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Original Research Article

Early Point-Of-Care Lung Ultrasound Reduces Mortality in Patients with Acute Respiratory Distress in Resource-Limited ICU: A Prospective Observational Study

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Abstract: ***Background*:** Acute respiratory distress is a major cause of morbidity and mortality in critical care, particularly in resource-limited settings where access to conventional imaging is often delayed. Point-of-care lung ultrasound (POCUS) has emerged as a rapid, reproducible, and non-invasive bedside tool that enables early etiological assessment, guides timely therapeutic decisions, and may improve patient outcomes. We aimed to evaluate the effect of early POCUS on in-hospital mortality among patients admitted with acute respiratory distress to the intensive care unit of the Essos Hospital Center. ***Methods***: We performed a prospective observational study in the intensive care unit of the Essos Hospital Center. All consecutive adult (≥18 years) patients admitted with acute respiratory distress over a 12-month period were included. Patients were stratified into two groups based on whether early point-of-care lung ultrasound (POCUS) was performed within the first hour of admission by a trained physician. Demographic, clinical, echocardiographic, diagnostic, and outcome data were collected prospectively. The primary outcome was in-hospital mortality, and secondary outcomes included time to definitive diagnosis and identification of the primary etiology.

Keywords: Acute Respiratory Distress, Point-Of-Care Lung Ultrasound, Intensive Care Unit, Mortality.

INTRODUCTION

Acute respiratory distress (ARD) is a common and life-threatening condition in critically ill patients, representing a major cause of morbidity and mortality in intensive care units worldwide [1]. Rapid identification of the underlying cause is critical to guide timely and appropriate therapy, which can directly influence patient outcomes. In resource-limited settings, access to conventional imaging such as chest radiography or computed tomography is often delayed or unavailable, contributing to diagnostic uncertainty and treatment delays [2]. Point-of-care lung ultrasound (POCUS) has emerged as a rapid, bedside, non-invasive, and reproducible diagnostic tool. It enables early detection of key pulmonary pathologies, including alveolo-interstitial syndromes, pleural effusions, pneumonia, and pneumothorax, and allows clinicians to make faster, evidence-based therapeutic decisions [3, 4]. While studies from high-resource settings have demonstrated the diagnostic and management benefits of early POCUS, data on its impact on clinical outcomes in low- and middle-income countries remain limited [5]. Understanding whether early POCUS can reduce mortality and improve diagnostic efficiency in critically ill patients with ARD is essential for optimizing care in resource-constrained ICUs. This study aimed to evaluate the effect of performing lung ultrasound within the first hour of admission on in-hospital mortality and time to definitive diagnosis among adult patients admitted with acute respiratory distress to the intensive care unit of the Essos Hospital Center.

PATIENTS AND METHODS

We conducted a prospective observational study in the intensive care unit of the Essos Hospital Center, a first-category public hospital in Cameroon that

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provides emergency and critical care services to a large urban population. The study was carried out over a 12-month period, from February 2025 to February 2026. All consecutive adult patients aged 18 years or older admitted to the unit with acute respiratory distress were eligible for inclusion. Acute respiratory distress was defined using predefined clinical and physiological criteria indicating an acute impairment of respiratory function. Patients were considered to have acute respiratory distress when they presented with new-onset dyspnea or a rapid worsening of pre-existing dyspnea accompanied by objective signs of respiratory compromise. These included tachypnea, defined as a respiratory rate of ≥25 breaths per minute, and hypoxemia, defined as a peripheral oxygen saturation (SpO_2) of ≤92% while breathing ambient air or the need for supplemental oxygen to maintain adequate oxygen saturation. Clinical assessment also incorporated signs of increased work of breathing, including the use of accessory respiratory muscles, intercostal retractions, thoraco-abdominal asynchrony, or other indicators of respiratory distress. Patients were enrolled consecutively at the time of admission in order to obtain a representative cohort of critically ill adults presenting with acute respiratory distress. To assess the impact of early lung ultrasound on clinical outcomes, patients were stratified according to whether point-of-care lung ultrasound (POCUS) was performed within the first hour following admission. Lung ultrasound examinations were carried out at the bedside by anesthesiologist-intensivists trained in clinical ultrasound, using standardised lung ultrasound protocols. The decision to perform early POCUS was guided by the initial clinical assessment and reflected routine clinical practice in the management of acute respiratory distress in the unit.

Baseline demographic characteristics, medical history, presenting symptoms, and vital signs were prospectively recorded at admission. Laboratory results and available imaging findings were also collected. Lung ultrasound findings were documented in detail, including the presence of alveolo-interstitial patterns, pleural effusion, pneumothorax, or pulmonary consolidation. Clinical management decisions influenced by ultrasound findings (such as modification of oxygen therapy, initiation of diuretic treatment, or the performance of interventional procedures) were also recorded. The primary outcome of the study was in-hospital mortality. Secondary outcomes included the time from admission to definitive etiological diagnosis and the identification of the underlying cause of acute respiratory distress. Data were collected using standardised case report forms and subsequently entered into a secure electronic database. Quality assurance procedures included random audits of patient records and independent review of ultrasound images by a second experienced clinician to ensure data accuracy and consistency.

All statistical analyses were performed using IBM SPSS Statistics version 26.0. Continuous variables were examined for normality using the Shapiro-Wilk test and visual inspection of histograms. Data are presented as mean ± standard deviation (SD) for normally distributed variables and as median with interquartile range (IQR) for non-normally distributed variables. Categorical variables are expressed as absolute numbers and percentages. Baseline characteristics of patients were compared between the early point-of-care lung ultrasound (POCUS) group and the non-POCUS group. Continuous variables were compared using the Student's *t* test when normally distributed or the Mann–Whitney *U* test when distributional assumptions were not met. Categorical variables were compared using the χ^2 test or Fisher's exact test, as appropriate. The primary outcome of the study was in-hospital mortality. The association between early lung ultrasound and mortality was first explored using univariable analysis. Subsequently, a multivariable logistic regression model was constructed to evaluate the independent association between early POCUS and in-hospital mortality after adjustment for potential confounding factors. Variables considered clinically relevant or showing a univariable association with the outcome ($p < 0.10$) were included in the multivariable model. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were calculated. Secondary outcomes included the time from admission to definitive etiological diagnosis and the identification of the underlying cause of acute respiratory distress. Time to diagnosis was compared between groups using non-parametric tests owing to its skewed distribution. A two-sided *p* value of less than 0.05 was considered statistically significant for all analyses. Missing data were assessed and handled using complete-case analysis when the proportion of missing values was minimal. The study protocol was approved by the ethics committee of the Essos Hospital Center. Written informed consent was obtained from patients or, when this was not possible, from their legal representatives before enrolment.

RESULTS

Patient Characteristics

During the 12-month study period, a total of 162 consecutive adult patients admitted to the intensive care unit of the Essos Hospital Center for acute respiratory distress were included in the analysis. Among them, 94 patients (58.0%) underwent early point-of-care lung ultrasound (POCUS) within the first hour following admission, whereas 68 patients (42.0%) did not receive early ultrasound assessment.

The median age of the study population was 54 years (interquartile range [IQR] 41–67), and 97 patients (59.9%) were male. Baseline demographic characteristics, comorbidities, and physiological parameters at admission were broadly comparable between the two groups, although patients in the early POCUS group had slightly lower median oxygen saturation at presentation. The most common comorbid conditions were hypertension (34.6%), chronic heart disease (18.5%), and diabetes mellitus (16.7%). Initial

clinical presentation was characterised by severe dyspnea and tachypnoea in the majority of patients, with a median respiratory rate of 29 breaths per minute (IQR 26-34). Hypoxemia was frequently observed at admission, with a median peripheral oxygen saturation of 88% (IQR 83-91) on room air. Table I summarises the baseline characteristics of the study population.

Table I: Baseline characteristics of patients admitted with acute respiratory distress

Characteristic	Early POCUS (n=94)	No early POCUS (n=68)	*p* value
Age, years (median, IQR)	53 (40–66)	55 (43–69)	0.42
Male sex, n (%)	55 (58.5)	42 (61.8)	0.67
Hypertension, n (%)	31 (33.0)	25 (36.8)	0.61
Diabetes mellitus, n (%)	14 (14.9)	13 (19.1)	0.47
Chronic heart disease, n (%)	16 (17.0)	14 (20.6)	0.56
Respiratory rate, breaths/min (median, IQR)	30 (27–34)	28 (25–33)	0.09
SpO_2 on admission, % (median, IQR)	87 (82–90)	89 (85–92)	0.04
Systolic blood pressure, mmHg	118 ± 21	121 ± 24	0.38

Lung Ultrasound Findings and Diagnostic Orientation

Among the 94 patients who underwent early POCUS examination, lung ultrasound identified several characteristic patterns that contributed to the rapid identification of the underlying cause of respiratory failure. The most frequently observed pattern was an alveolo-interstitial syndrome characterised by multiple bilateral B-lines, identified in 39 patients (41.4%). Pleural effusion was detected in 22 patients (23.5%), while lung consolidation suggestive of pneumonia was observed in 19 patients (19.8%). Pneumothorax was identified in 6 patients (6.4%). Early ultrasound assessment significantly reduced the time to definitive aetiological diagnosis. The median time from admission to diagnostic orientation was 45 minutes (IQR 30–70) in the early POCUS group compared with 125 minutes (IQR 80–190) in the group without early ultrasound assessment ($p < 0.001$). The principal ultrasound findings are presented in Table II**.**

Table II: Lung ultrasound findings in the early POCUS group

Ultrasound finding	n (%)
Alveolo-interstitial syndrome	39 (41.4)
Pleural effusion	22 (23.5)
Pulmonary consolidation	19 (19.8)
Pneumothorax	6 (6.4)
Normal	8 (8.5)
Total	**94 (100)**

Clinical Outcomes and Mortality

Overall in-hospital mortality in the study cohort was 24.7% (40/162). Mortality was significantly lower among patients who underwent early POCUS compared with those who did not receive early ultrasound evaluation (18.1% vs 32.8%, $p = 0.03$). In univariable analysis, factors associated with increased mortality included advanced age, lower oxygen saturation at admission, the presence of shock, and the absence of early lung ultrasound assessment. Multivariable logistic regression analysis demonstrated that early lung ultrasound remained independently associated with reduced in-hospital mortality after adjustment for potential confounders. Patients who underwent early POCUS had a significantly lower risk of death compared with those who did not receive early ultrasound assessment. The results of the multivariable analysis are summarised in Table III.

Table III: Multivariable logistic regression analysis of factors associated with in-hospital mortality

Variable	Adjusted Odds Ratio (aOR)	95% CI	*p* value
Early lung ultrasound (POCUS)	0.42	0.20–0.88	0.02
Age (per 10-year increase)	1.31	1.05–1.67	0.01
SpO_2 at admission (%)	0.94	0.90–0.98	0.003
Presence of shock	2.76	1.29–5.94	0.008

DISCUSSION

This study adds to an expanding body of evidence suggesting that early point-of-care lung ultrasound (POCUS) can meaningfully influence outcomes in patients with acute respiratory distress, particularly in settings where delays in conventional imaging are common. In our cohort, integration of lung ultrasound within the first hour of admission was associated with a significant reduction in in-hospital mortality and a marked shortening of time to etiological diagnosis, suggesting that bedside imaging can

effectively bridge the gap between initial clinical assessment and definitive therapeutic action. These findings align with recent research demonstrating that lung ultrasound not only improves diagnostic accuracy but also has the potential to influence management decisions and patient trajectories. For example, a prospective multicenter study of patients with acute respiratory failure reported that early POCUS changed clinical management in more than 40 % of cases, leading to earlier targeted therapies and reduced complications compared with conventional diagnostic pathways [6]. Moreover, several recent meta-analyses have confirmed the high diagnostic performance of lung ultrasound across a range of acute pulmonary conditions, including pneumonia, pulmonary edema, and acute respiratory distress syndrome (ARDS), with pooled sensitivities and specificities consistently exceeding those of chest radiography [7]. Such diagnostic superiority is particularly relevant in critical care, where early and accurate etiological differentiation can alter treatment strategies and improve outcomes. In addition, emerging evidence suggests that lung ultrasound findings are independently correlated with severity scores and outcomes in ARDS and other causes of respiratory failure, reinforcing its role as both a diagnostic and prognostic tool [8]. In resource-limited environments, where access to computed tomography and even timely chest radiographs may be constrained, the ability of POCUS to rapidly guide clinical decision-making is especially valuable. Recent studies in low- and middle-income countries have shown that lung ultrasound performed by trained clinicians is feasible, reproducible, and associated with earlier interventions and reduced morbidity, even in the absence of advanced imaging facilities [9, 10]. Taken together, these data support the interpretation that early lung ultrasound can function not only as a diagnostic adjunct but as a central component of initial care pathways for critically ill patients with respiratory distress, with the potential to improve survival in both high- and low-resource settings.

The observed reduction in mortality in our cohort is likely multifactorial, reflecting both the diagnostic and therapeutic benefits of early point-of-care lung ultrasound (POCUS). By enabling rapid, bedside identification of the underlying etiology of respiratory failure, POCUS substantially reduces diagnostic uncertainty and facilitates timely, targeted interventions. In our study, the most frequent findings included alveolo-interstitial syndromes, pleural effusions, and pulmonary consolidations, pathologies that directly informed immediate management strategies, such as optimisation of oxygen delivery, initiation of diuretic therapy, or prompt antimicrobial administration. Beyond its diagnostic value, POCUS is dynamic and repeatable, allowing clinicians to monitor the evolution of pulmonary pathology and adapt therapy in real time, which is particularly critical in unstable patients. These observations are supported by recent meta-analytic evidence demonstrating that lung ultrasound maintains high diagnostic accuracy in critically ill patients with acute respiratory failure, with pooled sensitivities and specificities exceeding 0.89 and 0.94, respectively [11, 12]. Collectively, these data underscore the capacity of early POCUS to accelerate decision-making, optimise treatment selection, and ultimately improve clinically meaningful outcomes, including survival, in high-risk critical care populations [12].

Moreover, the real-time, dynamic application of POCUS enables clinicians to conduct serial bedside assessments and adapt management instantaneously, a capability that is especially critical in hemodynamically unstable, critically ill patients. This continuous, iterative evaluation likely accounts for the shortened diagnostic intervals and improved survival observed in the early ultrasound cohort. Supporting this mechanistic rationale, observational studies consistently demonstrate that lung ultrasound scores are independently predictive of mortality in acute respiratory distress syndrome (ARDS), underscoring the integrated diagnostic and prognostic value of POCUS and its potential to redefine clinical decision-making pathways in critical care [13].

Our findings are broadly consistent with prior investigations demonstrating the diagnostic accuracy and clinical utility of lung ultrasound in acute respiratory failure and critical care. A recent narrative review underscored the role of POCUS in airway and respiratory assessment, emphasizing its critical importance for rapid diagnosis in patients with undifferentiated respiratory distress, where timely intervention can be life-saving [14]. Meta-analytic evidence confirms that lung ultrasound reliably detects ARDS and can distinguish focal from non-focal sub-phenotypes, demonstrating high specificity and supporting its role in precise phenotypic characterization and targeted management in critically ill patients [15]. Additional studies have reported associations between lung ultrasound aeration scores and short-term mortality in critically ill patients, including those undergoing non-invasive respiratory support [16].

Although much of the literature has focused on diagnostic accuracy or prognostic scoring, recent studies increasingly link lung ultrasound findings to patient-centered outcomes. Prospective cohort data show that elevated lung ultrasound scores are independently associated with mortality, treatment failure, and the need for escalation of respiratory support in acute respiratory failure [16]. In sepsis populations evaluated in low-resource settings, the presence of B-lines on lung ultrasound has been independently correlated with higher mortality and adverse clinical outcomes, highlighting the broader utility of lung ultrasound for early risk stratification and informed clinical decision-making [17].

The implications of our findings are particularly relevant for intensive care units operating in resource-

limited settings. In many low- and middle-income countries, access to advanced imaging modalities such as computed tomography or even timely chest radiography is often constrained. In this context, bedside lung ultrasound offers a highly accessible, cost-effective, and reproducible diagnostic tool, capable of rapid deployment by trained clinicians, thereby bridging critical gaps in diagnostic capacity. Previous studies have confirmed both the feasibility and acceptability of lung ultrasound in low-resource environments, demonstrating its utility in assessing the severity of lung injury and guiding early, targeted management [18].

Study Limitations

Several limitations of this study should be acknowledged. First, the observational design precludes definitive conclusions regarding causality between early lung ultrasound and reduced mortality. Although multivariable adjustment was performed to account for potential confounders, the possibility of residual confounding cannot be entirely excluded. Selection bias may also have occurred, as the decision to perform early POCUS was based on clinical judgment rather than random allocation. Second, the study was conducted in a single center, which may limit the generalizability of the findings to other institutions with differing patient populations, staffing models, or levels of ultrasound expertise. Third, ultrasound examinations remain operator-dependent, and variations in clinician experience may have influenced the interpretation of findings, despite the implementation of quality assurance protocols.

CONCLUSION

Our study demonstrates that early point-of-care lung ultrasound (POCUS) substantially improves clinical outcomes in patients with acute respiratory distress, particularly in settings where conventional imaging is delayed or unavailable. By enabling rapid bedside identification of underlying pathology, guiding timely targeted interventions, and supporting dynamic serial assessments, POCUS reduces diagnostic uncertainty, accelerates clinical decision-making, and is associated with a meaningful reduction in in-hospital mortality. These findings highlight the dual diagnostic and prognostic utility of lung ultrasound, reinforcing its role as a core component of initial care pathways for critically ill patients. Moreover, the feasibility, reproducibility, and cost-effectiveness of POCUS in resource-limited settings emphasize its potential to bridge critical gaps in diagnostic capacity, inform early risk stratification, and improve patient-centered outcomes globally. Collectively, these results position early lung ultrasound as a transformative tool in critical care, with important implications for both high- and low-resource environments.

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