysfunction in pulse Doppler evaluation and a normal ejection fraction. Systolic dysfunction may also be associated in some cases.

Echocardiogram helps in the diagnosis of other structural abnormalities like tumours, cardiomyopathies, pericardial disorders, etc. Some of the structural abnormalities present as systolic heart failure, some as diastolic heart failure and some as combined systolic and diastolic heart failure. Echocardiogram helps in assessing both systolic and diastolic dysfunctions and plans for appropriate therapeutic strategies.

Cardiac Tamponade

Cardiac tamponade should be considered in any patient presenting with breathlessness and hypotension. An early echocardiogram clinches the diagnosis and pericardiocentesis will be life saving.

Pericardial effusion have multiple causes like infection, malignancy, myxedema, connective tissue disorder, trauma, etc. When pericardial effusion is large and accumulates rapidly it results in cardiac tamponade.⁴

Pericardial effusion (Fig. 4) is viewed as an echo free space between pericardium and the heart. A swinging heart is characteristic of cardiac Tamponade with large effusion. The swing periodicity of 2:1 (i.e. Two swings per cardiac cycle) is more suggestive of cardiac tamponade.⁵

Other features of cardiac tamponade include:

- RV diastolic collapse
- RA diastolic collapse
- LV free wall paradoxical motion
- SVC and IVC congestion
- Exaggerated Inspiratory augmentation of right sided flow and decrease of left sided flow
- Phasic variation in right ventricular outflow tract and left ventricular outflow tract flow.

Pulmonary Embolism

Pulmonary embolism (PE) presents as acute cardiopulmonary decompensation in emergency room or in hospitalized patient. Every clinician encounters this dramatic presentation but the diagnosis is usually hampered because of poor understanding of the problem. The precursor of PE is deep vein thrombosis. Common causes of PE could be pregnancy, postmenopausal, cancer, oral contraceptives, long air travels, etc.

Plasma D-Dimer assay, chest x-ray, ECG are initial screening test available in emergency room. Echocardiography helps in the diagnosis of PE in emergency room. Visible thrombi can rarely be seen in RV or pulmonary artery. Most often the clue for PE is indirect due to sudden increase in RV afterload.⁶

1. Right ventricular dilatation
2. Right ventricular hypokinesia with spacing of apex (McConnell's sign) due to normal left ventricle pulling the apex.
3. D shaped left ventricular cavity caused by the inter ventricular septum being pushed to the left by the pressure overloaded RV.
4. Pulmonary artery dilatation
5. Lack of inspiratory collapse of IVC > 50% with inspiration, implying RA pressure > 10 mm Hg.
6. Tricuspid regurgitation with PA pressure > 35 mm Hg (from TR velocity jet by Bernoulli's equation. Pressure gradient = $4V^2$ where V= velocity)

The finding of regional RV dysfunction with severe free wall hypokinesia sparing the apex (McConnell sign) is specific for PE. Doppler study can show Doppler alternans of pulmonary and tricuspid flow.

Echo in Stroke Patients

Cardiac source of emboli can present as stroke to emergency department. Cardiogenic emboli can be due to:

- i. LA thrombus
- ii. LV thrombus
- iii. LA myxoma
- iv. Vegetations
- v. Paradoxical embolism through R-L shunt.
- vi. Prosthetic valve thrombosis
- vii. Miscellaneous –
 - Mitral annular calcification
 - Sclerotic aortic valve
 - Mitral valve prolapse
 - Atrial septal aneurysm

LA Thrombus (Fig. 5)

Left atrial thrombus is commonly associated with mitral stenosis and atrial fibrillation. Stasis of blood within LA predisposes to thrombus formation. Left Atrial appendage (LAA) is the most common site of thrombus. Left atrial appendage is better visualized using a transoesophageal echo. Echocardiogram also allows detection of spontaneous echo contrast within left atrium, possibly a precursor of thrombi and certainly a risk factor for embolization. The spontaneous echo contrast or smoke is the swirling, hazy echo appearance associated with low blood flow and associated red blood cell protein interaction (Rouleau formation).

LV Thrombus (Fig. 6)

LV Thrombus is commonly associated with recent myocardial infarction, LV aneurysm and dilated cardiomyopathy. Thrombi mostly involves the apex of LV, most often in the presence of akinesis or dyskinesis. Mural thrombus appear as amorphous echogenic structures of variable shapes adherent to the endocardium. Echocardiography can also identify thrombi that are most likely associated with embolic risk. A large sized, mobile thrombus protruding into the LV cavity is associated with high embolic risk. Hyperkinetic wall motion adjacent to the thrombus and an echo-lucent center (actively growing thrombus) increased the risk of emboli.

Cardiac Tumor (Fig. 7)

Left atrial myxoma and papillary fibroelastomas are the tumors commonly associated with systemic embolization. An embolic stroke in a young person particularly in sinus rhythm should raise the suspicion of cardiac tumour or infective endocarditis.

LA myxoma most often arise from the area of fossa ovalis. They can be quite large occupying most of LA and protruding into mitral orifice. A LA myxoma needs to be differentiated from LA thrombus. Thrombus has a layered appearance and located in posterior portion of LA. Myxomas have a mottled appearance with areas of echolucency.⁷

Papillary fibroelastoma usually arises from aortic or mitral valve. They are small generally 0.5-2.0 cms in diameter and are often confused with vegetations. These tumours attached to the downstream side of the valve by a small pedicle, and are irregularly shaped with delicate frond like surface. Mobility is common and is a risk factor for embolization.

Vegetations (Fig. 8)

Vegetations which are Hallmark of Infective Endocarditis can embolise resulting in stroke. Echocardiography helps to identify predisposing heart disease for infective endocarditis, detects

vegetations and the complications of infective endocarditis. It is also useful in assessing the haemodynamic consequences of infective endocarditis and helps in prognostication. A vegetation is typically irregularly shaped highly mobile mass. They are usually attached to the upstream side of the valve. Vegetations may also attach to chordae, chamber walls or any foreign body like pacemaker lead, indwelling catheter and prosthetic valve sewing ring. They may be sessile or pedunculated. Vegetations at higher risk of embolisation are large vegetations (>10 mm size) higher mobility and with multiple sites of involvement.

Paradoxical Embolism

Paradoxical embolism through an atrial septal defect or patent foramen ovale can present as stroke. Deep vein thrombus can embolise and the eustachian valve of inferior vena cava can divert the emboli through ASD/PFO into systemic circulation paradoxically causing a stroke.

Echocardiography helps to assess these structural defects responsible for stroke. A PFO is significant for causing stroke when with contrast echocardiography more than 10 microbubbles are seen in left atrium within three cardiac cycles. Such PFO are large ones with potential for R-L shunting causing stroke.

Echo in Syncope

Syncope accounts for about 3% of emergency department visits. Syncope is an important clinical problem because it may represent a benign symptom or it could be the warning sign before sudden cardiac death. Orthostatic hypotension and reflex mediated causes represent the commonest cause of syncope. Cardiac causes represent second most common cause of syncope.

Cardiac causes of syncope can be a structural disorder or an arrhythmic disorder.

Various anatomic cardiac causes of syncope are:

- Severe aortic stenosis – valvular; Subvalvular; Supraaortic
- Large atrial myxoma
- Hypertrophic obstructive cardiomyopathy (HOCM).

Severe Mitral Stenosis

- Severe pulmonary stenosis
- Cardiac tamponade
- Massive pulmonary embolism
- Severe pulmonary hypertension
- Acute myocardial infarction

Echocardiogram helps in the accurate diagnosis of various structural cardiac disorder, evaluate the severity of disorder and also plans the appropriate treatment strategy.

Echo in Palpitation

Arrhythmias are important cause of palpitation. These arrhythmias can occur in a structurally normal heart or when there is an underlying disorder. Echocardiogram is useful to diagnose the anatomical disorders (Fig. 9). Arrhythmias such as atrial fibrillation have a high prevalence of associated underlying cardiovascular diseases which often have specific therapeutic implications. Furthermore echocardiogram is useful to evaluate the LV function and left atrial size which determine the success of cardioversion.

Transoesophageal echocardiogram (TEE) plays an important role in guiding the management of patients with atrial fibrillation due to stasis of blood more commonly in left atrial appendage. Restoration of sinus rhythm by electric cardioversion can be associated with embolic events. Hence the conventional approach is anticoagulation for 6 weeks followed by cardioversion and

then continued anticoagulation therapy for 6 weeks. This exposes the patient to long duration of anticoagulation with attendant risk of bleeding. The second approach is the TEE guided cardioversion, wherein patient is anticoagulated with heparin and undergo TEE. If there is no thrombus in TEE electrical cardioversion is undertaken at that time reducing exposure to precardioversion anticoagulation. If thrombus is detected conventional anticoagulation done and cardioversion is deferred.

2D echo can also provide a clue to the presence of underlying structural heart disease, which may be causing recurrent VT and syncope like.

1. Ischemic heart disease. By showing areas of scarred tissue (akinetic and dyskinetic segments)
2. Dilated cardiomyopathy
3. Hypertrophic cardiomyopathy
4. Right ventricular dysplasia.

We can plan appropriate treatment strategies.

Echo in Hypotension and Shock

In patients presenting with hypotension not due to a cardiac arrhythmia 2 D echo helps in excluding the cardiac causes of hypotension like:

1. Acute cardiac tamponade
2. Extensive myocardial infarction with severe systolic dysfunction
3. Right ventricular infarction
4. Mechanical complication of myocardial infarction
 - a. Cardiac free wall rupture
 - b. Papillary muscle rupture
 - c. Rupture of ventricular septum
5. Massive pulmonary embolism.

Cardiac tamponade. It can be diagnosed easily, quickly and confidently with the aid of echo. On 2D echo, the following features suggest tamponade

- a. Right ventricular free wall early diastolic collapse
- b. Right atrial free wall diastolic collapse
- c. Decreased RV diameter, especially RVOT ≤ 7 mm
- d. Dilated IVC (> 2.2 cm) with 50% decrease in diameter on inspiration.

Doppler study across the mitral and tricuspid valve shows characteristic variation of the E-wave (early diastolic filling) velocity with respiration. Normally E-wave across tricuspid valve (TV) and mitral valve (MV) shows respiratory variations of 25 and 15% respectively. However, in tamponade, the E-wave across TV and MV show respiratory variation of > 40 and 25% respectively.

The most effective treatment of cardiac tamponade is removal of pericardial fluid. Echocardiography not only detects fluid in the pericardial space but also delineates the location of fluid, which aids in aspiration of the fluid. Collection of fluid preferentially behind the heart with very little inferior or anterior collection, even though compressing the heart requires surgical drainage. The echodensity of fluid in the pericardial space also can predict success of needle aspiration. For example, following blunt trauma in chest, resulting in hemopericardium the blood may get clotted and appears echodense rather than echo lucent. Clot is not amenable to needle aspiration but instead requires surgical removal. **Pericardiocentesis**, though life saving, a blind percutaneous attempt has a high rate of complications. Puncture of cardiac 2 D echocardiography can guide pericardiocentesis by locating the optional site of puncture and the distance from puncture site to the effusion.

Further, the position of the needle in the pericardial space can be confirmed by injecting agitated saline contrast through the needle in the pericardial space, which will not be washed out

of the pericardial space. The success of aspiration also can be monitored by observing disappearance of right ventricular/right atrial free wall collapse and loss of marked respiratory variation of E wave velocity at mitral and tricuspid inflow.

Extensive myocardial infarction: According to the shock registry, the causes of cardiogenic shock in 251 patients after acute MI were severe LV failure in 85%, mechanical complications in 8%, RV infarct in 2% and comorbid conditions in 5%. Severe LV systolic dysfunction can be readily diagnosed by calculating ejection fraction, filling pattern at mitral inflow shows a restrictive pattern (E/A >2:1 with deceleration time of E wave <160 msec) suggesting increased LVEDP. Presence of normal systolic LV function in patient of myocardial infarction with shock, should lead to suspicion of a mechanical complication (free wall rupture, rupture of ventricular septum or papillary muscle), hypovolemia or right ventricular infarct. 2D echocardiography can readily help in differentiating the different conditions (Fig. 10).

1. *Cardiac free wall rupture:* 2D echo, though not always successful in delineating site of rupture, helps in demonstrating blood in the pericardial space and features of tamponade as discussed above. This early detection allows prompt surgical repair with a survival rate of >50%. Sometimes pseudoaneurysm forms following cardiac rupture, which can only be detected by 2D echo. Pseudoaneurysm is characterized by a small neck, with ratio of diameter of entry to maximal diameter of the pseudoaneurysm <.5. There is always to and fro blood flow through the rupture site that can be documented by color flow imaging. Occasionally, free wall rupture does not extend through complete thickness but is contained by epicardial layer sub-epicardial aneurysm. Both pseudoaneurysms and sub-epicardial aneurysm should be treated urgently by surgery because of their potential to rupture.
2. *Infarct related VSD* can be diagnosed by 2D echo with colour doppler in 0% of cases. The defect is usually located in the region of thinned out myocardium with dyskinetic motion. Once detected, the therapeutic option is mechanical closure either percutaneously or by surgery as medical treatment per se has a high mortality of 90%. Similarly, 2D echo with colour Doppler is the best way to study papillary muscle rupture and severity of MR. Decision of whether valve needs to be repaired or replaced can be assessed from structural assessment of the mitral valve. Survival after urgent surgery is excellent.
3. Right ventricular infarct. *Hemodynamically significant RV infarct is usually* associated with inferior wall MI. Clinically, patients have shock with clear lung fields and raised JVP. On 2D echo the RV appears dilated and hypo to akinetic in association with left ventricular inferior wall hypokinesia or akinesia.

Hypotension and shock is commonly encountered in emergency room. It can be of cardiac etiology or a purely noncardiac entity such as hemorrhage, hypovolemia and sepsis.

Hemorrhage and hypovolemia most commonly due to trauma results in hypotension and shock. In such a scenario an echocardiogram reveals a small underfilled ventricle and hyperdynamic motion. This is reliable evidence of intravascular volume depletion and has obvious therapeutic implications.

Echo in Chest Trauma

Cardiovascular lesions resulting from chest trauma are potentially fatal but are not recognized frequently as they occur in the setting of multiple organ injury. Clinical examination, cardiac enzyme measurement, chest X-ray and ECG are often not sensitive or specific to detect cardiac contusion or other structural abnormalities.

Potential cardiac complications of chest trauma include:

1. Ventricular dysfunction (especially contusion of RV as it is close to chest wall)
2. Cardiac tamponade
3. Cardiac rupture (free wall, ventricular septum, aorta)

4. Valvular rupture
5. Aortic rupture
6. Intra cardiac thrombus

All the above complications can be detected by 2D Echo with TEE being especially helpful in lesions of aorta. TEE can also be helpful in evaluating cardiac or valvular rupture in patients with sub-optimal transthoracic window because of chest injury.

THERAPEUTIC VALUE OF ECHO IN EMERGENCY ROOM

Echocardiography Guided Pericardiocentesis

In the emergency department pericardiocentesis is a blind procedure. Echocardiography plays a valuable role in therapeutic pericardiocentesis. Multiple echocardiographic imaging window should be used to determine the distribution of fluid and depth from the surface of the chest at which contact with the fluid is anticipated by the pericardiocentesis needle. Through continuous echo guidance, the needle is visualized to enter the pericardial cavity. If the location of the pericardiocentesis needle is in doubt agitated saline can be injected through the needle to define the location. A cloud of echo contrast in the previously clear pericardial space indicates that the needle is in right place. Echocardiogram is also used to determine the completeness of fluid removal.

Estimation of Central Venous Pressure

Central Venous Pressure (CVP) offers information regarding the patient's haemodynamic state. Echocardiogram offers a quick and noninvasive way to estimate the CVP.

CVP is estimated by Echo by viewing the inferior vena cava or internal jugular vein. Normally, IVC narrows during inspiration and distends during expiration. When CVP is elevated IVC will be distended throughout both the inspiration and expiration. If CVP is low then IVC is completely collapsed during inspiration. This information is useful in guiding fluid management in emergency room patients.

Internal jugular vein (IJV) examination also helps in estimating the CVP. If the CVP is elevated (>10 mmH₂O) the IJV appears to be of the same size or larger than adjacent common carotid artery in semiupright position. If CVP is low, the IJV appears to be collapsed.

Cardiac Pacing

Cardiac pacing is done in emergency room for many indication like asystole, unstable, bradycardia, Type II second degree AV block and third degree AV block. Cardiac pacing is done by transcutaneous or transvenous route.

When transcutaneous pacing is used echocardiogram is used to determine whether mechanical capture is successful. Ventricular capture can occur without detectable pulse or blood pressure. Ventricular contractions in echo correlating with pace spike confirms ventricular capture.

Transvenous pacing is performed blindly or by ECG guidance. Echocardiogram help in placement of pacing lead. Using bedside echo the operator can look for the tip of the Pacing lead and place it in right ventricular apex.

OTHER AREAS OF BEDSIDE ECHO IN EMERGENCY

Detection of Pulseless Electrical Activity (PEA)

Patients with cardiac arrest present to emergency department every day and resuscitative efforts are done. Patients with PEA have an electrical rhythm but no palpable pulse and echocardiogram will show a ventricular standstill. Patients with visualized cardiac standstill have poor survival rates despite resuscitative efforts. Hence, echocardiogram can confirm a cardiac standstill during PEA and indicate the physician to cease the resuscitative efforts.

CONCLUSION

Echocardiography thus is a very important tool in emergency department offering vital clues in early diagnosis and also very useful in assisting therapeutic procedures. The fact that echocardiography is a portable rapid, noninvasive technology which can be repeated when required makes it highly useful in emergency department. Hence all physicians managing critically ill patients should learn the skill of echocardiographic examination in a focused manner. This skill adds to the clinical acumen towards a correct diagnosis and treatment.

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Multiple Choice Questions

1. **Echocardiogram is useful in acute myocardial infarction in:**
 - A. Estimating the size of infarct
 - B. Detection of complications
 - C. Assessment of reperfusion
 - D. Assessment of ejection fraction
 - E. All of the above
2. **Heart failure with normal ejection fraction can be caused by all of the above *except*:**
 - A. Mitral stenosis
 - B. Hypertensive heart disease
 - C. Dilated cardiomyopathy
 - D. Constrictive pericarditis
 - E. Restrictive cardiomyopathy
3. **The common cause of cardiogenic source of emboli in our clinical practice is:**
 - A. LA myxoma
 - B. Atrial septal defect
 - C. Mitral valve prolapse
 - D. Mitral stenosis
4. **Acute aortic dissection is readily diagnosed by which of the following diagnostic means?**
 - A. Transthoracic echocardiography
 - B. Intravascular ultrasound
 - C. Transesophageal echocardiography
 - D. Aortagram
5. **Echocardiogram is useful in assisting the following therapeutic procedures *except*:**
 - A. Cardiac pacing
 - B. Angioplasty
 - C. Balloon mitral valvotomy
 - D. Pericardiocentesis
6. **Acute breathlessness with hypotension is a presentation in which of the following?**
 - A. Cardiac tamponade
 - B. Pulmonary embolism
 - C. Acute myocardial infarction
 - D. Aortic dissection
 - E. All of the above
7. **Which of the following is not a echo feature of cardiac tamponade?**
 - A. RV diastolic collapse
 - B. Regional wall motion abnormality
 - C. Swinging heart
 - D. IVC congestion
 - E. Phasic Doppler variation of outflow tract

1. E 2. C 3. D 4. C 5. B 6. E 7. B