Novel diagnostic procedure

Saved by focused echo evaluation in resuscitation

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Summary

A 74-year-old woman received thrombolysis for pericarditis. She subsequently developed shock and cardiac arrest. The case report describes the events of how a simple immediate bedside focused echo proved to be a life saving assessment. Current availability and training issues in focused transthoracic echo are discussed.

BACKGROUND

The use of focused transthoracic echo (TTE) is developing as part of the initial assessment of the critically ill patient, with some literature but little evidence to support its use. It allows an immediate, non-invasive, real-time assessment with no risk to the patient.

Use of TTE has been sporadic, due to the limited access to suitable ultrasound machines and training. We present a case report of a life saving intervention following a periresuscitation TTE performed by a minimally TTE trained Anaesthetic Registrar. Current availability and training issues in focused TTE are discussed.

CASE PRESENTATION

A 74-year-old woman was admitted to the emergency department with a 3-day history of increasing chest pain. A 12 lead ECG showed no abnormality. Three hours later with worsening chest pain there was clear ECG evidence of ST elevation (figure 1). A decision to thrombolysate was made. The patient received tenecteplase, clopidogrel, aspirin, atenolol and an infusion of heparin. Due to the accompanying hypotension, a bedside TTE was performed by a consultant cardiologist showing good left ventricular function with no regional wall motion abnormalities. A CT thorax was requested to exclude aortic dissection. Despite volume resuscitation the patient became progressively hypotensive, tachycardic and anuric, with a pH of 7.2 and lactate of 7.1 mmol/l⁻¹ necessitating a referral to the intensive care team.

INVESTIGATIONS

Initial assessment, in the presence of hypotension, tachycardia and reduced heart sounds included a focused TTE scan (focused echocardiographic evaluation in resuscitation (FEER) protocol) using a MicroMaxx (Sonosite, Bothell, Washington, USA). This showed a 2 cm pericardial effusion (figure 2). No right ventricular diastolic collapse was evident. Fluid boluses and an infusion of dobutamine were required to achieve a mean arterial pressure (MAP) of 65 mm Hg prior to transfer to the CT scanner. The subsequent CT scan confirmed the presence of a pericardial effusion and bilateral pleural effusions but no evidence of aortic dissection.

TREATMENT

While awaiting further cardiology review (in light of the pericardial effusion) the patient had a pulseless electrical activity cardiac arrest. Intubation and immediate cardiac massage were performed in accordance with the UK advanced life support resuscitation council guidelines. Within 30 s she had return of spontaneous circulation. An infusion of epinephrine was required to maintain a MAP of >60 mm Hg. A repeat focused TTE confirmed tamponade (figure 3), and pericardial paracentesis was performed under direct ultrasound visualisation using the Seldinger technique. Suppurative blood-stained fluid, 240 ml, was withdrawn, which resulted in an immediate return of blood pressure. The epinephrine infusion was weaned within minutes. The patient was transferred to intensive therapy unit, where the insertion of a central venous catheter and bilateral chest drains were performed using ultrasound guidance.

The following day, respiratory support was weaned and she was extubated 24 h later. Within 3 weeks she had made a full recovery and was discharged home. Her final diagnosis was community-acquired pneumonia, suppurative pericarditis with the subsequent development of a haemorrhagic pericardial effusion and tamponade due to thrombolysis and anticoagulation.

DISCUSSION

TTE has, until recently, been the sole remit of cardiology departments. TTE use by non-cardiologists has been slow to develop. Non-cardiologists have limited time available to complete the extensive training required to perform formal TTE studies. Focused TTE employs a simplified and shortened TTE examination, concentrating on the exclusion of gross pathologies and abnormalities.¹⁻⁵ The skills and training needed to perform focused TTE are substantially less than those for formal diagnostic TTE. Hellmann *et al* studied the rate at which residents could learn TTE to assess left ventricular size, function and mitral and aortic valve competency. Using linear regression to gauge their performance, the residents demonstrated rapid learning of TTE interpretation with minimal didactic teaching and progression of skills with experience.⁶ Manasia *et al*⁷ performed a similar study using non-cardiologist intensivists

Figure 1 12 lead ECG showing ST elevation.

Figure 2 Subcostal view showing a 2 cm pericardial effusion.

with similar findings. These are encouraging, although not all learning curves are linear and extrapolation of regression lines must be interpreted with caution. There are no benchmarks to assess competency, and different individual learning rates must be accounted for in any training program.

With the increased availability of portable high-resolution ultrasound machines, interest in focused TTE has developed within a number of specialities. These include intensive care, anaesthesia and emergency medicine. The questions asked are similar in most situations; is the heart

beating? Is it underfilled? Is it contracting well? Is the right ventricle bigger than the left? Or is there a pericardial or pleural effusion present?

In intensive care, Cholley *et al* have suggested that TTE can reliably assist with the decision between fluids or diuretics, and vasodilators or inotropes. Key haemodynamic parameters can be achieved without the hazards of a pulmonary artery flotation catheter.⁸ A focused assessed transthoracic echocardiography protocol (FATE) for use in ICU has been developed by Dr E Sloth. This involves an abbreviated TTE protocol consisting of four standardised

Figure 3 Subcostal view showing tamponade with right ventricular diastolic collapse.

acoustic views including parasternal, apical, subcostal and pleural. It is used routinely on patients admitted to intensive care and has been found to be clinically useful in 97% of patients.⁹ This is taught as a 2-day course with assessment and examination.¹⁰

The use of focused TTE in resuscitation and the peri-arrest situation is developing rapidly. In a study by Joseph *et al*, for diagnosing a cardiac cause of shock, TTE was 100% sensitive, 95% specific with a positive predictive value of 97% and negative predictive value of 100%. The imaging, however, was performed by fully trained, certified and experienced echocardiographers.² Breikreutz *et al* have developed a peri-resuscitation TTE protocol called FEER for the rapid assessment of myocardial insufficiency. This has been used successfully in Germany in prehospital and in-hospital resuscitation and has been integrated into an advanced cardiovascular life support type resuscitation protocol.¹¹

HEART scan is Australia's answer to focused echocardiography for the non-specialist. This stands for haemodynamic echocardiographic assessment in real time and is more advanced than FEER and FATE, including simple assessment of valvular function. HEART scan training consists of four interactive tutorials on DVD followed by a 2-day 'hands-on' course.¹²

Until now there has been no national consensus on training requirements for focused TTE. The British society of Echocardiography (BSE) has recognised a gap in formal training. The BSE has recently proposed an entry level/peri-resuscitation TTE training focused echo evaluation in

life support (FEEL) to avoid the danger of anyone 'having a go'. The BSE strongly supports the training of doctors in intensive care, acute and emergency medicine in focused echocardiography with specific focus on trainees dealing with the acutely ill patient. This program, devised by Dr S Price in conjunction with Dr R Breikreutz, is based on the FEER protocol. FEEL training can be achieved within a 1-day ATLS (standard lectures/workshops/handouts) type training course, followed by 50 recorded examinations reviewed and assessed by an experienced echocardiographer or cardiologist. The first UK FEEL course was held in March 2009 at the Royal College of Anaesthetists. The format and organisation of certification has been approved by the BSE. The BSE suggests a core level of basic training for all specialities to be provided and supervised locally. This training should be within a framework of clinical

Learning points

- ▶ The use of focused echocardiography is becoming widespread in the assessment of the critically ill patient.
- ▶ Focused echocardiography allows an immediate, non-invasive, real-time assessment with no risk to the patient.
- ▶ There are several basic courses available with minimal teaching required and a rapid learning curve.
- ▶ Finally, saddle-shaped ST elevation can be caused by pericarditis.

governance and in co-operation with the echocardiography department. Evidence of maintenance of skills and competency will be necessary with revalidation. Courses will be nationally advertised and accessible to all in the near future.

Competing interests None.

Patient consent Obtained.

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