EDITORIAL

Bedside Ultrasound: Ideal Diagnostic Approach for Patients with Undifferentiated Shock?

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Shock is defined as a state of acute circulatory failure leading to decreased organ perfusion, with tissue hypoxia due to reduced oxygen delivery, increased oxygen consumption or inadequate oxygen utilization.[1] The effects of shock on end-organs are reversible if appropriate therapy can be administered early before multi-organ failure (MOF) sets in. Shock is classified as hypovolemic –due to fluid loss and hemorrhage, distributive-as in septic, anaphylactic, toxic, neurogenic or endocrine causes, cardiogenic due to-myocardial failure, arrhythmias, valvular disease, and obstructive as in-pulmonary embolism, cardiac tamponade and pneumothorax. At times patient can have more than one reason for shock. While there are adequate studies on specific types of shocks individually, there is limited data on epidemiology of different types of shock in adult patients presenting in emergency department. Available information from pediatric data suggests that septic shock and hypovolemic shock are commonest followed by cardiogenic, obstructive and anaphylactic.[2,3] Patients with no clear cut history of pre-existing illness or precipitating event and obvious clinical findings of cause are considered as having undifferentiated shock.

Goal in management is to recognize shock and quickly identify and treat the cause and stabilize patient. Shock index (SI) of >0.5-0.8, calculated as heart rate divided by systolic blood pressure, is more accurate predictor of shock than hypotension and tachycardia alone.[4] Classically cool extremities, low BP, raised jugular venous pressure (JVP) and lung crepitations are characteristics of cardiogenic shock. Obstructive shock has clear chest and may have signs of cardiac tamponade. Hypovolemic shock is characterized by tachycardia, low JVP and signs of dehydration. Septic shock has initial warm shock due to hyperdynamic circulation, followed by cold sock. But, clinical assessment alone is not always sufficient to classify shock. A study that compared JVP measured by cardiologists to right atrial pressures measured by a pulmonary arterial catheter in 96 patients found an elevation over the clavicle to be only 65% sensitive and 85% specific.[5] A number of laboratory tests are typically performed after initial stabilization with fluids, oxygenation and vasopressor administration but there is no test that is confirmatory of diagnosis. Elevated lactate levels and metabolic acidosis are seen in all patients with significant shock. Leukocytosis, elevated CRP are common findings in septic shock but not specific. Chest X ray and ECG are done in most patients, but are confirmatory of etiology in limited number of patients. Some of the specific investigations like angiography, 2D echo with color Doppler, for cardiogenic shock and CT pulmonary angiography for pulmonary thrombo-embolism (PTE) are either time consuming, invasive and may involve shifting critically ill patient elsewhere and do not serve the purpose in setting of shock. Radiological tests using contrast are harmful in patients with renal failure. Laboratory tests for markers of heart failure and sepsis like N-terminal pro b-type Natriuretic Peptide (NT-BNP), procalcitonin (PCT) are frequently used but have limited therapeutic application and are more useful for prognosis rather than diagnosis.[6] Hence, evaluation by bed-side investigation which is not time consuming or invasive is ideal.

Point of care (POC) ultrasound with RUSH (Rapid Ultrasound in Shock) protocol involves a 3-part bedside physiologic assessment of heart first, followed by ultrasound of the chest and abdomen and major blood vessels simply defined as "the pump," "the tank," and "the pipes".[7] When performed by trained personnel this serves as a quick diagnostic tool in critically ill patients with undifferentiated shock to classify them in broad categories and guide fluid therapy, vasopressor administration and even for therapeutic procedures like pericardiocentesis in cardiac tamponade. In this issue of journal, Tanvi Vaidya, et al have evaluated ultrasound as a tool to classify shock based on findings of cardiac, lung and abdominal parameters, performed within 1 hour of admission to ICU.[8] They have selected patients with clinically undifferentiated shock and compared ultrasound based diagnosis with subsequent diagnosis based on clinical, biochemical parameters and other specific tests. Individual ultrasound parameters that predicted type of shock are also evaluated. In this study ultrasound showed maximum sensitivity, specificity, negative and positive predictive values in the setting of obstructive shock and least in distributive shock. However, clinical and biochemical parameters, used as "gold standard" cannot always accurately differentiate between types of shock and at times there can be overlap-as in hypovolemic and distributive shock, which formed majority of shock patients in this study. Also, evaluation should begin earlier in emergency department (ED) as sometimes there is considerable time lapse before patient is shifted to ICU. Overall ultrasound helped in early classification of type of shock and forming management strategies and authors have rightly recommended use of ultrasound as modality of first choice for assessment of patients with undifferentiated shock. Its utility on patient's outcome should be assessed in future studies.

In summary, POC ultrasonography is portable, inexpensive, rapid and

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safe modality of diagnosis that does not expose the patient to ionizing radiation. It helps to narrow the differential diagnosis and identify a potentially treatable etiology for patients with clinically undifferentiated shock. In a prospective observational study of 110 critically ill patients with undifferentiated shock, the use of ultrasound was associated with reduced infusion of intravenous fluids, increased administration of vasopressors, and improved 28-day survival.[9] Major disadvantage of POC ultrasonography is its limited sensitivity for many of the etiologies associated with shock like pulmonary embolism that necessitates other definitive investigations to rule out PTE in critically patients.[10,11] Due to bed-side availability, speed, noninvasive nature and its ability to provide repeated assessment of physiology during resuscitation, this modality has now found a place into resuscitation protocol in emergency department to augment clinical evaluation and guide resuscitation of shock patients.[12] In India, efforts are going on towards training doctors working in emergency department for performing emergency ultrasound with a short 4 days workshop so that the knowledge can be applied to managing critically ill shock patients in both trauma and non-trauma setting.[13] But clinicians must realize that many forms of shock may coexist in a given patient. For example, hypovolemia may be present along with cardiogenic shock and may result in discordant hemodynamic features. In such cases, therapeutic response to empiric therapies (fluid challenge) may allow the clinician to determine which form of shock is predominant. While septic shock is the most common cause of distributive shock, other causes requiring totally different therapy like anaphylaxis, neurogenic shock, liver failure and adrenal insufficiency can present with similar physiological derangements and this needs to be determined clinically. Also, sepsis can present with characteristics of distributive, hypovolemic, and even cardiogenic shock.[14] Clinicians have to consider broad differential diagnosis while evaluating patients with distributive pathophysiology to avoid missing treatable options. Bed side ultrasonography should be used as complimentary to clinical evaluation, keeping in mind its limitations in evaluating undifferentiated shock patients presenting in ED.

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