

RAPID IDENTIFICATION OF RUPTURED ABDOMINAL AORTIC ANEURYSM USING POINT-OF-CARE ULTRASOUND IN THE EMERGENCY DEPARTMENT: A CASE REPORT

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Abstract

A ruptured abdominal aortic aneurysm (AAA) is a catastrophic cardiovascular emergency which carries high risk of morbidity and mortality. Clinical manifestation includes severe abdominal pain, back or flank pain, syncope, hypotension, gastrointestinal bleeding and cardiovascular collapse. Misdiagnosis is often due to atypical presentation and results in fatal consequences. Rapid diagnosis of ruptured AAA is essential because it influences the patient's prognosis. Timely and accurate diagnosis can be made in the Emergency Department using point-of-care ultrasound (POCUS) which has high sensitivity and specificity. We report a case of an elderly male who came with non-specific abdominal pain to the Emergency Department. Timely diagnosis of ruptured AAA was made with POCUS. The diagnosis was made by a non-radiologist using POCUS, however, the decision for ruptured AAA repair was only made by surgical team following computed tomography scan of the abdomen.

Keywords: Abdominal aortic aneurysm, Emergency, Ultrasound

Introduction

Abdominal aortic aneurysm (AAA) is a focal dilatation of the abdominal aorta with outer diameter greater than 3.0 cm or vessel diameter exceeding 50% than normal (1). AAA is often asymptomatic and remains undetected until it ruptures. Ruptured AAA carries mortality risk as high as 85 – 90% (1-3). Clinical features of rupture AAA include classical triad of abdominal pain, syncope and hypotension (4). However, patients may have atypical presentation that mimics renal colic, gastrointestinal bleed or acute myocardial infarction. These similarities in presentation often lead to misdiagnosis and contribute to higher rate of fatality (5, 6). Therefore, prompt, accurate and reliable diagnosis of ruptured AAA is crucial (7).

Point-of-care ultrasound (POCUS) has been widely used over the past two decades and the Royal College of Emergency Medicine has included POCUS as a mandatory component in the curriculum of emergency medicine since 2010. Recent evidence has shown that POCUS improves examination technique in the diagnosis and management of acute unwell patients (8). In addition, there was a

significant increase of POCUS usage as an adjunct due to its availability and it has brought the 'radiology department' services to patient's bedside rather than sending especially critical and unstable patients to the Radiology Department. The use of POCUS in the Emergency Department (ED) can further expedite diagnosis of ruptured AAA and served as a cost effective and non-invasive screening tool (9, 10).

We report a case of an elderly male who presented non-specific abdominal pain, and the diagnosis of ruptured AAA was promptly made in the ED using POCUS.

Case Report

A 66-year-old male presented with vague abdominal discomfort for two days, with worsening pain over the past 10 hours. The pain was described as dull aching pain over the central abdomen with radiation to the back. It was associated with nausea, non-bilious and non-bloody vomiting twice prior to the presentation. Otherwise, he denied symptoms of chest pain, shortness of breath, altered bowel habit, abdominal distension, constitutional

symptoms, limb weaknesses, urinary symptoms and fever. He was initially seen at a private clinic and discharged home with medication for dyspepsia, but the symptoms did not resolve. He was a chronic smoker with history of abdominal surgery more than 30 years ago for perforated gastric ulcer. He had no other medical illness and denied usage of traditional medication.

Upon arrival to the ED, he was alert, appeared uncomfortable due to abdominal discomfort, not pale and not in respiratory distress. He was normotensive with the blood pressure (BP) of 124/90 mmHg, heart rate of 107 beats per minutes (bpm), oxygen saturation of 99% under room air, afebrile and a pain score of 8/10. Peripheral pulses were equal with good volume. There was no radio-radial pulse delay or radio-femoral pulse delay. Abdominal examination revealed a faintly palpable, pulsatile mass located at the epigastric and umbilical region with tenderness on gentle palpation. Bowel sound was present. Other systemic examinations were unremarkable.

Electrocardiogram showed a sinus tachycardia with heart rate of 100 bpm with no ischaemic changes. Chest radiograph showed no widened mediastinum. An abdominal ultrasound which was performed by a medical officer in the ED revealed an AAA measuring 8.7 cm x 8.3 cm with eccentric mural thrombosis and para-aortic haematoma (Figure 1). Following POCUS revelation of AAA, immediate surgical referral was made. As patient was stable, the surgical team decided on contrast-enhanced computed tomography (CECT) for further surgical assessment and plan.



Figure 1: Point-of-care ultrasound (POCUS) in transverse view shows abdominal aortic aneurysm (AAA) measuring 8.7 cm x 8.3 cm with eccentric mural thrombus (white arrow), and para-aortic anechoic area (black arrow) with posterior enhancement suggestive of para-aortic haematoma

The CECT scan of abdomen revealed a huge infrarenal AAA measuring 9.3 cm x 9.8 cm x 12 cm with eccentric mural thrombus extending to both common iliac and left internal iliac artery, complicated with aneurysmal rupture as

evidence by presence of large retroperitoneal haematoma showing contrast extravasation indicating active bleeding (Figure 2).

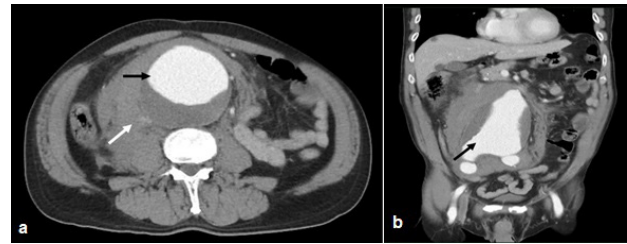


Figure 2: (a) Contrast-enhanced computed tomography (CECT) scan of abdomen in axial view revealed infrarenal abdominal aortic aneurysm (AAA) with partially thrombosed lumen by eccentric mural thrombus (black arrow). There was a large acute hyperdense right retroperitoneal haematoma (white arrow) which indicates ruptured AAA. (b) CECT scan of abdomen in coronal view shows large infrarenal AAA (black arrow) with involvement of bilateral common iliac arteries

Laboratory findings showed haemoglobin level of 14.8 g/dL, leukocytosis with white cell count of $17.0 \times 10^9/L$, and platelet count of $262 \times 10^9/L$. His blood sugar, serum electrolytes, renal profile, liver functions test and coagulation profile were within normal ranges. His venous blood gases showed compensated metabolic acidosis with a pH of 7.37, pO_2 of 6.9 kPa, pCO_2 of 4.7 kPa, HCO_3^- of 19.6 mmol/L, base excess of -4.6 and serum lactate of 2.7 mmol/L.

Upon returning from computed tomography (CT) room, his BP dropped to 70/40 mmHg with heart rate of 118 bpm. He appeared pallor with cold clammy hands. He was resuscitated with one unit of whole blood in the ED to restore his circulatory function. He was subsequently pushed to the operating theatre for emergency laparotomy repair of ruptured AAA. Intraoperative findings show ruptured infrarenal AAA with extension to bilateral common iliac and left external iliac artery, with contained hematoma 12 cm x 10 cm and presence of atheromatous plaque. The ruptured AAA was repaired using bifurcation graft and left internal iliac artery ligated. Following successful emergency surgery, he was admitted to the intensive care unit (ICU).

However, he developed reperfusion injury with rhabdomyolysis, bilateral lower limb ischaemia, paralytic ileus and acute renal failure with metabolic acidosis. On day 22 of hospitalisation in the ICU, he succumbed to septic shock secondary to nosocomial infection with multi-organ dysfunction.

Discussion

Aneurysmal dilatation of the abdominal aorta is a disease of aging with the incidence of 2-4% in population above

50 years old, with average time of diagnosis between 65-70 years old, and men are mostly affected (11). According to Howard *et al.*, two third of acute AAA events occurred at the age 75 years and above, with strong association related to smoking and hypertension (2). Other associated risk factors for AAA include older age (more than 65 years old), male sex, family history, hypercholesterolaemia and atherosclerotic vascular disease (1, 2, 4, 11). Abdominal Aortic Aneurysm is defined as aortic transverse diameter of more than 3.0 cm based on imaging either by ultrasound or CT (1). Infrarenal aorta was the commonest location for AAA which constitutes approximately 85% of all cases (1, 3, 9).

Aortic aneurysmal disease was previously known as a form of atherosclerosis, but currently it is recognised as a degenerative process of all three layers of the arterial wall (tunica intima, media and adventitia). Four processes were involved in the pathophysiology of AAA which are: [1] lymphocyte and macrophage infiltration into vessel wall; [2] destruction of elastin and collagen matrix in the media and tunica adventitia; [3] thinning of tunica media due to loss of smooth muscle cell; and [4] neovascularization (1, 11). Ruptured AAA defined as presence of blood outside of tunica adventitia of the aneurysm wall, which results in profuse retroperitoneal haemorrhage (9). The risk of ruptured AAA is negligible in aorta diameter less than 4 cm; however, there is exponential rise in risk of rupture once aorta diameter greater than 5 cm with annual rupture risk of 30-50% if aortic diameter greater than 8cm with mortality risk of 90% if the AAA ruptures (1, 3, 6). This patient had high risk of mortality. Although the surgical intervention was successful, the cause of death was due to septic shock.

In this case, the patient was diagnosed by general practitioner (GP) as acute dyspepsia and was discharged without confirmatory investigations. However, in the GP setting, inadequate presenting symptoms, non-specific physical findings and inability to conduct ultrasound may limit the diagnostic capability. The clinical features of AAA are often asymptomatic and only minority of patients with ruptured AAA has classical triad of abdominal or flank pain, hypotension and pulsatile abdominal mass. AAA with atypical clinical features was often misdiagnosed as nephrolithiasis, gastrointestinal bleed, diverticulitis, or myocardial infarction, which results in medical catastrophe due to delay in correct diagnosis (5). Therefore, rapid identification of ruptured AAA is crucial as it determine patient's survival outcome (7).

Since the past decade, POCUS has been incorporated into the ED care of critically ill patients in shock. POCUS refers to portable ultrasound system that allows the assessment of patients without requiring them to be physically present in the radiology department. It is used to address specific pathological hypothesis at patient's bedside in emergency care unit. POCUS can be used to identify lung pathology in respiratory failure, assist in procedures such as pleural tapping, insertion of central venous access and pericardiocentesis, assess cardiac activity during cardiac

arrest and also can be used in determining type of shock in undifferentiated hypotension. POCUS assists in more accurate diagnosis and allows direct visualization of pathology or abnormal physiological state. Meanwhile, Focus Assessment with Sonography in Trauma (FAST) is a part of POCUS and used primarily in trauma setting to identify intraperitoneal bleeding (10). POCUS is readily available, a safe and non-invasive diagnostic modality for ruptured AAA, with sensitivity of 98% and specificity of 100% (1, 3, 9, 11). POCUS allows rapid diagnosis of ruptured AAA, and it had been found to improve patient's outcome (4, 5, 12, 13). Reed and Cheung (2014) found that rapid diagnosis of ruptured AAA was made within 60 minutes using POCUS in the ED compared to 111 minutes without POCUS, and subsequently speed up the process of transferring patient to the operating theatre for surgical intervention (13).

This patient was diagnosed to have ruptured AAA within one hour in the ED. However, the diagnosis could have been made earlier if bedside ultrasound was performed by the GP or an earlier referral to the tertiary center made. There have been multiple studies evaluating the use of POCUS by the emergency physician. The results suggested that although minimal training is required, an accurate diagnosis of ruptured AAA can be made by non-radiologists (5, 7, 14, 15). Based on a meta-analysis in 2014, non-radiologists (acute care physician, emergency medicine residents and physician, surgical residents) were able to perform POCUS with limited training and achieved acceptable level of sensitivity 98% (95% CI, 94.2 – 99.2) and specificity of 99% (95% CI, 97.9 – 99.5) for the diagnosis of AAA while avoiding misdiagnosis (14).

United States Preventive Services Task Force (USPSTF) recommendation supports screening for AAA in men between the ages of 65 to 75 years old with history of smoking with ultrasound as outpatient because of high incidence of AAA in this group (16). Therefore, all patients with abdominal pain in high-risk groups should be screened for AAA using POCUS.

CECT provides additional information regarding actual size and extension of the aneurysmal lumen, presence of active extravasation and retroperitoneal haemorrhage but it is the modality of choice that is limited only for hemodynamically stable patients (11). In this case, patient initially was hemodynamically stable and sent to CECT following POCUS to assist in definitive surgical management.

Catalano *et al.* have reported that there were eight sonographic findings of ruptured AAA, which are deformation of aneurysmal shape, inhomogeneous luminal thrombus, focal discontinuity of the thrombus layer, floating intraluminal thrombus, focal disruption of outer aneurysmal wall, para-aortic hypoechoic area, retroperitoneal hematoma and hemoperitoneum. Among eight sonographic findings above, the most sensitive finding is retroperitoneal hematoma with sensitivity of 72%, and specificity of 100%; followed by thrombus inhomogeneity with specificity of 69% and specificity of 75% (17). Three

of these findings (AAA deformation, luminal thrombus and para-aortic hematoma) were present in our patient which supported the diagnosis of ruptured AAA.

Once the diagnosis of ruptured AAA has been made, immediate consultation with vascular surgeon should be done. There are two methods of ruptured AAA repair, either via open or endovascular aneurysmal repair (EVAR). Patients who underwent EVAR had lower mortality and shorter hospital stay for survivors (18). Due to extensive involvement of AAA, decision for open AAA repair was made for this patient.

Conclusion

This case highlights the importance of timely and prompt diagnosis of ruptured AAA in order to prevent treatment delay and eventually improve patient's outcome. The use of POCUS in the primary care is advantageous and may expedite the diagnosis of this life-threatening condition. POCUS also serves as an accessible, cost effective and non-invasive screening tool, which can be utilized by GP and pre-hospital care settings.

Competing interests

The authors declare that they have no competing interests.

Ethical Clearance

Informed consent to use this case report for publication had been obtained from the patient.

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