Brief Communication

Point of Care Ultrasound: An Invaluable Bedside Management Tool

Dr. Latif Raiyan Rahman[1]

[1.] Consultant, Acute Internal Medicine, University Hospitals of Leicester.

Point of Care Ultrasound(POCUS) is rapidly becoming an indispensable bedside tool in the management of acutely unwell medical patients. Its use has expanded vastly in the last few years with more and more clinicians developing the skill of using POCUS in their daily practice while working in acute settings. Particular use is noted in areas like emergency medicine, acute medicine and critical care medicine This article reviews the current use and future scope of use of POCUS in acute medicine.

What is POCUS?

Point of Care Ultrasound is the use of bedside ultrasound to assess the state of various organs in a focused manner to give a focused information to a select few questions. It varies from the traditional ultrasound in the following way:

Traditional Ultrasound	Point of Care Ultrasound
Done in a separate department	Done Bedside
Done by a separate team	Done by the team looking after the patient
Gives broad information on the area being scanned	Gives focused information against a select few questions on the area being scanned
More time consuming	Quick

The areas in which POCUS is being commonly used includes the following:

- Heart (often referred to as Point of Care Echo)
- Lungs
- Great Vessels(e.g Aorta, Inferior Vena Cava, Internal Jugular Vein, Carotid Artery)
- Lungs
- Abdomen
- Deep Veins
- Eyes (Optic Nerve)

Procedures: Vascular access (peripheral and central), Ascitic Tap and Drain, Pleural tap and Drain, Chest Drains, Lumbar Punctures

An overview of the Different Areas in which POCUS is used:

Heart:

Point of Care Heart Ultrasound may be used to give a qualitative estimation against the following questions:

- Contractility of LV? (hyperdynamic? impaired?)
- Contractility of RV? (impaired?)
- LV size? (dilated? underfilled?)
- RV Size? (enlarged?)
- Is there any pericardial effusion? Any features to raise suspicion of pericardial tamponade? Stroke Volume assessment? Is the stroke volume responsive to fluids? (through a sonographic marker called VTI and VTI variation with respiration and with IV Fluids)

The above questions can be invaluable in understanding the etiology behind haemodynamic instability and shock (for e.g cardiogenic/hypovolemic/obstructive/distributive) and in fluid status assessments for patients where this is necessary (e.g AKI, hyponatremia).

It is notable that point of care heart ultrasound does not routinely comment on regional wall motion abnormalities or valvular function but increasing expertise in this field can enable physicians to do so as well.

Lungs:

Point of Care Lungs Ultrasound may be used to comment on the following:

- Is there any Pleural effusion
- Is there any Consolidation/lower respiratory tract infection?
- Is there any evidence to suggest Pulmonary oedema? (this often needs concurrent point of care echo)
- Is there any evidence to suggest Pneumothorax?

The above can be invaluable to understand the etiology behind hypoxia and any respiratory status dysfunction.

Abdomen:

Point of Care Abdomen Ultrasound may be used to comment on the presence or absence of the following:

- Hydronephrosis
- Distended Bladder
- Intra abdominal free fluid (e.g ascites)
- The above can be of invaluable importance in various pathologies including:
- AKI (bilateral hydronephrosis or a distended may suggest post renal AKI)
- Abdominal trauma (e.g haematoma)
- Acute Abdomen (any free fluid may suggest an acute intra abdominal inflammatory process) Ureteric colic (hydronephrosis may suggest calculi in the urinary tract)
- Urinary retention (distended bladder)
- Urinary catheter malfunction (distended bladder even with the catheter in situ)

It can be extended, in case the right skill set is present, to comment on the biliary tract and liver and spleen size and for any obvious gross abnormalities in the liver parenchyma.

Vascular Ultrasound:

Point of Care Vascular Ultrasound may be used to confirm the presence of Deep Vein Thrombosis of the lower extremity vessels with great accuracy. The limitations of POCUS however means that a DVT cannot be ruled out with 100% sensitivity, meaning that an absence of DVT on POCUS cannot fully confirm that a DVT is indeed not present.

In case the correct skillset is available, POCUS can also be used to comment on the presence of DVT in the upper extremity vessels but this is much more difficult and on the presence of haematomas in the upper or lower limbs.

Great Vessels:

POCUS can be used to scan the great vessels and this can yield valuable information as described below:

Aorta: Any obvious evidence of aortic dissection? Any aortic aneurysm? (However, it must be remembered that POCUS is not 100% sensitive to reliably rule out these pathologies)

Inferior Vena Cava: Is the IVC underfilled, suggesting hypovolemia? Is the IVC distended and non collapsible with respiration, suggesting systemic venous congestion? These answers are invaluable in assessing the fluid status of patients in cases where fluid status assessment is of great importance (e.g patients with haemodynamic instability, AKI, hyponatremia, etc).

The size and collapsibility of IVC with respiration can guide whether a patient with haemodynamic instability will respond to IV fluids.

Internal Jugular Vein: POCUS can be used to scan the IJV and comment on the 'sonographic JVP' which is far more accurate than conventional ways to measure JVP at the bedside. This is an invaluable measure in assessing patients' fluid statuses. In addition, the variation in diameter of the JVP with respiration can be invaluable in assessing the fluid responsiveness of patients with haemodynamic instability.

Hepatic/Portal/Renal Veins: POCUS of these vessels can be used as an additional potent marker to confirm and assess the degree of systemic venous congestion in patients who are suspected to be fluid overloaded. POCUS of these vessels, along with IVC POCUS, can be used together to put together a composite score called the VEXUS score which can then quantify the degree of fluid overload. This can be invaluable in assessing the response to diuretics in patients with fluid overload. Equally, a serial VEXUS score can be used to detect early organ congestion in patients who are being given IV fluids for whatever reason.

Eyes:

- POCUS can be used to comment on the optic nerve sheath diameter which is a validated tool to screen for the presence of raised intracranial pressures.
- The above can be of invaluable importance in the assessment of patients with headache as well as in the management of any patients where raised intracranial pressures is a possibility.
- If the correct skillset is available, it can also be used to comment on the presence of pathologies like retinal detachment, lens dislocation and vitreous hemorrhage.

Procedures:

POCUS is an invaluable tool in various medical procedures including:

Pleural procedures (diagnostic and therapeutic pleural tap) Chest Drain

Ascitic tap and drain

Vascular access (peripheral and central)

Lumbar Puncture

POCUS helps identify the correct anatomy, helps make the procedures a lot safer and also decreases the frequency of procedure-failure as well.

Accreditation, Governance and Regulation of Training in POCUS:

POCUS is often used as a valuable assessment and management tool in acutely unwell patients to provide high-stake information about the patient's condition which can then have a powerful impact on the way patients are managed. Hence it is of utmost importance that POCUS is done by appropriately skilled clinicians. To facilitate the training of clinicians in POCUS for clinicians in an accountable and structured manner and to ensure that there is appropriate governance in place to regulate this training and subsequent practice, it is very important that there are appropriate organizations who can oversee this regulation and governance. These organizations would be responsible for drawing up a national curriculum on POCUS, design the training process, facilitate an appropriate structure for training, assess training, arrange a process for accreditation, and subsequently ensure that this accreditation can be maintained in a way where there is no deskilling post accreditation.

An example of the above can be seen in the way the Society for Acute Medicine (SAM), UK, has designed and regulates the Focused Acute Medicine Ultrasound (FAMUS) curriculum in UK or the way the Intensive Care Society (ICS) of UK has designed and regulates the Focused Ultrasound in Critical Care (FUSIC) curriculum and accreditation process.

CASE STUDIES:

The below illustrates a few case studies which depict the role and importance of POCUS in managing patients with acute medical conditions:

Case 1:

An elderly gentleman presents with sudden onset acute shortness of breath for 1 day on a background of ongoing worsening of breath for last 1 month. Examination reveals him to be severely hypoxic, tachypneic and having a high work of breathing. He is haemodynamically stable and is noted to have normal heart sounds, no gallop rhythm, regular pulses and bilateral basal crepitations. His JVP is raised at 2 cm and he has bipedal oedema.

A provisional diagnosis of heart failure is made and a chest X ray is ordered which shows mild bilateral pulmonary congestion. Because neither the clinical examination nor the chest X ray is enough to explain that heart failure is the sole reason behind the sudden deterioration over a short duration of one day and the severe hypoxia and tachypnoea, a point of care ultrasound and echo is done which shows significant Right ventricular dilation, RV impairment, and mild pulmonary oedema. In the context of the POCUS findings, an urgent CTPA is requested which shows bilateral extensive pulmonary embolism.

Case 2:

A middle aged woman with a background of heart failure presents with hyponatremia with a Na level of 115. She has been recently started on diuretics for her heart failure (furosemide, spironolactone). Clinically, she has high BMI and is noted to have bipedal oedema. Her skin is deemed to be 'dry'. JVP and lung assessment is difficult due to body habitus. A chest X ray is ordered to help with volume assessment and that does not show any pulmonary oedema but shows mild bilateral basal pleural angle blunting (longstanding for her).

A provisional diagnosis of diuretic induced hyponatremia is made and her diuretics are stopped. However, her Na keeps on falling further. A point of care ultrasound and echo is done which shows the following features: Severe biventricular impairment and left ventricular dilation.

- Distended Inferior Vena Cava with minimal respiratory variation
- Distended Internal Jugular Vein upto 5 cm
- Evidence of hepatic and portal venous congestion
- Bilateral pleural effusion and mild bibasal pulmonary congestion

Based on the above POCUS findings, she is deemed to have fluid overload and her hyponatremia is deemed to be hypervolemic in nature. As such, her diuretics are restarted and the dose increased. Her Na gradually gets better after the diuretic increase.

Case 3:

A middle aged man presents with a unilateral leg swelling after having a recent angiography involving femoral vein access. Examination reveals a uniformly swollen right leg but no bruising of the overlying skin. DVT is a suspected diagnosis and he is started on empirical treatment dose low molecular weight heparin and an urgent doppler leg scan is requested, which is scheduled to happen 2 days later. He has an interim point of care leg ultrasound which shows no evidence of DVT but shows a large haematoma. Based on the POCUS findings, his leg swelling is deemed to be secondary to haematoma, his LMWH is immediately stopped and an urgent departmental scan arranged which confirms the haematoma and rules out DVT. He is managed appropriately.

Case 4:

An elderly lady presents with haematuria and is catheterised. During the course of the admission, she is noted to have a large drop in her hemoglobin as well as a rapidly declining renal function. Her catheter is noted to have a poor drain output. A point of care ultrasound of her abdomen is done which shows a severely distended bladder with the bladder constituents showing mixed echogenicity suggesting bloody constituents of the bladder. She is also noted to have bilateral hydronephrosis.

As such, based on the POCUS, she is deemed to have:

- A. Clot retention secondary to haematuria causing bladder blockage.
- B. Drop in Hb secondary to haematuria
- C. Severe AKI secondary to urinary tract obstruction secondary to clot retention (post renal AKI).

As such, she has bladder irrigation under the guidance of the urologists and also has appropriate management for her haematuria under the urologists' guidance. Her renal function improves steadily.

Case 5:

A middle aged man with a background history of IHD presents with fever and shortness of breath for 3 days. On arrival, he is noted to be severely hypoxic, tachypnoeic and also found to have haemodynamic instability with hypotension, tachycardia and poor peripheral perfusion. He is noted to have crepitations bilaterally and a chest X ray shows bilateral pulmonary infiltrates. JVP is not assessable and he is noted to have chronic leg swelling due to amlodipine.

He is deemed to be in volume overload secondary to heart failure and is also deemed to have sepsis. Due to this, he is not provided further IV fluids rather is referred to ITU for inotropic support.

A POCUS is performed which shows the following: Hyperdynamic Left ventricle.

Underfilled left ventricle

Collapsed IVC

Collapsed Internal Jugular vein

Diffuse bilateral B lines and bilateral consolidation. Parapneumonic effusion right side.

Based on the above POCUS findings, he is deemed to have sepsis secondary to pneumonia and his haemodynamic instability is deemed to be due to hypovolemia and sepsis. As such he is resuscitated with IV fluids alone and does not end up needing inotropes. His condition improves with correct treatment with antibiotics and IV fluids and other sepsis management.

Conclusion:

In conclusion, POCUS is a potent bedside assessment and management tool, particularly in acute medicine, emergency medicine and critical care medicine. It significantly improves the accuracy of assessment when applied in the correct clinical context. It can be done in a rapid manner, in the patent's bedside and can add valuable information in various clinical contexts like haemodynamic instability, respiratory failure, AKI, hyponatremia, and other acute medical settings. But for POCUS to be used in an appropriate manner, it is vital that doctors practicing POCUS are appropriately trained in an accountable manner and there is an appropriate governance system in place to monitor and regulate the accuracy and scope of their practice.