

Introduction

Septic shock, a subset of sepsis with circulatory and metabolic dysfunction, carries a high mortality rate due to profound vasodilation, tissue hypo perfusion, and organ failure. It arises from dysregulated host responses, progressing through inflammatory, immunosuppressive, and mixed phases. Early recognition using multiplescoring systems like Sequential organ failure assessment with aggressive resuscitation-including fluid therapy, vasopressors, and antibiotics—are critical to improve outcomes. Lung ultrasound (LUS) plays a key role in evaluating septic shock patientslike Bed side lung ultrasound in emergency (BLUE) and Fluid administration limited by lung sonography (FALLS). Lung ultrasound scores like classical and modified scores (cLUSS, mLUSS) help quantify lung aeration loss and guide fluid management. However, assessing fluid responsiveness remains challenging, with IVC ultrasound providing limited reliability. Integrating LUS with hemodynamic monitoring improves septic shock management, though further research is needed to refine protocols and optimize outcome.

Aim of the Work

The goal of this cohort study was to assess the utilization of critical care lung ultrasound score in managing and predicting outcome in mechanically ventilated septic shocked patients.

Patients and Methods

This prospective cohort study enrolled 70 mechanically ventilated adultpatients with septic shock (per Sepsis-3 criteria: qSOFA ≥2, lactate >2 mmol/L, vasopressor-dependent) admitted to Alexandria Main University Hospital’s ICUs. Exclusion criteria included obesity, chest wall injuries, decompensated heart failure, renal impairment, and pregnancy. Patients underwent comprehensive assessment, including:

- Clinical evaluation (GCS, hemodynamics, respiratory status).
- Laboratory tests (CBC, renal/liver function, CRP, ABG).
- Scoring systems (APACHE II, SOFA).
- Imaging (chest X-ray, echocardiography for IVC distensibility).
- Serial lung ultrasounds (LUS) at 0, 6, and 24 hours using the modified Lung Ultrasound Score (mLUSS) to assess aeration changes post-resuscitation.

Primary outcomes were 7- and 28-day mortality, while secondary outcomes included ICU stay duration, ventilator days, and vasopressor dependence. The study aimed to correlate mLUSS trends with clinical outcomes, optimizing fluid and vasopressor management in septic shock. Ethical approval and informed consent were obtained.

Results

The study revealed statistically significant differences in clinical outcomes between non-survivors and survivors. Non-survivors exhibited higher modified Lung Ultrasound Scores (mLUS) (20.72 ± 4.17 vs. 12.87 ± 3.72 , prolonged mechanical ventilation (11.15 ± 3.77 vs. 8.13 ± 3.26 days, longer ICU stays (17.0 ± 3.69 vs. 12.58 ± 3.80 days, and extended hospital stays (20.33 ± 2.64 vs. 16.90 ± 3.22 days, compared to survivors, as summarized in Table (1)

Table 1: Mean mLUS in Comparison between non- survived and survived regarding ICU stay, Hospital stay, MV days (n = 70).

	Not survived (n = 39)	Survived (n = 31)	Test of Sig	p
Mean mLUS				
Min. – Max.	11.0 – 30.0	5.0 – 18.0	t= 8.200*	<0.001*
Mean ± SD.	20.72 ± 4.17	12.87 ± 3.72		
Median (IQR)	20.0 (18.50 – 23.0)	14.0 (10.0 – 16.0)		
MV days				
Min. – Max.	3.0 – 18.0	3.0 – 15.0	t= 3.538*	<0.001*
Mean ± SD.	11.15 ± 3.77	8.13 ± 3.26		
Median (IQR)	11.0 (9.0 – 14.0)	8.0 (5.50 – 9.50)		
ICU stay				
Min. – Max.	7.0 – 23.0	6.0 – 18.0	U= 221.00*	<0.001*
Mean ± SD.	17.0 ± 3.69	12.58 ± 3.80		
Median (IQR)	17.0 (15.50 – 19.50)	14.0 (9.50 – 15.00)		
Hospital stay				
Min. – Max.	14.0 – 24.0	6.0 – 20.0	U= 237.00*	<0.001*
Mean ± SD.	20.33 ± 2.64	16.90 ± 3.22		
Median (IQR)	20.0 (18.50 – 22.50)	18.0 (15.50 – 19.00)		

IQR: Inter quartile range
SD: Standard deviation
t: Student
t-test
U: Mann Whitney test
p: p value to compare between
the two studied groups
*: Statistically significant at p
≤ 0.05

Regarding the Receiver Operating Characteristic (ROC) curve of our study it showed that the mLUS can predict mortality among septic shock patients at AUC=0.942 and cut off value > 18 with 100% specificity and 74.36% sensitivity and predict mortality among septic shock patients at cut off value > 16 with 80.65% specificity and 87.18% sensitivity. Lastly at cut off value > 12 with 38.71% specificity and 97.44% sensitivity as visualized in Table (2) and Figure (1)

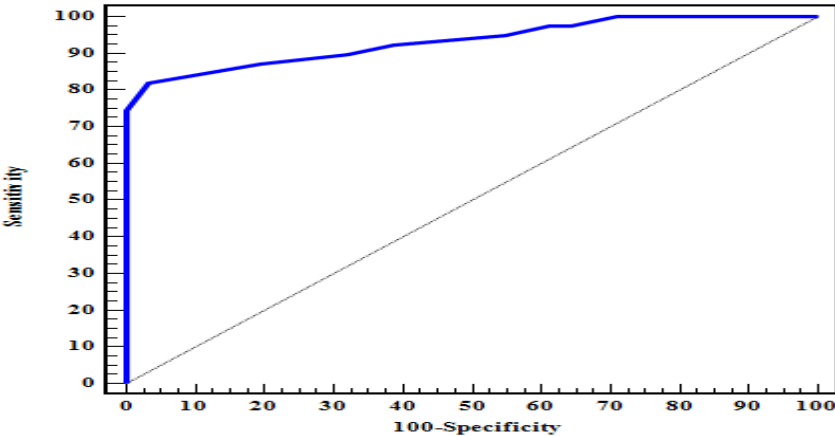


Figure 1:
ROC curve for Mean mLUS
in predicting outcome

Table 2: Prognostic performance for Mean mLUS in predicting outcome (n=70).

	AUC	p	95% C.I	Cut off	Sensitivity	Specificity	PPV	NPV
Mean mLUS	0.933	<0.001*	0.876 – 0.990	>18	74.36	100.0	100.0	75.6
				>16	87.18	80.65	85.0	83.3
				>12	97.44	38.71	66.7	92.3

AUC: Area Under a Curve
CI: Confidence Intervals
PPV: Positive predictive value
*: Statistically significant at p ≤ 0.05

p value: Probability value
NPV: Negative predictive value

Conclusion

- Early modified Lung Ultrasound Score (mLUSS) within 24 hours of mechanical ventilation effectively predicts outcomes in septic shock patients. A direct correlation exists between mLUSS and SOFA scores, reinforcing its utility in assessing disease severity. Higher mLUSS was associated with prolonged ICU/hospital stays, extended mechanical ventilation, and increased 7- and 28-day mortality. Additionally, an elevated IVC diameter (cutoff ≥2.08 cm) correlated with higher mortality, while elevated lactate, lower GCS, reduced MAP, and decreased urine output signaled worse prognosis.
- Adjusting mLUSS cutoff values allows tailored risk stratification-lower thresholds improve sensitivity for early detection, while higher thresholds enhance specificity for severe cases. These findings support mLUSS as a valuable bedside tool for prognostication and guiding resuscitation strategies in septic shock, complementing traditional markers like lactate and SOFA scores.