ORIGINAL ARTICLE

Lung Ultrasound Using KH Screening Tool in Undifferentiated Shock Patients Arriving to ER

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Abstract

Background: Detection of various types of shock in patients presented to the emergency department for early resuscitation and management with the use of lung ultrasound at the patient's bedside.

Aim: The study aimed to evaluate the undifferentiated shock patients presented to the emergency department by using the KH screening tool in our hospital.

Materials and methodology: All patients who presented to the emergency room (ER) with undifferentiated shock were included in this study. The KH screening tool was performed on the patient by the emergency physician taking of the patient. This study was single-centre prospective diagnostic study conducted in our hospital using the KH screening tool.

Results: This study included 159 patients who presented to our emergency department. The KH screening was found to be >90% accurate in identifying patients with undifferentiated shock. In our study, of the cases, 41% fall into the 61–70 age group, 27% fall into the 51–60 age group, 13% fall into the more than 70 age group, 12% fall into the 41–50 age group, and only 8% fall into less than 40 age group, 73% of the patients were males and 27% were females and 71% of the patients in whom the KH screening tool was performed has been discharged after appropriate treatment.

Conclusion: The use of the KH screening tool was successful in the majority of the patients for it was performed. The KH screening tool was easy, quick and done at the patient bedside in identifying the undifferentiated shock patients who presented to our emergency department.

Keywords: Bedside lung ultrasound in emergency protocol, Emergency department, Extended focused abdominal sonogram for trauma, Fluid administration limited by lung sonography protocol, KH screening tool, Rapid ultrasound in shock protocol, Undifferentiated shock.

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Introduction

Because shock is the most common cause of death worldwide, the most important aspect of care is early recognition and response to restore perfusion. Assessing the patient in shock can be difficult due to its intricate pathophysiology and wide range of overlaid clinical signs. The emergency physician must determine the type and cause of shock to devise an emergency management strategy to avoid a negative outcome. Our study aims to define the role of emergency bedside lung ultrasound in the assessment of a patient in shock. In our emergency department, we conducted a prospective study using bedside lung ultrasound to evaluate patients admitted with undifferentiated shock using the KH hospital screening tool, which included the bedside lung ultrasound in emerge (BLUE) protocol, fluid administration limited by lung sonography (FALLS) protocol, rapid ultrasound in shock (RUSH) protocol, and extended focused abdominal sonogram for trauma (E-FAST) (Flowchart 1).

Materials and Methodology

Design

This is a prospective observational study.

Setting

This study was conducted in 159 patients arriving at the emergency department from January 2021 to September 2023.

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Conflict of interest: None

Inclusion Criteria

Age >18 years with features of sepsis were included in the study.

Exclusion Criteria

Age <18 years and patients who were not willing were all excluded from the study.

KH Screening Tool Components

The BLUE protocol, is used to identify the cause of acute dyspnoea using lung ultrasound at the patient's bedside. This is the

Flowchart 1: KH screening tool

BLUE Protocol – Look for lung sliding, if present – Pulmonary embolism; if absent – Pneumothorax; if both (lung point) – Pneumonia and also to check for PLAPS point.

FALLS Protocol – Acute circulatory failure; follows BLUE protocol; assess for fluid responders-hypovolemic shock and non-fluid responders-distributive shock (sepsis).

RUSH Protocol – The PUMP – To assess the cardiac function and fluid collection around the heart; The TANK – To assess the inferior vena cava for fluid therapy and jugular veins to measure the right atrium pressure; The PIPE – To assess the aorta for rupture or clot to rule out deep vein thrombosis, aortic aneurysm or dissection.

E-FAST Protocol – To assess the free fluid in traumatic and non-traumatic patients. The areas of E-FAST are right and left upper quadrant, pelvis and right and left lungs to rule out free fluid Morison's pouch, perisplenic space, rectovesicle pouch or pouch of douglas, pleural effusion respectively.

simplified method for pulmonary oedema, asthma or COPD and pneumothorax using the BLUE points with a sensitivity of >88%.

The FALLS protocol for the management of undifferentiated shock. The main advantage of this protocol is to rule out the types of shock by fluid correction for hemodynamic stability.

The RUSH protocol, with physiological assessment in 3 steps (the assessment of pump, tank and pipes). The pump to evaluate the heart, for the existence of pericardial effusion, and right ventricular strain; the tank for the evaluation of inferior vena cava and jugular vein size for fluid administration to correct the hemodynamic instability by compressibility index; the evaluation of the pipe, whether the pipes are ruptured or clogged. For example, Aortic aneurysm and aortic dissection, or clot in pipes to rule out venous thromboembolism.

The E-FAST protocol in trauma patients for assessing free fluid in intra-abdominal including pelvic/intra-thoracic/cardiac tamponade in five quadrants; right and left upper abdominal quadrant, cardiac, pelvic and lungs.

Results

Out of 159 cases, 41% of the cases are in the 61–70 age group, 27% of the cases are in the 51–60 age group, 13% in the >70 age group, 12% are in the 41–50 age group and only 8% in <40 age group.

73% of the patients are males and 27% of the patients are females in our study.

Out of 159 cases, the most common co-morbidities were diabetes mellitus in 147 patients; with the next 11 patients of COPD; 10 patients with systemic hypertension, chronic kidney disease and thyroid disorder; 8 cases of coronary artery disease; 7 cases of bronchial asthma and 6 cases of cerebrovascular attack (Fig. 1).

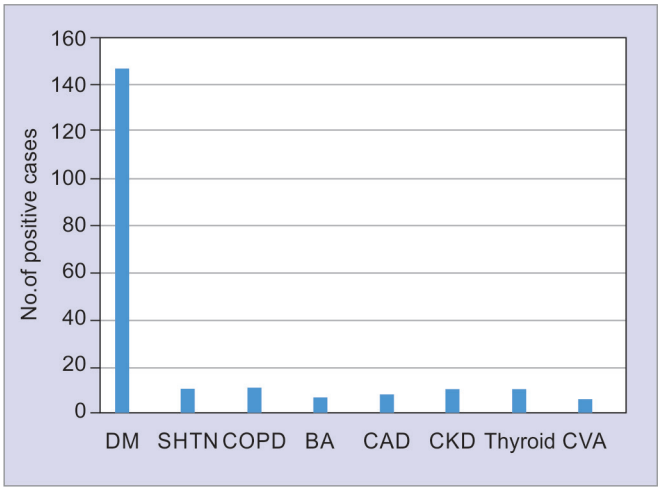

Fig. 1: Co-morbidity

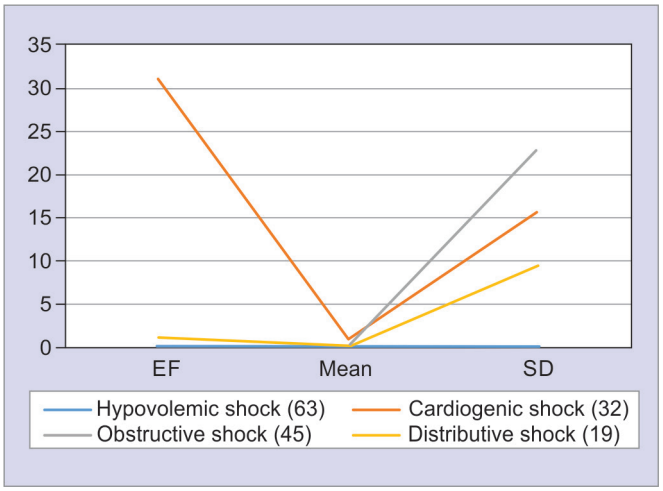

Fig. 2: Diagnosis vs RUSH-EF

By investigations, Arterial blood gas analysis of pH and lactate level; 45% of cases in pH of 7.0–7.9, 6% of cases in 5.0–5.9 pH, 66% of cases in less than 2.0 lactate level, and 29% of cases in more than 9 lactate level.

By diagnosis distribution, 63 cases of hypovolemic shock, 45 cases of obstructive shock, 32 cases of cardiogenic shock and 19 cases of distributive shock.

By ultrasound protocol, 34 positive cases in BLUE protocol; 49 positive cases in FALLS protocol; ejection fraction (EF) of less than 20 in 3 cases of RUSH protocol and IVC compressible in 41 cases of RUSH protocol; and 47 positive cases in E-FAST protocol.

By diagnosis vs BLUE protocol, the *p* value is not significant in hypovolemic, cardiogenic, obstructive and distributive shock.

By diagnosis vs FALLS protocol, the *p* value is not significant in hypovolemic, cardiogenic, obstructive and distributive shock.

By diagnosis vs RUSH protocol, the p value is null in hypovolemic and cardiogenic shock; and not significant in obstructive and distributive shock (Figs 2 and 3).

By diagnosis vs E-FAST, the *p* value is not significant in hypovolemic, cardiogenic, obstructive and distributive shock.

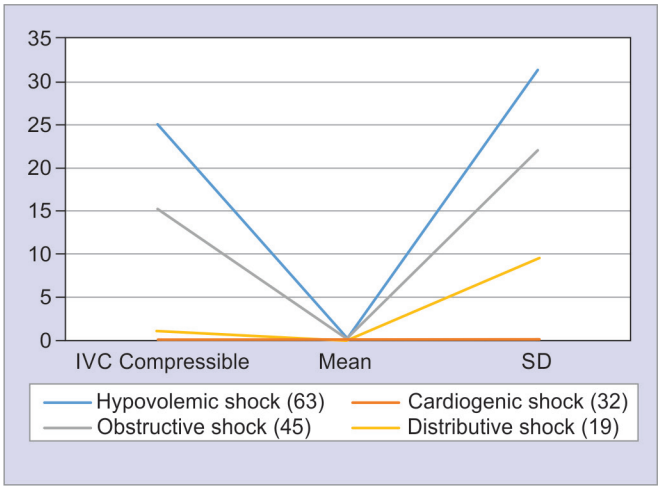

Fig. 3: Diagnosis vs RUSH–IVC compressible

By outcome, 71% of the patients have been discharged; 12% of the patients went against medical advice; and 17% of the patients were dead. In these 52 cases in hypovolemic shock have been discharged, 4 went against medical advice and 7 were dead; 21 cases in cardiogenic shock have been discharged, 6 went against medical advice and 5 were dead; 10 cases in distributive shock have been discharged, 3 went against medical advice and 6 were dead; 30 cases in obstructive shock have been discharged, 6 went against medical advice and 9 were dead.

Discussion

In this study, the A lines/A profile of the lung ultrasound was done using the KH screening tool which was found to be positive in 30.81% of the patients. In which the hemodynamic stability of these patients were assessed and found to have decreased blood pressure due to volume loss and sepsis. Lichtenstein et al.,[1,2] stated hemodynamic assessment of shock using lung ultrasound (FALLS protocol) with positive A-lines in identifying hypovolemic shock and showed 93% specificity. It has many advantages as a simple, bedside to assess the volume status of the patient in shock, less time and can be performed even in an insufficient equipment setting. The B line/B profile of the lung ultrasound was done using the KH screening tool which was found to be positive in 21.38% of patients in our study. These patients had laboured breathing and the cause was ruled out by bedside lung ultrasound in which patients were found to have pulmonary oedema in our study. Lichtenstein et al.[3–7] stated that the BLUE protocol and use of lung ultrasound in acute respiratory failure diagnosis in 260 patients admitted to the intensive care unit (ICU) as an observational study with A-line and lung siding predicted asthma (sensitivity of 89% and specificity of 97%); diffuse B-lines with lung sliding predicted pulmonary oedema (sensitivity 97% and specificity 95%); typically normal anterior profile with deep vein thrombosis (DVT) stipulated pulmonary embolism (sensitivity 81% and specificity 99%); and absent lung sliding represented pneumothorax (sensitivity 81% and specificity 100%). The EF and inferior vena cava (IVC) compressibility were done using the KH screening tool to rule out the cardiac status of the patient, which was 25.7% and 21.38% respectively in our study.[8–11] Tanvi et al.,[12] stated ultrasonographic findings in different types of shock which showed the presence of hypovolemic shock of 71.8% in hyperdynamic heart, 90% A-profile of the lung, 100% inferior vena cava (IVC) collapsibility; the distributive shock of 71.8% in normal left ventricular function contractility, 79.5% A-profile of lungs, 79.5% IVC collapsible; the cardiogenic shock of the hyperdynamic left ventricle in all the patients, 81.1% B-profile of lungs; the obstructive shock of 60% in right ventricular strain patients and 40% in cardiac tamponade patients. Mohammad Reza Ghane et al.,[13] stated RUSH assessment and its precision in different types of shock which comprised 77 patients in Iran tertiary care centre using kappa value between initial and final diagnosis after the RUSH examination. The free fluid accumulation surrounding the heart, in abdominal and pelvic cavities and also in the lung regions using the KH screening tool was done to rule the cause of undifferentiated shock which was positive in 29.55%. Dorothy Habrat[5] stated E-FAST is the best ultrasonographic examination in trauma patients for identifying free fluid surrounding the heart, in the abdominal cavity, pelvis and also in the lung region. Sasmaz MI et al.,[14] researched the POCUS protocol. 180 patients from Turkey's emergency room (ER) participated in this study. The purpose of this study was to use ultrasound to compare the initial and final diagnoses.

Limitations

The limitations of this study were single-centred with less sample size and the observers were not blinded to the clinical presentation of the patient.

Conclusion

To conclude the study, the KH screening tool helped identify the patients with undifferentiated shock presented to the Emergency Department and has proved to be successful in the majority of the patients in whom it was performed. The KH screening tool is quick, easy and done at the patient's bedside and had shown greater outcomes in patients with undifferentiated shock in whom radiological imaging such as X-computed tomography (CT) is needed to rule out the cause and arrive at the diagnosis and appropriate management to the patient.

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