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MODIFIED RAPID ULTRASOUND FOR A SHOCK PATIENT

Zouheir Ibrahim Bitar[1], Saifaldin Ahmed[2], Meshaal Alkandery[3], Ossama Sajeh Maadarani[1]

[1] Critical Care Unit, Ahmadi Hospital, Kuwait Oil Comoany, Ahmadi, Kuwait
[2] Alexandria University, Faculty of Medicine, Manchester program, Alexandria, Egypt
[3] Arabian Gulf University, Manama, Bahrain

Corresponding author's e-mail: zbitar2@hotmail.com

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ABSTRACT

Background: Clinical evaluation of a patient with undifferentiated shock is challenging without the bedside clinical utility of point-of-care ultrasound (POCUS). Scenarios can become complicated when a patient becomes non-transferrable in the critical care unit. POCUS can aid physicians in diagnosing and implementing early management. The retroperitoneal space can accommodate significant bleeding before it becomes apparent. The retroperitoneal space is not included in the POCUS protocol for patients in shock.

Case presentation: We present a case of the history of ischemic cardiomyopathy and atrial fibrillation on apixaban. The patient developed hypotension and severe anaemia. The cause of shock was unclear clinically until POCUS showed a retroperitoneal hematoma. In this shock patient the hematoma was detected by a modified rapid ultrasound that added examination of the retroperitoneal space.

Discussion: The retroperitoneal space is highly vascular and liable to bleed in patients on antiplatelet and anticoagulation. Including the space in the standard POCUS protocols for shock enables visualization of the retroperitoneal compartment and enhances the ability to detect hidden fluid accumulations.

Conclusion: A modified POCUS protocol, including the retroperitoneal space, for a patient with unexplained haemorrhagic shock, can help in early detection of the site of haemorrhage.

KEYWORDS

Retroperitoneal space, shock, modified RUSH protocol

LEARNING POINTS

- The retroperitoneal space can hold a significant amount of blood before it becomes clinically apparent.
- Including the retroperitoneal space in the Rapid-Ultrasound for Shock and Hypotension protocol can help in early detection of the site of haemorrhage in a patient with unexplained haemorrhagic shock.

INTRODUCTION

The retroperitoneum is the region situated behind the parietal peritoneum (the lining of the abdominal cavity) and lined posteriorly by the muscles of the back wall of the abdomen. The anatomical area extends from the diaphragm to the pelvis. Its side boundaries are defined by the fat layers

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outside the peritoneum, contained by the transversalis fascia. The great abdominal blood vessels (aorta and vena cava) are located centrally within this space. It has three parts: the anterior pararenal space, the perirenal space, and the posterior pararenal space[1]

Bleeding into the retroperitoneal space is a major concern, as the space has a limited capacity to accommodate a significant amount of blood. Consequently, patients can lose considerable volume without obvious initial distress, leading to the delayed onset of clinical signs and potentially resulting in hypovolemic shock late in the progression[2].

Different point-of-care ultrasound (POCUS) protocols have been designed to manage patients with undifferentiated shock, aiming to rapidly detect free peritoneal, pleural, and/or pericardial fluid. However, few include the retroperitoneal space[3]. We present a case of a retroperitoneal hematoma induced by antiplatelet therapy in combination with apixaban, detected using a modified POCUS protocol that includes the retroperitoneal space.

CASE DESCRIPTION

A 68-year-old male with a history of ischemic cardiomyopathy due to an anteroseptal S-T elevation myocardial infarction in 2021 was found to have multivessel disease by coronary angiography and managed with primary percutaneous coronary angiography, followed by staged percutaneous coronary intervention and multiple stents. Seven coronary stents were inserted. He was later diagnosed with atrial fibrillation and started on apixaban 5 mg twice daily.

He presented to the emergency room with generalized anasarca and shortness of breath.

On initial examination, he was conscious, afebrile, mildly tachypnoeic, maintaining oxygen saturation on room air (respiratory rate 28 breaths/minute), with a blood pressure of 100/60 mmHg. Physical examination showed bilateral basal crackles in the lungs, a gallop rhythm on heart auscultation, and severe, bilateral lower limb oedema up to the knees with scrotal oedema, and symptoms consistent with biventricular heart failure.

Point-of-care echocardiography showed severe dilatation with reduced left ventricular systolic function, an ejection fraction of 20%, moderate mitral regurgitation, a dilated right ventricle with tricuspid annular plane systolic excursion (TAPSE) of 11 mm, and a distended inferior vena cava that was not collapsible. Lung ultrasound showed severe bilateral B-lines with bilateral pleural effusion.

Laboratory tests *(Table 1)* showed elevated inflammatory markers (C-reactive protein), elevated N terminal pro-B-type natriuretic peptide, and elevated troponin T. Ultrasound of the abdomen and pelvis demonstrated congestive hepatomegaly with a dilated inferior vena cava and mild ascites.

Case	In the ward day 1	In the ward day 2	In the CCU	8 hours	24 hours
WBC count (×10^9/l)	7.5	15.6	12.2	9.2	7.25
RBC count (cells/µl)	4.5	2.56	1.9	2.7	3.16
Platelets (×10^9/l)	187	200	166	150	180
HCT (%)	40	30	24.2	23.5	26.6
Haemoglobin (g/l)	14.2	9.5	8.1	79.1	8.9
Activated partial thromboplastin time (s)	40	36	40.7	30	32.6
Prothrombin time (s/INR)	31.5/2.38	32/2.57	40.7/3.41	39.5/1.70	16.7/1.41
ALT (U/l)	18	-	14	13	20
AST (U/l)	26	-	57	56	67
LDH (U/l)	220	450	640	310	289
Bilirubin (µmol/l)	8	51	46	12	14
BUN (mmol/l)	15.4	21.9	22.9	30	18
Creatinine (µmol/l)	110	130	225	414	120
Lactate (mmol/l)	1	1.44	4	1.44	1
Pro-B-type natriuretic peptide(pg/ml)	16749	-	24776	-	-

Abbreviations: CCU, critical care unit; WBC, white blood cell; RBC, red blood cell; INR, international normalized ratio; ALT, alanine aminotransferase; AST, aspartate aminotransferase; LDH, lactate dehydrogenase; BUN, blood urea nitrogen.

Table 1. Laboratory tests.

The patient was admitted to the critical care unit (CCU) with decompensated heart failure with reduced ejection fraction and fluid overload due to biventricular failure. He was managed conservatively with inotropes (initially levosimendan, later switched to dobutamine) and intravenous (IV) furosemide. Sacubitril-valsartan was considered, but not started, due to borderline blood pressure (92/60). The patient was then transferred to the ward after stabilization.

The following day, he developed two episodes of fever and was empirically started on piperacillin-tazobactam after cultures were obtained. Polymerase chain reaction testing later confirmed H1N1 influenza, and antibiotic therapy was switched to oseltamivir. Sacubitril-valsartan and beta-blockers continued to be withheld, and the furosemide dose was reduced due to fluctuating blood pressure.

Two days later, the patient was referred back to the (CCU) with cardiorenal syndrome (hypotension, oliguria, and worsening renal function). At this point, examination revealed hepatomegaly with disturbed liver enzymes (congestive hepatopathy symptoms). Oseltamivir was stopped on day 5, after the fever subsided.

Subsequently, the patient developed hypotension, severe anemia, and right-sided abdominal pain with swelling and tenderness over the right flank. There was no melena, and no hematemesis.

We used the Rapid Ultrasound for Shock and Hypotension (RUSH) protocol to evaluate critically ill patients, which showed no pericardial effusion and bilateral mild pleural effusion. There was moderate ascites. We extended the point-of-care abdominal ultrasound examination by sliding the abdominal curvilinear probe to the posterolateral thoracoabdominal junction, which showed a right-sided retroperitoneal hematoma lifting the right kidney anteriorly and in proximity to the right psoas muscle *(Video 1)*. The hematoma extended from the level of the liver to the pelvic inlet. It measured anteroposterior diameter (12 × 9 cm). Because the patient was critically ill, a computed tomography (CT) scan could not be performed.

The patient was managed conservatively with vasopressors, transfusion of 2 units of fresh-frozen plasma and 4 units of packed red blood cells, recombinant activated Factor VII, and 1 g of tranexamic acid. He required intubation and mechanical ventilation due to respiratory distress and persistent hypotension.

After the patient was stabilized, a CT scan of the abdomen revealed a large right-sided retroperitoneal hematoma extending from the level of the liver to the pelvic inlet, lifting the right kidney anteriorly and lying close to the right psoas muscle *(Fig. 1 and 2)*. No active bleeding was seen. Other findings included bilateral pleural effusions with basal consolidation, moderate ascites, generalized anasarca, a distended stomach (with a nasogastric tube in situ), and a dilated ascending and transverse colon. The vascular surgery team advised conservative management given the absence of active bleeding on CT angiography.

The following day, the patient developed an episode of



Video 1. Right-sided retroperitoneal hematoma. https://youtu.be/NdzAXGMNzs4

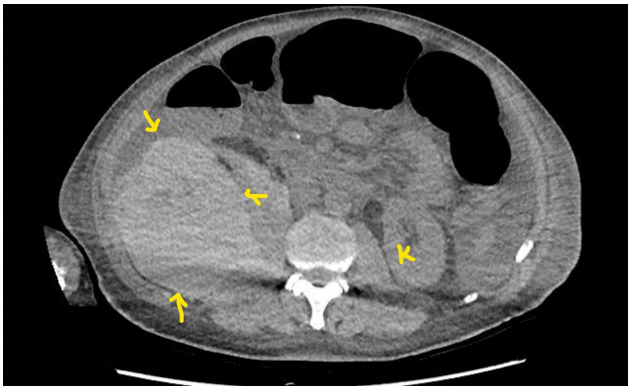


Figure 1. Computed tomography scan of the abdomen showing a large right-sided retroperitoneal hematoma (arrows). Abbreviations: K, kidney.

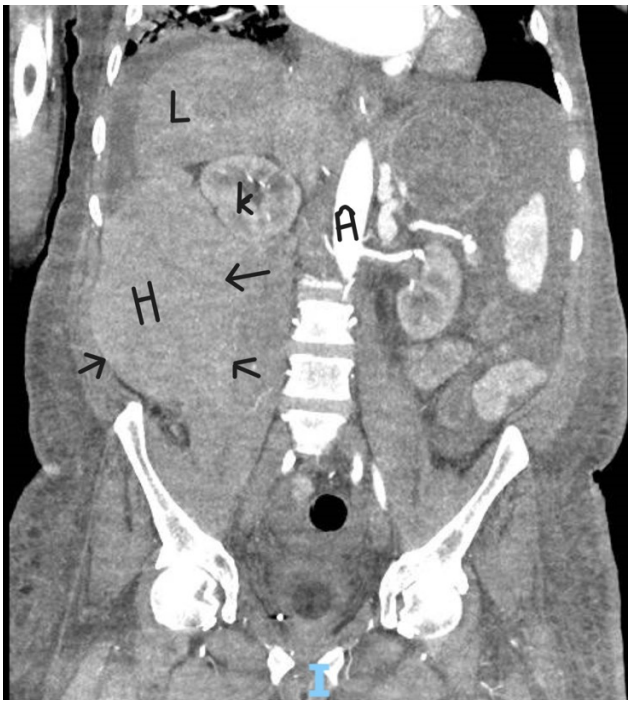


Figure 2. Computed tomography scan of the abdomen, arterial phase coronal section showing a large right-sided retroperitoneal hematoma extending from the level of the liver to the pelvic inlet, lying close to the right psoas muscle (arrows). Abbreviations: L, liver; A, aorta; H, hematoma, K, kidney.

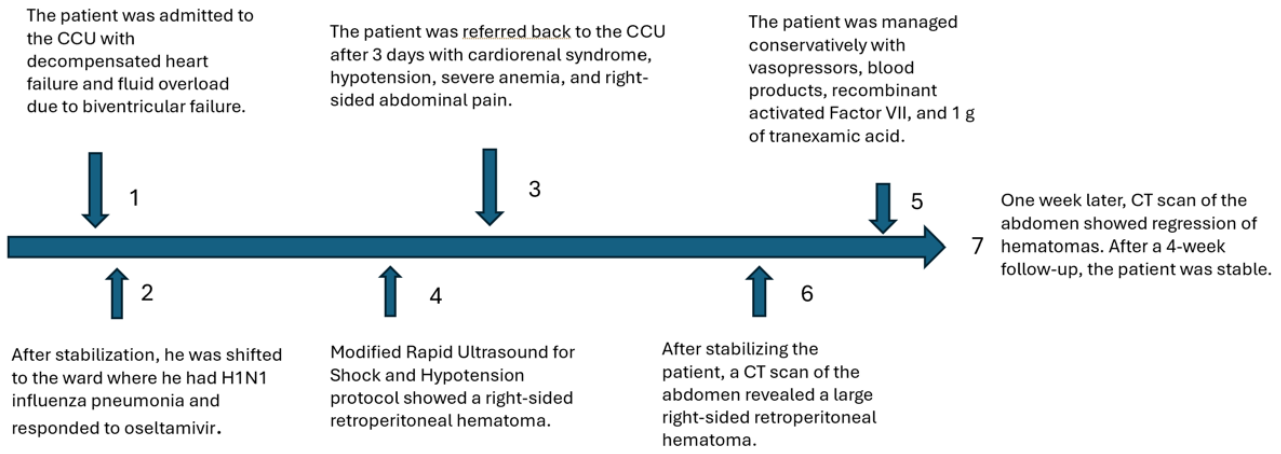


Figure 3. Case summary. Abbreviations: CCU, critical care unit; CT, computed tomography.

wide-complex tachycardia, which aborted spontaneously; he was subsequently given 2 g of IV magnesium sulphate. In view of persistent volume overload, the plan, discussed with the family, was to initiate haemodialysis to achieve ultrafiltration of 2–3 litres. On day 3 after continuous venovenous hemofiltration, the patient was weaned from the ventilator and extubated. One week later, CT scan of the abdomen showed regression of hematomas, and the patient was started on clopidogrel alone. After a 4-week follow-up, the patient was stable, receiving regular dialysis, and had no further complaints. The case summary is shown in *Figure 3*.

DISCUSSION

Spontaneous retroperitoneal hematoma (SRH) is bleeding into the retroperitoneal space without trauma or invasive intervention, or in patients on anticoagulation or antiplatelet therapy, as the retroperitoneum is a highly vascular space[4]. The median age of reported SRH cases is approximately 70 years[5]. The most important risk factor is that the patient is on anticoagulation or antiplatelet therapy with a chronic medical condition. Patients with chronic medical conditions, such as abnormal coagulation, hypertension, and renal disease, are at an increased risk of developing an SRH[6]. Our patient had all the risk factors of age, chronic conditions, and concomitant use of apixaban and clopidogrel.

In a systematic review, POCUS demonstrated high sensitivity and a positive likelihood ratio for identifying the aetiology of shock, particularly in cases of obstructive shock. It is unclear whether the use of POCUS truly improves patient outcomes[7]. The RUSH protocol is a cornerstone in the assessment of critically ill patients with acute circulatory failure and shock[8]. The extended Focused Assessment with Sonography in Trauma (FAST) examination, which is part of the RUSH protocol, is used to assess the "leakiness of the tank." The leakiness of the tank involves identifying internal blood loss, including bleeding into the pericardial, peritoneal, pleural cavities, diffuse fluid leakage, or other atypical fluid collections[8]. Traditionally, the FAST exam targets the anatomical zones: the pericardium, the pleural spaces, the right and left upper quadrants, and the pelvic region. In the present case, however, we adapted the conventional RUSH methodology by altering probe placement. Specifically, the transducers for the upper quadrants were repositioned to access the posterior thoracoabdominal interface. This modification enabled visualization of the retroperitoneal compartment, thereby enhancing the ability to detect occult fluid accumulation.

This focused diagnostic extended examination is valuable for patients who are hemodynamically unstable and have unclear sources of bleeding. A prime example includes individuals taking dual antiplatelet agents or oral anticoagulation who present with abdominal pain and a drop in their haemoglobin levels. By including views of the posterior thoracoabdominal junction, this expanded RUSH protocol significantly enhances our ability to detect a hidden or elusive retroperitoneal haemorrhage.

Management of SRH is usually conservative, including volume replacement, vasopressor support, packed red blood cells and other blood products, and reversal of anticoagulation[9]. Angiographic intervention with possible embolization of the bleeding sites is reserved for shocked patients without response to resuscitation, ongoing transfusion requirement, expanding hematoma, or active contrast extravasation on CT imaging[6].

CONCLUSION

A modified RUSH protocol, including the retroperitoneal space, can help in early detection of the site of haemorrhage in a patient with unexplained haemorrhagic shock.

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