International Journal of Anesthesia and Clinical Medicine
2026, Vol. 14, No. 1, pp. 1–6
https://doi.org/10.11648/j.ijacm.20261401.11

Research Article

Post Traumatic Acute Respiratory Distress Syndrome in the Emergency and Critical Care Units of the Douala General Hospital Cameroon

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Abstract

Introduction: Acute Respiratory Distress Syndrome (ARDS) is a severe, life-threatening complication of major traumatic injury, contributing significantly to morbidity and mortality in emergency and critical care settings globally. Data on the specific clinical profile and outcomes in Sub-Saharan African trauma centers are scarce. Objective: The Objective was to describe the epidemiology, clinical profile, severity of injury (Injury Severity Score, ISS), surgical management, and therapeutic outcomes of post-traumatic ARDS among adult trauma patients managed at the Emergency and Critical Care Unit (ECCU) of Douala General Hospital (DGH). Materials and methods: the method was a retrospective observational study was conducted over a 24 months period (January 2022 to December 2024) at DGH, including 68 consecutive adult trauma patients who developed ARDS based on the Berlin criteria. Data collected included demographics, mechanism of injury, ISS, associated injuries (especially Thoracic Trauma and Traumatic Brain Injury [TBI]), ASA physical status, intra-operative events, ARDS severity, and final outcomes (survival vs. death). Results: The mean age was 39.8 ±14.7 years, with a male predominance (79.4%). Severe trauma (ISS ≥25) accounted for 79.4% of the cohort, with a mean ISS of 31.6 ±11.2. The most frequent injuries were Thoracic Trauma (50.0%) and Long Bone Fractures (42.6%). Early complications included shock (44.1%) and massive hemorrhage (36.8%). Urgent surgeries were performed in 67.6% of operative cases. ARDS onset occurred at a median of 2.8 days post-injury. The overall in-hospital mortality was 32.4%. Independent predictors of mortality included ISS≥35, the presence of shock on admission, and severe TBI. Therefore, post-traumatic ARDS represents a major burden in the DGH ECCU, driven by high-velocity blunt trauma and associated with a significant mortality rate of 32.4%. Conclusion: These findings emphasize the necessity of strict, multidisciplinary protocols focused on prompt hemorrhage control, optimized resuscitation, and early identification of high-risk trauma patterns to improve critical care outcomes.

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Received: 14 December 2025; **Accepted:** 26 December 2025; **Published:** 23 January 2026

Keywords

Acute Respiratory Distress Syndrome, Intensive Care, Emergency, Trauma, Douala, Cameroun

1. Introduction

Trauma remains a global public health crisis, recognized as a leading cause of death and disability, particularly impacting young adults in low- and middle-income countries (LMICs) [1]. Among the critical complications encountered in the peri-operative and critical care phases, Post-Traumatic Acute Respiratory Distress Syndrome (ARDS) represents a devastating form of acute lung injury [2]. ARDS is defined by the Berlin criteria and characterized by severe hypoxemia and bilateral pulmonary infiltrates of non-cardiogenic origin [3].

The pathophysiology of post-traumatic ARDS is complex, stemming from two major pathways: Direct Lung Injury (e.g., pulmonary contusion, aspiration) and Indirect Lung Injury (systemic inflammatory response syndrome (SIRS) triggered by severe tissue damage, shock, massive blood transfusion, or severe sepsis) [4]. It reported incidence in major trauma registries ranges from 10% to 30%, with associated mortality rates often exceeding 40% [5, 6].

Understanding the specific injury patterns, physiological insults, and management sequences that lead to ARDS in a high-volume, resource-constrained environment like Douala General Hospital (DGH) is crucial. This study was undertaken to delineate the clinical and epidemiological profile of adult trauma patients who developed ARDS at DGH, assess the impact of surgical and critical care management choices, and identify independent predictors of mortality to inform local clinical protocol development.

2. Materials and Methods

2.1. Study Design and Setting

A retrospective observational study was conducted within the Emergency and Critical Care Unit (ECCU) of Douala General Hospital (DGH), a major tertiary and trauma referral center in Cameroon. The study covered a continuous 24 month period. The Douala is a tertiary health care institution, standing as a corner centre for the management of multiple specialty including an emergency of more than 8000 visits per year among which many trauma cases.

2.2. Ethical Approval

After obtaining the administrative clearance form the medical and surgical critical care units, This study was approved by the Institutional review board of the Committee of Douala General Hospital.

2.3. Study Population

Inclusion Criteria:

1) Adult patients aged ≥18 years.
2) Admitted to the ECCU following traumatic injury.
3) Developed ARDS during their hospital stay based on the Berlin definition [3]:

Acute onset (within 1 week of a known clinical insult, i.e., trauma).

Bilateral opacities on chest imaging (not fully explained by effusions, atelectasis, or nodules). Respiratory failure not fully explained by cardiac failure or fluid overload. Impaired oxygenation quantified by $PaO_2/FiO_2 \leq 300$ mmHg (with PEEP or CPAP≥5 cm H_2O).

Exclusion Criteria:

1) Patients with pre-existing chronic lung disease (e.g: COPD, interstitial lung disease).
2) Inadequate or incomplete medical and anesthesia documentation required for ARDS diagnosis or outcome assessment.

2.4. Data Collection and Variables

Data were extracted from patient medical records, anesthesia logs, and ECCU charts by the principal investigator s using a standardized data abstraction form. Key variables included:

Injury Severity: Mechanism of injury, ISS, and specific associated injuries (Thoracic trauma, TBI, Abdominal trauma).

Management: ASA physical status classification on arrival, type of surgery performed (urgent vs. elective/delayed), amount of intra-operative blood transfusion (≥4 units), and intra-operative hemodynamic events (hypotension).

ARDS Profile: Time of ARDS onset (days post-injury) and ARDS severity based on the Berlin definition (Mild, Moderate, Severe).

Outcomes: ECCU length of stay, Multi-Organ Failure (MOF), Sepsis, and final patient disposition (survival vs. death).

2.5. Data Analysis

Descriptive statistics were used to summarize patient characteristics. Continuous variables were presented as mean ±standard deviation (SD) or median with interquartile range (IQR). Categorical variables were expressed as frequencies (n)

and percentages (%). Univariate analysis (Chi-square test, Fisher's exact test, or T-test) was used to compare variables between survivors and non-survivors. A p-value of <0.05 was considered statistically significant. Statistical analysis was performed using SPSS Statistics, version 28.0 (IBM Corp.).

3. Results

3.1. Demographics and Mechanism of Injury

A total of 68 patients met the inclusion criteria. The mean age was 39.8±14.7 years, with a strong male predominance 54(79.4%). The most common mechanism of injury was blunt trauma 28(41.2%), encompassing falls and assaults. Road Traffic Accidents (RTA) were the most frequent single cause of injury.

Table 1. Injury mechanism.

Mechanism of Injury	Frequency (n=68)	Percentage (%)
Blunt trauma (Non-RTA)	28	41.2%
Road Traffic Accident (RTA)	18	26.5%
Penetrating trauma	12	17.6%
Fall from height	7	10.3%
Assault	3	4.4%

3.2. Injury Severity and Patterns

The cohort was characterized by severe injury: the mean ISS was 31.6±11.2, and 79.4% of patients were classified as having severe trauma (ISS≥25).

Table 2. Injury severity score.

ISS Category	n (%)	Percentages (%)
16−24	14	20.6
25−34	26	38.2
≥35 (Critical)	28	41.2

Polytrauma (injury to two or more body regions) was present in 57.4% of the cohort. Thoracic trauma (including rib fractures and pulmonary contusions) was the most common associated injury, highlighting its direct contribution to ARDS development.

Table 3. Trauma differenciation.

Trauma type / Associated Injury	Frequency (n)	Percentage (%)
Thoracic trauma	34	50.0%
Long bone fractures	29	42.6%
Traumatic brain injury (TBI)	21	30.9%
Abdominal trauma	18	26.5%

3.3. Management Profile and ARDS Characteristics

The necessity for immediate intervention was high, reflected by the surgical urgency and physiological derangement:

Surgical Urgency: Of the 52 patients who underwent surgery, 67.6% required urgent procedures (laparotomy, thoracotomy) for immediate hemorrhage control or damage control.

Physiological Status (ASA): A majority of patients presented in severe physiological distress, with 42.6%classified as ASA IV (constant threat to life) and 5.9% as ASA V (not expected to survive without intervention).

Intra-operative Events: Hypotension (shock) was documented in 44.1% of cases, and 25% required massive transfusion (≥4 units).

ARDS Onset and Severity: The median time to ARDS onset was early, at 2.8 days post-injury. The majority of patients developed Moderate (PaO2/FiO2 100–200) or Severe (PaO2/FiO2<100) ARDS, accounting for 76.5% of the cohort.

Table 4. Berlin classification in the sample.

ARDS Severity (Berlin Criteria)	n (%)	Percentages (%)
Mild (200−300 mmHg)	16	23.5
Moderate (100−200 mmHg)	32	47.1
Severe (<100 mmHg)	20	29.4

3.4. Outcomes and Predictors of Mortality

The overall in-hospital mortality rate for patients who developed post-traumatic ARDS was 32.4% (n=22). Univariate analysis revealed that mortality was significantly higher in patients presenting with the following characteristics: ISS≥35 (n=15 deaths, p<0.01). Presence of shock on admission (n=12 deaths, p=0.02). Development of Severe ARDS (n=10 deaths, p<0.01). Co-existence of Severe TBI and ARDS (n=8 deaths, p=0.04). Development of Sepsis or MOF as a complication (n=14 deaths, p<0.01).

4. Discussion

4.1. Epidemiology and Injury Severity Profile

This study confirms that post-traumatic ARDS is a critical challenge at DGH, with an affected cohort characterized by high-energy mechanisms (Blunt Trauma and RTA) and overwhelming injury severity. The mean ISS of 31.6 places this population firmly within the domain of polytrauma, far exceeding the threshold for major trauma (ISS≥16) [1]. This severity profile explains the high incidence of ASA IV status, reflecting the severe physiological derangement—primarily shock and massive hemorrhage—upon arrival, which are potent triggers for systemic inflammation and subsequent ARDS [4, 6]. The male predominance observed (79.4%) is consistent with global epidemiology, reflecting higher occupational and road-use risk exposure among young men in LMICs [7].

4.2. Pathophysiological Triggers and Early ARDS Onset

The median time to ARDS onset of 2.8 days post-injury is considered *early-onset* ARDS and strongly points towards indirect lung injury driven by systemic factors rather than purely direct injury 8]. The high frequency of shock (44.1%), massive hemorrhage (36.8%), and urgent surgical needs highlights the massive "second hit" inflammatory response caused by ischemia-reperfusion injury and trauma-induced coagulopathy [4]. Furthermore, the 50% incidence of thoracic trauma (direct lung contusion) provides the necessary "first hit" to prime the lungs, making them hyper-responsive to systemic inflammatory mediators released during resuscitation and surgery [9]. The management priority must therefore shift towards mitigating the systemic response through damage control resuscitation.

4.3. Mortality Rate in a Resource-limited Context

The overall mortality rate of 32.4% observed in our cohort is significant but falls within the wide range (30%−50%) reported for ARDS in LMICs and resource-constrained settings [10]. This rate, while concerning, is lower than some figures reported internationally for severe ARDS (≥40%), suggesting that DGH's multidisciplinary trauma and critical care team provides effective initial stabilization and surgical control. However, the strong association between mortality and factors such as ISS≥35, the presence of shock, and the development of sepsis/MOF aligns perfectly with international literature [5, 12]. This indicates that failure is often multifactorial, stemming from uncontrolled injury burden and subsequent systemic complications, rather than isolated respiratory failure.

4.4. Surgical Management and Peri-operative Risk

The high proportion of urgent surgeries (67.6%) underscores the immediate threat to life posed by these injuries. Surgical intervention, while essential for hemorrhage control, is itself an inflammatory "second hit" that can precipitate ARDS [12]. The documentation of frequent intra-operative complications, including hypotension (44.1%) and massive transfusion (25%), confirms the peri-operative period as a high-risk phase where the insult that drives ARDS severity occurs. This supports the concept of Damage Control Surgery (DCS) and Damage Control Resuscitation (DCR), advocating for abbreviated surgery focused on definitive hemorrhage and contamination control, deferring extensive reconstructive procedures until the patient is physiologically stable [13, 14].

4.5. ARDS Severity and Neurological Comorbidity

The finding that 76.5% of patients presented with moderate or severe ARDS necessitates rigorous application of lung-protective ventilation (LPV) strategies [15]. Furthermore, the co-existence of ARDS and severe TBI (30.9%) creates a major therapeutic conflict. LPV often requires permissible hypercapnia, which can be detrimental in TBI due to increased intracranial pressure (ICP). This management dilemma requires cautious monitoring and titration of therapies, such as utilizing higher PEEP levels to maximize oxygenation while monitoring for signs of cerebral hypoperfusion, a highly resource-intensive practice that must be supported by local guidelines [16 17].

4.6. Future Directions and Protocol Improvements

Based on these findings, future quality improvement initiatives at DGH should focus on: (1) Formalizing restrictive fluid resuscitation and DCR protocols to minimize indirect lung injury from fluid overload and massive transfusion, particularly for patients with ISS≥25 [14, 18]. (2) Implementing universal, early ARDS risk screening (e.g., based on ISS, shock, and TBI status) to enable immediate adoption of lung-protective ventilation settings for high-risk patients before ARDS is fully developed [19]. (3) Strengthening multidisciplinary communication between trauma surgery, anesthesiology, and critical care teams to ensure seamless application of DCR principles throughout the ECCU admission and operative phases.

5. Conclusions

Post-traumatic ARDS remains a major cause of mortality in the emergency-critical care setting. Early identification of high-risk trauma patterns, optimization of peri-operative care, and strengthening multidisciplinary protocols are essential to improving outcomes.

Abbreviations

ARDS	Acute Respiratory Distress Syndrome
ASA	American Society of Anesthesiology
C-PAP	Continuous Positive Airway Pressure
COPD	Chronic Obstructive Pulmonary Disease
DGH	Douala General Hospital
DCS	Damage Control Surgery
DCR	Damage Control Resuscitation
ECCU	Emergency and Critical Care Unit
BMI	Body Mass Index
LPV	Lung-Protective Ventilation
ISS	Injury Severity Score
PEEP	Positive Expiratory Pressure
LMIC	Lower and Midlle Incombe Country
SD	Standard Deviation
RTA	Road Traffic Accident

Acknowledgments

The authors would like to thank the dedicated staff of the Emergency, critical Unit and the Department of Radiology at University Hospital for their invaluable assistance in data collection and their commitment to patient care.

Author Contributions

Ngono Ateba Glwadys: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing

Metogo Mbengono Junette Arlette: Resources, Software, Supervision, Validation, Visualization, Writing – original draft

Banga Nkomo Douglas: Investigation, Methodology, Project administration

Ndom Ntock Ferdinand: Data curation, Methodology

Owono Etoundi Paul: Visualization, Writing – original draft, Project administration

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Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request and subject to the approval of the Douala General Hospital Research Directorate.

Conflicts of Interest

The authors declare that they have no competing interests.

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Biography

Ngono Ateba Glwadys is a Cameroonian medical professional specializing in critical care and emergency medicine. she is known for her work as a Physician in the medical and surgical critical units (Surgical and Medical Intensive Care Unit) at the Douala General Hospital (DGH). Her clinical practice and research focus on critical conditions prevalent in Sub-Saharan Africa. She is is an active contributor to scholarly research, particularly in the fields of intensive care, ENT (Ear, Nose, and Throat), and obstetrics/gynecology. Her published works include studies on: The epidemiology and outcomes of septic shock in an ICU setting at Douala General Hospital. The impact of fluid balance on mortality in septic shock patients. Research related to Epistaxis (nosebleeds) and cochlear implantation in Cameroon. The use of endoscopy in the diagnosis of Fallopian tube diseases. Her involvement in these studies highlights her dedication to addressing high-morbidity diseases and improving patient outcomes in Cameroonian health institutions.

Research Field

Ngono Ateba Glwadys: Emergency medicine; Disaster medicine; Anesthesiology; Critical care; Global health policy; Hemodynamic; Cardiology; *Pediatrics andadolescent health.*