Emergency physician use of ultrasonography to evaluate hypotension: a case report

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In a non-trauma patient, several conditions giving rise to hypotension and cardiovascular collapse can be immediately life-threatening. These include cardiac tamponade, ruptured abdominal aortic aneurysm, pulmonary embolism, and massive acute myocardial infarction. Prompt diagnosis is essential because correct immediate treatment and disposal decisions will affect the outcome. This is a report of a case in which the emergency physician used ultrasonography to evaluate a patient with hypotension, leading to timely intervention. Sonographic diagnosis also guided subsequent disposal and management decisions. This utility of ultrasonography in the emergency department setting is discussed. (*Hong Kong j.emerg.med.* 2002;9:226-230)

Keywords: Cardiac tamponade, echocardiography, emergency department, ultrasound

Introduction

The use of ultrasonography (US) by emergency department (ED) physicians has been growing in popularity. US is rapid, accessible, noninvasive, accurate, and can diagnose several life-threatening conditions to guide immediate clinical decisions. Its applications in Emergency Medicine have been well described in textbooks and academic literature.[1-8] However its availability in EDs throughout the world, and the ability of emergency physicians to perform US, is still far from universal. The author reports a case in which an Accident & Emergency (A&E) Department doctor in Hong Kong used US to evaluate a patient with hypotension, leading to timely intervention.

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Case report

A 70-year-old man attended the A&E Department complaining of dizziness and intermittent retrosternal chest pain for two days, which had been increasing in severity. On arrival, his blood pressure was 100/51, and pulse 94/min. His heart sounds were normal, with no murmur, and chest was clear on auscultation. He had no past history of heart disease, hypertension, nor any major illness. Electrocardiogram (ECG) at first showed sinus rhythm with no evidence of acute ischaemia. While awaiting chest radiograph, he became diaphoretic pulse became weak, and was then promptly taken to the resuscitation room for further management.

His blood pressure was found to be 53/33 with pulse rate of 107/min. and fluid resuscitation was initiated. Neck veins were not visibly distended, heart sounds were not muffled, and his trachea was mid-line. His abdomen was soft, non-tender, with no palpable mass. He was alert to voice and denied severe chest pain, only vague discomfort. However, a repeat ECG

showed significant ST elevation over the lateral leads, with reciprocal changes, diagnostic of acute myocardial infarction. (Figure 1) Bedside US was performed by the A&E doctor using an Aloka SSD-1700 scanner with a 3.5MHz convex probe. A large pericardial effusion was visualised through echocardiographic subcostal view. (Figure 2) Scanning of the abdominal aorta showed no aneurysm. (Figure 3) Central venous

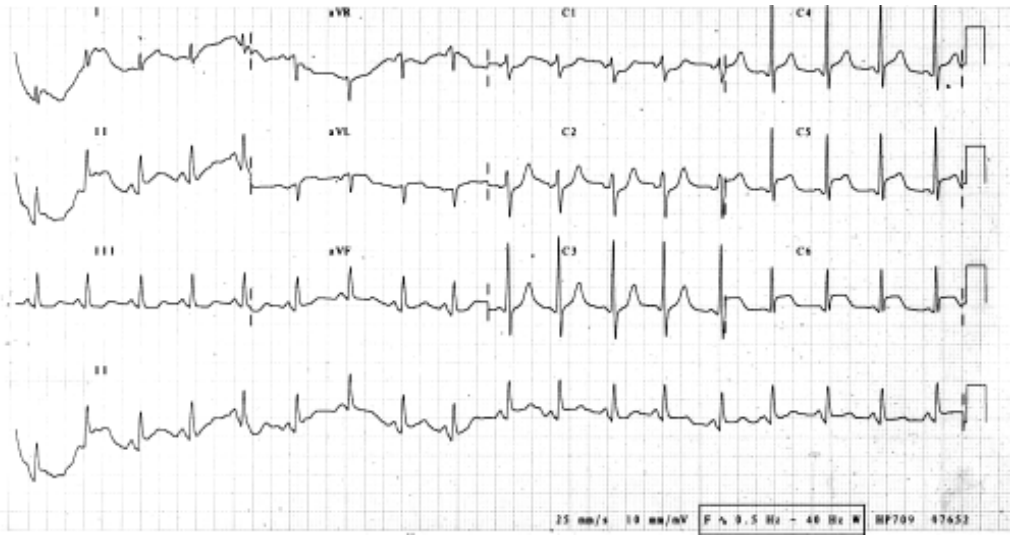

Figure 1. Electrocardiogram (repeated) of patient, showing significant ST elevation over lateral leads, with reciprocal changes.

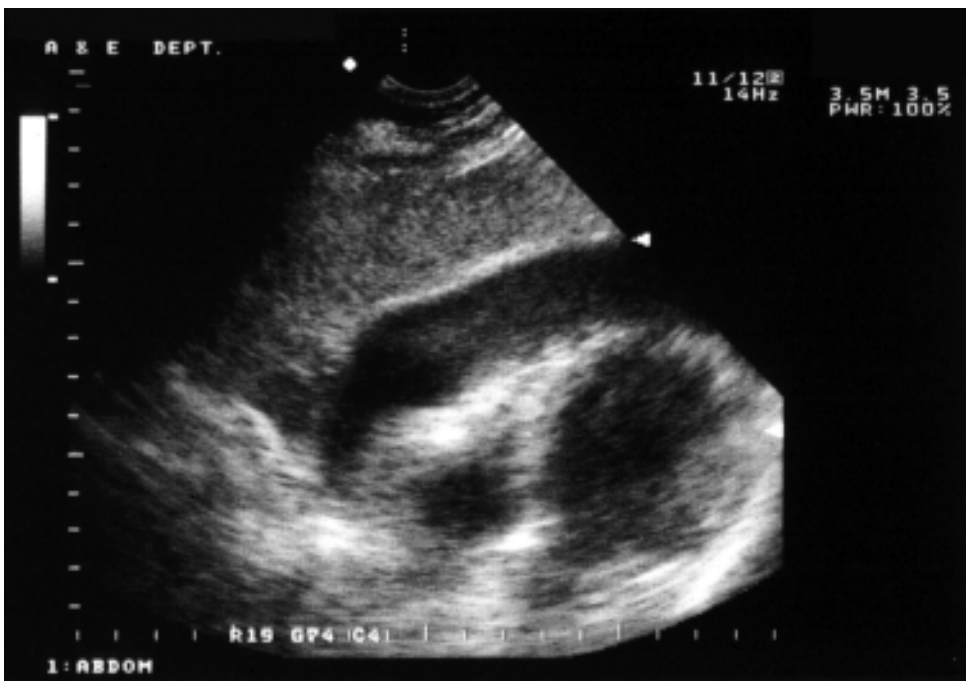

Figure 2. Emergency cardiac ultrasound (subcostal view) of patient, showing a large hypoechoic area of pericardial effusion.

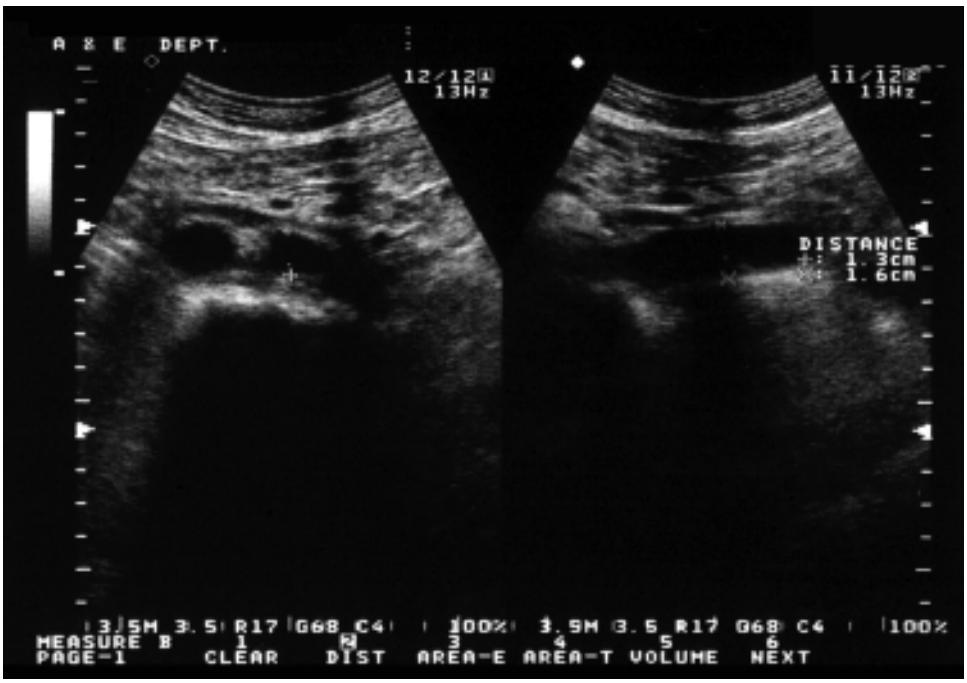

Figure 3. Emergency ultrasound focused on patient's abdominal aorta, showing no aneurysm. Left: transverse section. Right: longitudinal section.

pressure (CVP) measured through internal jugular vein was 25.5 cm. The cardiologist on call was immediately notified and he arrived to perform pericardiocentesis under US guidance. Fresh blood of 200 ml was aspirated, and the catheter was left in-situ for continuous drainage. The patient's haemodynamics improved, with blood pressure 134/59 and CVP 12 cm.

It was clear at this stage that the patient most likely had cardiac free wall rupture and cardiac tamponade complicating his acute myocardial infarction; and he required urgent operation. Blood was crossed-matched and transfusion commenced before he was urgently transferred to another institution with cardiothoracic surgical expertise and facilities. Unfortunately, his condition deteriorated en route and he eventually did not survive to have the operation.

Discussion

In the setting of acute myocardial infarction (AMI), hypotension may be due to cardiogenic shock or cardiac tamponade.[1-8] Urgent distinction between the two is vitally important because this influences immediate management decisions. Cardiogenic shock is visualised by US as marked global wall motion abnormalities. These patients usually have discrete left ventricular dysfunction. A massive right ventricular infarct, however, will show a vigorous left ventricle with a large, hypodynamic, thin-walled right ventricle. AMI may be complicated by cardiac tamponade, due to cardiac rupture with resultant acute haemopericardium. In these situations, urgent pericardiocentesis may be a life-saving procedure. Haemopericardium can be promptly diagnosed by bedside US, and the correct treatment instituted, as in the reported case. The visualisation of pericardial effusion and diastolic collapse of the right-sided chambers associated with hypotension is diagnostic of cardiac tamponade. The classic findings of elevated CVP, muffled heart sounds and paradoxical pulse are frequently difficult to detect.[5,9] US can show pericardial fluid and signs of cardiac tamponade before the appearance of these clinical signs.[6,8] Such was the case with our reported patient, in whom the signs of distended neck veins and muffled heart sounds were looked for but considered not evident.

Ischaemic rupture of the left ventricular free wall may account for between 10% to 25% of deaths in patients with AMI.[7] Since emergency physicians have adopted the responsibility of giving thrombolytic reperfusion therapy to AMI patients, we are also responsible to identify these high-risk cases in which thrombolysis is contraindicated. The use of US to detect pericardial effusion will greatly aid our therapeutic decision-making in these situations.

Non-cardiac causes of hypotension can also be accurately diagnosed by emergency US. In hypovolaemia, echocardiography will usually show a hyperkinetic heart with small right-sided chambers.[2-4] The patient with pulmonary embolism will display a vigorous left ventricle and a massively dilated right ventricle. Abdominal aortic aneurysm is also easily and rapidly detectable by US. Focused US to exclude abdominal aortic aneurysm was also performed by the emergency physician in our reported case. Rose et al have described a sonographic protocol for the evaluation of the undifferentiated hypotensive patient.[10] Three US applications: 1) the detection of intraperitoneal fluid; 2) abdominal aorta; and 3) subcostal view echocardiography, are combined into a single protocol for rapid patient evaluation by the ED physician.

Interest continues to grow in the bedside use of US by emergency physicians. As early as 1993 in the United States, the Society for Academic Emergency Medicine had published a model curriculum for physician training in emergency US.[11] Numerous articles have described the usefulness of ED ultrasound and echocardiography.[5-8,10,12] One study demonstrated that cardiac US performed by emergency physicians is reliable in evaluating for pericardial effusions.[13] Another study showed that emergency physicians with limited goal-directed training in echocardiography were able to determine left ventricular function with reasonable accuracy in hypotensive ED patients.[14] In Australia, ED ultrasound scanning for abdominal aortic aneurysm by emergency physicians has been shown to be accurate, accessible, and a skill easily acquired.[15] Emergency US is also used in EDs in Europe. A study in the Netherlands described the use of echocardiography in the ED setting to detect myocardial ischaemia.[16]

Soldati reports that since 1998, in his ED in Italy, thoracic US has been used to supplement focused abdominal sonography for trauma (FAST) to diagnose haemothorax, haemoperitoneum, lung parenchymal contusions and pneumothorax.[17] The training of emergency physicians in US detection of pneumothorax may also benefit the management of trauma patients.[18]

In Hong Kong, the development of US in Emergency Medicine is relatively new, but it is progressing rapidly. The Hong Kong College of Emergency Medicine endorses the principles that emergency US should be available 24 hours a day in EDs, and that emergency physicians providing ultrasound services should have appropriate training.[19] At present, most larger A&E units possess an ultrasound scanner. However, emergency physicians with formal training and credentials to perform emergency US are still not available 24 hours a day.

The case reported is a good illustration of how emergency US can be beneficially used by A&E doctors to guide important decisions in therapy and patient disposition.

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