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Management of Acute Respiratory Distress Syndrome (ARDS): clinicians' knowledge and practice

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Abstract

Background: Acute Respiratory Distress Syndrome (ARDS) is common in the Intensive Care Unit (ICU) setting and is associated with high mortality. Delayed diagnosis and failure to institute evidenced-based management have been associated with poor outcomes. Knowledge of the diagnostic criteria for ARDS and the adoption of recommended management practices by clinicians in the ICU is therefore required to reduce mortality.

Objective: This study sought to assess the knowledge and current management practices of ARDS among clinicians in a surgical ICU of the Korle-Bu Teaching Hospital.

Methods: This was a cross-sectional study involving a purposive sample of 15 clinicians (Specialist Anaesthesiologists) who work at the Korle-Bu Teaching Hospital Surgical ICU. A self-administered structured questionnaire was used to obtain data on the sociodemographic characteristics, knowledge and management practices of clinicians on ARDS. Clinicians' knowledge and management practices were scored based on conformity with the ARDSnet Ventilatory Protocol. Categorical data were summarised as frequencies and proportions, and continuous data as Mean ± standard deviation.

Results: Clinicians (Specialist Anaesthesiologists) had good knowledge about ARDS (Mean knowledge score = 21.00 ±3 .87), and their management practices were above average (Mean practice score = 8.53±2.50). The clinicians rarely (40%) or never (60%) practised prone ventilation.

Conclusion: Specialist Anaesthesiologists had good clinical knowledge of ARDS and applied appropriate management strategies. However, prone ventilation was rarely adopted.

Keywords: Acute Respiratory Distress Syndrome (ARDS); Mechanical Ventilation; Intensive Care Unit (ICU); Prone Ventilation.

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INTRODUCTION

Acute Respiratory Distress Syndrome (ARDS) is a severe lung injury resulting in hypoxemic respiratory failure and accounts for 10% of Intensive Care Unit (ICU) admissions [1]. It is associated with a high overall mortality rate estimated to be up to 50% [2]. The management procedures employed for ARDS are mainly supportive, with mechanical ventilation being the cornerstone of management [3]. The inability of clinicians to appropriately diagnose the condition and begin the recommended therapeutic interventions early has been a challenge in the management of ARDS. ARDS is diagnosed based on definitions which have evolved over the years [4]. These "definitions" are criteria drawn to describe the characteristics (with clinical signs and diagnostic tests) to look out for to accurately diagnose ARDS. A study by Ferguson et al. [5] to assess and compare the diagnostic accuracy of three definitions (the American-European Consensus Conference (AECC) definition, the lung injury score, and the Delphi definition) discovered that out of the

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patients found to have diffuse alveolar damage at autopsy, only 47.6% had it recognised clinically. The study revealed an under-recognition of ARDS by clinicians and variations in the specificities of the definitions studied. The current definition, the Berlin definition criteria [6], by the European Society of Intensive Care Medicine (ESICM), the American Thoracic Society (ATS), and the Society of Critical Care Medicine (SCCM) was developed to address the limitations of previous definitions. The criteria require the presence of acute hypoxemic respiratory failure, onset within seven days of insult, or new (within seven days) or worsening respiratory symptoms; bilateral opacities on chest x-ray or CT not fully explained by effusions, lobar or lung collapse, or nodules; and cardiac failure not the primary cause of acute respiratory failure. Acute respiratory failure was defined as a ratio of arterial partial pressure of oxygen to fractional inspiratory oxygen concentration less than 300mmHg ($PaO2/FiO2 \leq 300$ mmHg) with positive end-expiratory pressure (PEEP) or continuous airway pressure (CPAP) ≥ 5 cmH20

The LUNG SAFE study [7], a large multicentre observational study to investigate the global impact of Severe Acute Respiratory Failure, was conducted to assess clinicians' recognition of ARDS, ventilation management, and the use of adjunctive strategies in clinical practice for patients with ARDS. The study revealed that the ability of clinicians to recognise ARDS per the Berlin criteria was low (34.0%), which negatively impacted the institution of appropriate management and, hence, the poor survival outcomes among patients. The Berlin definition, though relatively more reliable, has its limitations. The challenges of obtaining arterial blood gas results in resource-limited environments led to the introduction of the Kigali modification of the Berlin criteria [8]. It has been reported that clinicians delay or miss the diagnosis of ARDS in about two-thirds of patients when employing the Berlin definition. The inability of clinicians to timeously recognise ARDS hampers the early employment of therapeutic interventions that improve outcomes [9]. Numerous studies have been done globally on ARDS, which sought to evaluate the efficacy of plausible management strategies in an effort to provide clinicians with recommendations to better manage this complex condition. However, few studies have been done to evaluate how much clinicians know about the diagnosis and management of this condition. There is a paucity of literature from sub-Saharan Africa on the knowledge of ARDS among clinicians. This study, therefore, sought to assess the knowledge and current management practices of ARDS among clinicians in a surgical ICU of a tertiary hospital in Accra, Ghana.

MATERIALS AND METHODS

Study design and sites

A cross-sectional survey was conducted involving Specialist Anaesthesiologists working on the ground floor of the Surgical ICU of the Korle-Bu teaching hospital in Accra, Ghana. The Surgical ICU is a subsidiary of the Department of Anaesthesia and is manned by four (4) Consultant Anaesthesiologists, thirty (30) Specialist Anaesthesiologists, and an average of eighteen (18) Critical care nurses. Specialist Anaesthesiologists are the clinicians who admit and initiate the management of patients in the ICU. The study adopted purposive sampling of the fifteen (15) Specialist Anaesthesiologists who work at the Surgical ICU of a Tertiary Teaching Hospital in Ghana. The Surgical ICU was chosen because it is the unit that manages most cases of ARDS in the hospital.

Data Collection

The study was approved by the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences, University of Ghana, and the Research Unit of the Korle-Bu Teaching Hospital. Informed consent was obtained from participants prior to their recruitment into the study. A self-administered structured questionnaire was used for data collection, administered in-person or online using Google Forms. The questionnaire was used to obtain data on the sociodemographic characteristics, knowledge and management practices of clinicians on ARDS. Clinicians' knowledge and management practices were scored based on conformity with the ARDSnet management protocol.

Data analysis

Data were entered and analysed using the Statistical Package for Social Sciences (SPSS) software, version 26. Categorical data were summarised as frequencies and proportions, and continuous data as Mean (± standard deviation).

RESULTS

A total of fifteen (15) respondents were interviewed, with 66.7% (n = 10) being female. About two-thirds of the respondents (66.7%, n = 10) were aged between 30 and 39 years, while 26.7% (n = 4) were between 40 and 49 years. The majority of respondents (80%) had been practising in their speciality for six years or more (Table 1). The overall

Table 1: Background Information on participants

	n (%)
Gender	
Male	5 (33.3)
Female	10 (66.7)
Age (years)	
20-29	1 (6.7)
30-39	10 (66.7)
40-49	4 (26.7)
Years of experience	
1-5	3 (20.0)
6-10	5 (33.3)
11-15	4 (26.7)
16-20	3 (20.0)

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Mean ± SD knowledge score of respondents was 21 ± 3.87 and ranged between 11 and 26. Table 2 provides a summary of the responses to questions that assessed their knowledge of recognising and diagnosing ARDS. Table 3 provides a summary of the responses to questions that assessed knowledge of ARDS management strategies employed by respondents. The overall mean practice score of respondents was 8.5 ±2.5 and ranged between 4 and 12. Table 4 summarises the responses to questions relating to practices employed by respondents in the management of ARDS. Finally, Table 5 provides a summary of the level of knowledge of the respondents and their standard of practice.

Table 2: Knowledge of recognising and diagnosing ARDS

Items and Responses	n (%)
Accepted Criteria for ARDS diagnosis	
Berlin criteria	10 (66.7)
AECC criteria	3 (26.7)
Ashbaugh and Petty criteria	1 (6.7)
Berlin criteria and AECC criteria	1 (6.7)
Common Direct Causes of ARDS	
Choking	4 (26.7)
Pneumonia	15 (100)
Food poisoning	3 (20)
Sepsis	9 (60.0)
Lung contusion	13 (86.7)
Pancreatitis	8 (53.3)
Burns	9 (60.0)
Near Drowning	11 (73.3)
Common Presenting Symptoms and signs of ARDS	
Rhinorrhoea	0 (0)
Tachypnoea	15 (100)
Dysphagia	0 (0)
Dyspnoea	15 (100)
Diarrhoea	0 (0)
Hypoxemia	15 (100)
Uremia	0 (100)
Fever	3 (20.0)
Differential Diagnoses for ARDS	
Pulmonary Koch's	9 (60.0)
Acute pulmonary embolism	11 (73.3)
Pulmonary fibrosis	7 (46.7)
Cardiogenic pulmonary oedema	13 (86.7)
Rheumatoid pneumonitis	7 (46.7)
Hypersensitivity pneumonitis	8 (53.3)
Considerations in the diagnosis of ARDS	
Central Venous Pressure equal to or less than 15mmHg	0 (0)
Respiratory failure not fully explained by cardiac failure or fluid overload	14 (93.3)
Bilateral opacities partly explained by effusions, lobar and lung collapse, or nodules.	1 (6.7)
New or worsening respiratory symptoms occurring 14 days after a known clinical insult	3 (20.0)

Table 3: Knowledge of ARDS management strategies

Items and Responses	n (%)
Evidence-based practices and modalities for ARDS management	
Prone ventilation	13 (86.7)
Chest physiotherapy interventions such as postural hygiene and mucus clearance	9 (60.0)
Use of tidal volumes greater than or equal to 8ml/kg to address hypercapnia	1 (6.7)
The use of neuromuscular blockers	11 (73.3)
Nutrition therapy to manage lung inflammation and permeability	6 (40.0)
The use of mucolytic agents in inhalation therapy	7 (46.7)
Benefits of prone ventilation	
To reduce compression of the heart by lungs	3 (20.0)
To reduce alveolar shunts	11 (73.3)
To improve patient's inspiratory lung volumes	6 (40.0)
To redistribute lung densities with alveolar recruitments at dorsal regions	12 (80.0)
To reduce atelectasis	13 (86.7)
Benefits of high PEEP	
To open up collapsed lung tissue	15 (100)
To ensure maximum retention of oxygen in lung	3 (20.0)
To reduce alveolar shunts	11 (73.3)
To manage lung resistance	3 (20.0)
To improve oxygenation	14 (93.3)
To modulate CO_2 retention	2 (13.3)

Table 4: Practices employed in the management of ARDS

Items and Responses	n (%)
The stage of ARDS when NIV is used	
Mild and moderate stage	7 (46.7)
Mild stage	6 (40.0)
Severe stage	2 (13.3)
Use of low tidal volumes in ARDS	
Highly recommend	12 (80)
Not sure	2 (13.3)
Recommend sometimes	1 (6.7)
Frequency of adoption of prone ventilation	
Never	9 (60.0)
Rarely	6 (40.0)
Duration of prone ventilation employed	
12- 24 hours	5 (33.3)

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Table 5: Level of knowledge and standard of practice score

Variable	N (%)
Level of knowledge score	
0-13 (low)	1 (7.0)
14-19 (average)	2 (13.0)
20-28 (adequate)	12 (80.0)
Standard of practice score	
0-6 (low)	3 (8.0%)
7-8 (average)	6 (46%)
9-13 (adequate)	6 (46%)

DISCUSSION

The study aimed to assess clinicians' knowledge and current practices regarding managing ARDS in the ICU and evaluate clinicians' conformity to the evidence-based regimen for ICU management of ARDS. The mean knowledge score of the clinicians was 21.00 ± 3.87, with 80% of them having adequate knowledge of the diagnosis and management of ARDS. The average practice score was 8.53 ± 2.50, with 46% having adequate practice scores. About 60% of the clinicians had never practised prone ventilation, while 40% of them rarely did so.

Clinician's Knowledge

Studies such as the LUNG SAFE study [7] have attributed the outcomes of the management strategies of ARDS in the ICU to the under-recognition of ARDS among clinicians responsible for managing ARDS. In this study, most clinicians (66.7%) (Specialist Anaesthesiologists) agreed that the Berlin Definition was the currently accepted definition for diagnosing ARDS. These results contradict the study by Dushianthan et al. [10]. Perhaps the fact that the Berlin definition was introduced about a decade ago could account for the relatively high level of knowledge of clinicians in recognising the appropriate criteria utilised in diagnosing ARDS. In resource-limited settings where essential equipment required for diagnosis (mechanical ventilators, arterial blood gas analysers and chest radiograph equipment) are not readily available, the use of the Berlin definition could lead to the under-diagnosis and management of ARDS. In their study, Riviello et al. [8] highlighted this limitation and proposed the Kigali Modification. Our study, however, did not investigate the knowledge of clinicians on the Kigali modification in the diagnosis of ARDS.

Clinicians' Practices

Evidence-based guidelines for managing ARDS were developed by the American Thoracic Society (ATS), the European Society of Intensive Care Medicine (ESICM), and the Society of Critical Care Medicine (SCCM) in 2017. These guidelines included lung-protective ventilation for all ARDS patients' prone ventilation with the use of higher PEEP and recruitment manoeuvres. Other therapies recommended were the early use of neuromuscular blocking agents in severe ARDS [11], conservative fluid management [12] as well as clinical modalities such as chest physiotherapy [13], nutrition therapy [14] and inhalation therapy using mucolytics [15]. The clinical management guidelines for ARDS, though widely accepted, potentially pose a challenge as the adopted mechanical ventilation interventions meant to improve the condition can worsen lung injury and increase mortality [16]. Apart from lung-protective ventilation, not all the procedures are wholly embraced by clinicians because of the associated complications, the diversity of findings of clinical trials, and some misconceptions [17]. The practice of prone ventilation, for example, was found to be low in the APRONET study [18] due to a misconception that clinicians at the time had. The clinicians perceived that the hypoxemic state of the ARDS patients would have to be severe enough to warrant proning, which should not be so because prone ventilation could be applied irrespective of the patient's hypoxemic level. In this study, most clinicians preferred the use of low tidal volumes in the ventilator management of ARDS in the ICU, which is a safe and widely accepted standard practice supported by many studies such as Brower et al. [16], Walkey et al. [19], Papazian et al. [20]. Unsurprisingly, a study conducted at Komfo Anokye Teaching Hospital (KATH) by Osei-Ampofo et al. [21], where low tidal volume ventilation was not practised, recorded high mortality among patients with ARDS. The effectiveness of non-invasive ventilation in ARDS has been found to decrease with increasing severity of the disease. Its use has been found to be associated with increased ICU mortality [22,23]. The study by Ferguson et al., in aligning the therapeutic management options available with the severity of ARDS, also matched non-invasive ventilation to the mild stage of ARDS [24]. Therefore, it was concerning that half the clinicians who participated in this study would prefer to use non-invasive ventilation for the moderate stage of ARDS and that some even considered its use for the severe stage of ARDS.

Prone ventilation has been found to reduce mortality in patients with ARDS admitted to ICUs (PROSEVA study) [25] and Munshi et al. [26]. This study revealed that prone ventilation is rarely practised at the study site, with more than half of the participants never practising it. Lack of skill set, manpower, and proper bolsters to maintain the prone position were responses to reasons why prone ventilation was rarely practised in this study. The inability of clinicians to practice prone ventilation due to limited resources could potentially negatively impact outcomes. Clinicians who adopted prone ventilation occasionally did so for 12 to 24 hours, which is the widely accepted duration for prone ventilation [20,26]. The study demonstrated that most of the evidence-based management practices were being employed to manage ARDS patients in the ICU. Unlike many other studies on ARDS, this study did not seek to examine the outcomes of the use of the management strategies of ARDS in the ICU. However, the results, which indicate a generally high awareness of the recognition, diagnosis, and management of ARDS, are encouraging and can contribute to positive outcomes and survival for

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patients with ARDS [7,27]. The results also demonstrate that despite the generally high knowledge of clinicians, not all the evidence-based practices were being applied due to reasons such as lack of requisite skill set and resources, as seen in the case of prone ventilation. The gap between the knowledge of the benefits of prone ventilation and its practice in this study also implies that further investigations will be needed specifically on the practice of prone ventilation in the management of ARDS.

This study had some limitations. Intensivists and Specialist Anaesthesiologists are mainly the clinicians who are known to manage ARDS in the ICUs at the Korle-Bu Teaching Hospital and are expected to have ample knowledge about the study. Due to the depth of specialised knowledge required in the management of ARDS, very few of these clinicians were available at the study site.

Conclusion
Specialist Anaesthesiologists who manage patients at the surgical ICU of Korle-Bu Teaching Hospital have a high knowledge of diagnosis and management of ARDS. Their standard of practice was above average. Among the management strategies, prone ventilation was the least adopted.

DECLARATIONS

Ethical considerations
Ethical Clearance was obtained from the Korle-Bu Teaching Hospital Research Unit and the Ethical Committee of the School of Biomedical and Allied Health Sciences (SBAHS) with a clearance number of SBAHS/AA/RT/10658512/2020-2021.

Consent to publish
All authors agreed to the content of the final paper.

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Competing Interest
No conflict of interest was reported by the authors.

Author contributions
EYB and RD conceptualised the study, were involved in the research investigations and methodology design, and helped write and review the final manuscript. RA collected, entered and interpreted the data during the research, as well as worked on the initial and final drafts of the manuscript. GA participated in the data analysis, editing and interpretation of the data. DHB aided data collection during the research investigations. RGO contributed to reviewing the various sections of the manuscript before submission. All authors read, reviewed and approved the final manuscript.

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Availability of data
The data used for this article is available upon request to the corresponding author.

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