

Original Research Article

Study of etiology and scoring system in acute lung injury and acute respiratory distress syndrome patients

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Received: 07 June 2018

Accepted: 12 June 2018

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ABSTRACT

Background: The acute respiratory distress syndrome (ARDS) is a clinical disorder characterized by injury to the alveolar epithelium and endothelial barriers of the lung, acute inflammation, and protein rich pulmonary edema leading to respiratory failure. Present study was carried out to investigate the mortality pattern of ALI/ARDS in the patients and to study the etiological factors leading to ALI/ARDS also to study the clinical pattern in patients with ALI/ARDS.

Methods: All patients fulfilling the inclusion criteria as per the 1994 American European Consensus Conference on ARDS/ALI definition of ARDS/ALI were included in the study. On clinical examination the vital parameters were recorded. The respiratory system, abdominal, cardiovascular and central nervous systems were examined in detail. The severity of the illness was measured by the acute physiology and Chronic Health Evaluation (APACHE) Score, Multiple Organ Dysfunction score (MODS), lung injury score (LIS) and Sequential Organ Dysfunction Assessment (SOFA score). These scores were calculated on admission to our intensive care unit.

Results: Out of the 65 patients 35 survived and 30 died. A multiple organ dysfunction Score of less than or equal to 4 was seen in 29 patients and more than 4 in 36 patient and a score of less than or equal to 4 was seen in 21 survivors and 8 dead patients, while a score of more than four was found in 14 patients who survived versus 22 patients who died. A lung injury score of less than or equal to 2 was seen in patients and more than 2 in 46 patients and a score of less than or equal to 2 was seen in 14 survivors and 5 non-survivors patients, while a score of more than 2 was found in 21 patients who survived versus 25 patients who died.

Conclusions: The commonest etiological conditions leading to ALI/ARDS are pneumonia and tropical diseases including malaria, leptospirosis and dengue. The scoring systems, MODS, LIS and APACHE II are good indicators of the outcome of this condition. They are useful in tropical diseases as well.

Keywords: Acute respiratory distress syndrome (ARDS), Acute lung injury (ALI), Clinical scores

INTRODUCTION

The acute respiratory distress syndrome (ARDS) is a clinical disorder characterized by injury to the alveolar epithelium and endothelial barriers of the lung, acute inflammation, and protein rich pulmonary edema leading to respiratory failure.¹ It is a catastrophic condition

which, develops in critically ill patients with a wide range of underlying diseases. It is characterized by dyspnea, tachypnea, arterial hypoxemia, diffuse bilateral infiltrates on chest radiographs, and reduced pulmonary compliance. ARDS and acute lung injury (ALI) are the two ends of a spectrum of the same clinical disorder with ALI being at the lower end of the spectrum.

In recent times numerous studies have been under taken to understand the pathophysiology of ALI / ARDS and to evaluate the effectiveness of the various treatment modalities. There have been several attempts to define (ALI/ARDS) and provide a workable definition that would be useful in both clinical management and research.²

The following conditions are the most common causes of ARDS: sepsis, gastric aspiration, lung contusion, massive transfusion of blood, pneumonia, and major trauma.³ There have been quite a few attempts to find factors to predict the outcome in these patients and numerous scoring systems have been devised for determining the outcome and planning further management. It is essential to take all these factors while studying the etiologies and predicting outcomes in patients of ALI/ARDS as they add an exceptional challenge in management of ALI/ARDS.

The objectives of the present study were to study the mortality pattern of and etiological factors leading to ALI/ARDS in the patients admitted in an intensive respiratory care unit at a tertiary care institute and to study the value of scoring systems, MODS (Multiple Organ Dysfunction Score), SOFA (Sequential Organ Function Assessment), LIS (Lung Injury Severity) and APACHE II (Acute Physiological, Age and Chronic Health Evaluation II) in ALI/ARDS.

METHODS

A prospective study which included all patients with ALI/ARDS (as per the inclusion criteria) admitted in the intensive Respiratory Care Unit from July 2015 to July 2016.

Inclusion criteria

- PaO₂/FiO₂ <300 for ALI and PaO₂/FiO₂ <200 for ARDS regardless of presence or level of PEEP
- Chest X-ray with bilateral pulmonary infiltrates.

Exclusion criteria

All patients not fulfilling the inclusion criteria as per the 1994 American European Consensus Conference on ARDS/ALI definition of ARDS/ALI were excluded from the study.

The detailed clinical history included the onset, duration and the progress of the presenting complaints. It also included a search in the etiology of the condition leading to ALI/ARDS such as history of trauma or any surgery or blood transfusions, fractures. The details of treatment prior to admission in the IRCU were also taken into account.

On clinical examination the vital parameters were recorded. The respiratory system, abdominal, cardiovascular and central nervous systems were

examined in detail. The patient was investigated initially with required tests. The severity of the illness was measured by the acute physiology and Chronic Health Evaluation (APACHE) Score 4, Multiple Organ Dysfunction Score (MODS) 5, Lung Injury Score (LIS) 6 and Sequential Organ Dysfunction Assessment (SOFA Score).⁷ These scores were calculated on admission to our intensive care unit.

Risk factors for ALI/ARDS for each case were prospectively defined. Sepsis was defined as present if at least three of the following criteria were satisfied: The presence of pneumonia was defined from the radiographic presence of new infiltrate(s), coupled with identification of at least one pathogen in a sputum specimen and clinical evidence of infection.⁸

Routine standard care offered to these critically ill patients comprised of intensive nursing care, haemodynamic monitoring, central venous line, nasogastric tube aspiration, endotracheal intubation, mechanical ventilator support, total parenteral nutrition, intravenous crystalloid infusion with serial monitoring of hematological and biochemical parameters. The outcome was studied by calculating the number of days in IRCU, number of days on ventilator.

Statistical analysis

Statistical analysis of the data was done by SPSS 10 for Windows (SPSS, Inc., Chicago, Illinois). Data was entered in Microsoft Excel and results were analyzed in the form of percentage and proportions whenever appropriate.

RESULTS

Out of the 65 patients 35 survived and 30 died. It was seen from Table 1 that out of the 65 patients, 44 were males & 21 were female patients. The conditions leading to ARDS included, pneumonia (21 patients), tropical diseases including malaria, leptospirosis, dengue (15 patients), post-operative septicemia (8 patients), polytrauma (8 patients), pulmonary tuberculosis (6 patients), malignancy (3 patients), neurological disorders (2 patients) and poisonings (2 patients).

Table 1: The causes of death.

Age	Frequency	%	Sex	
			Male	Female
<25 years	18	27.7	07	03
25-50 years	35	53.8	27	14
>50 years	12	18.5	10	04
Total	65	100	44 (67.7%)	21 (32.3%)

It was seen from Table 2 that two patients one which was a case of hydrochloric acid poisoning and the other which

was a case of post-operative sepsis had history of gastric content aspiration, however the poisoning and sepsis respectively were responsible for ARDS as the patients had already fulfilled criteria for ALI/ARDS before the aspiration. Tropical diseases included Leptospirosis (6 patients), malaria (2 patients), Malaria and Leptospirosis (1 patient), dengue (1 patient), diseases which were clinically diagnostic of any of the previous diseases but were not confirmed by laboratory tests (5 cases).

Table 2: Diagnosis of the patients.

Diagnosis	Frequency	Percent
Pneumonia	21	32.3
Post operative septicemia	08	12.3
Polytrauma	08	12.3
PTB	06	9.2
Poisoning	02	3.1
Malignancy	03	4.6
Neurological disorder	02	3.1
Tropical diseases	15	23.1

It was seen from Table 3 that the time between onset of symptoms and the patient presenting to the hospital was less than 10 days in 43 patients and more than 10 days in 22 patients.

Table 3: Distribution of tropical diseases.

Tropical disease	Frequency	Percent
Leptospirosis	6	40
Malaria	2	13.3
Dengue	1	6.7
Malaria + leptospirosis	1	6.7
Not diagnosed	5	33.3

It was seen from Table 4 that Multiple Organ Dysfunction Score of less than or equal to 4 was seen in 29 patients and more than 4 in 36 patients. It was observed that a score of less than or equal to 4 was seen in 21 survivors and 8 dead patients while a score of more than four was found in 14 patients who survived versus 22 patients who died.

Table 4: Time between onset of symptoms and presenting to hospital.

Onset of symptoms	Number of patients
<10 days	43 patients
>10 days	22 patients

A LIS (Lung Injury Score) of less than or equal to 2 was seen in patients and more than 2 in 46 patients. It was observed that a score of less than or equal to 2 was seen in 14 survivors and 5 non-survivors patients while a score of more than 2 was found in 21 patients who survived versus 25 patients who died. An APACHE 2 (Acute Physiological Age Chronic Health Evaluation 2) score of less than or equal to 12 was seen in 25 patients and more

than 12 in 40 patients. It was observed that a score of less than or equal to 12 was seen in 19 survivors and 6 dead patients while a score of more than 12 was found in 16 patients who survived versus 24 patients who died.

SOFA (Sequential Organ Functional Assessment) score was less than equal to 5 in 30 patients and more than five in 35 patients. The SOFA, LIS scores were significantly higher for the cases with tropical diseases than the rest of the cases. Of the 65 patients 26 patients were not ventilated while 39 patients were ventilated. The patients were ventilated with similar ventilator strategies with a tidal volume of 8 ml/kg, PEEP of 8-10 cm of water whenever required and FiO₂ as per PO₂ on arterial blood gas analysis. Inverse ratio ventilation and prone position ventilation were tried in 5 and 1 patients respectively.

DISCUSSION

Much of the available data on the clinical course, risk factors, predictors of outcome and the effects on lung function in survivors are from western literature. The relatively higher prevalence of tropical diseases in India as compared to western countries adds a new dimension in the study of ALI/ARDS. The restricted financial resources add more challenges in management of ALI/ARDS. In our study, we used the 1994 American European Consensus Conference on ARDS/ALI definition of ARDS/ALI as the inclusion criteria. Present study had a total of 65 patients, out of which 35 survived and 30 did not survive. We had a mortality rate of 46.2% as compared to a Rocco et al, 74% in a study by Jerng et al.^{9,10}

Gender distribution pattern

In present study, there were 67.7% (n=44) male patients and 32.3% (n=21) female patients. 52.3% (n=23) of all the male patients and 33.3% (n=7) of all the female patients died. Thus, a lower mortality rate was observed in the female patients. In the study by Zilberberg et al there were 60.7% male patients and 39.3% female patients, and the mortality was similar in both the groups.¹¹ It has been advocated that gender affects the outcome of mechanical ventilation with females having a higher mortality.¹² However in our study 72.4% of the males and 50% of the females who were mechanically ventilated did not survive showing a lower mortality in females.

Age distribution pattern

The mean age of the patients in our study was 33.37 (±15.14) years in survivors and 39.40 (±15.49) years in the non-survivors. The mortality in the age group above 60 years of age (42.9%) was less as compared to that in the age group of 20-60 years (57.9%) contrary to the finding in a number of studies.^{11,13} The mortality was least in the age group of <20 years. Similar to our observation Vigg et al had a mortality which was the

highest in the age group of 20-60 years.¹⁴ This study included only dead patients who had ALI/ARDS.

Risk factors for ALI/ARDS

The risk factors for developing ALI/ARDS in present study were- Pneumonia (32.3%), Tropical diseases (23.1%), Postoperative sepsis (12.3%), Polytrauma (12.3%), Tuberculosis (9.2%), Malignancy (4.6%), Poisoning (3.1%), and Neurological disorder (3.1%). Among the patients that had not survived the pattern of the risk factors were as follows; Pneumonia (30%), Tropical diseases (26.7%), Postoperative sepsis (13.3%), Polytrauma (13.3%), Malignancy (10%), Poisoning (3.3%), Neurological disorder (3.3%)

In the study of dead patients of ALI/ARDS by Vigg et al the risk factors were follows; primary pulmonary infection (30%), recent abdominal surgery (10%), severe sepsis with multi organ failure (18%), peritonitis (5%), polytrauma (12%), Thermal burns >40% (6%), pancreatitis (10%), plasmodium falciparum malaria (4%), acute fulminant viral hepatitis (2%) and organophosphorus poisoning (1%).¹⁴ When compared with the risk factors associated with the non-survivors in our study, it is observed that the commonest risk factor is pneumonia and that the incidence of sepsis, polytrauma is quite similar in both the studies however the incidence of tropical diseases is much higher in present study.

In the study by Zilberberg et al the most prevalent predisposing conditions for ALI/ARDS were pneumonia (40%), sepsis (32%) and aspiration of gastric contents (9%). Others which including drug overdose, hyper transfusion, pancreatitis, fat embolism and undiagnosed cases (19%).¹¹ In the study by Jerng et al the most common risk factor was pneumonia (30%). In an extensive study in Argentina involving 4 ICU's the common risk factors were identified as sepsis, including pneumonia (44%), shock (15%), trauma (11%), gastric aspiration (10%). Thus, in most of these studies as well pneumonia is the commonest risk factor leading to ALI/ARDS.¹⁰

Predictors of mortality

Measures of lung injury severity and of severity of illness have variable success in predicting ARDS-associated outcome. A number of reports have found a direct association between poor oxygenation and mortality, whereas other studies have failed to identify a correlation.¹⁵⁻¹⁸ When tested prospectively, increasing severity of lung injury (using LIS score), measured at 24h, 48h, and 72h, was not associated with increased found to be independent of the LIS determined within the first 24h of mechanical ventilation. Similarly, some investigators have found that APACHE II scores predict outcome for ARDS.^{19,20} However, other investigators have not confirmed this finding.²¹⁻²³

In a study by Elisa Estenssoro et al APACHE II and SOFA scores were associated with a high mortality.²⁴ In another study by Rocco TR et al, predictors at the onset of ARDS were found to be MODS>8 or more and LIS>2.76.⁹ In the study in dead patients by Vigg et al of ALI/ARDS the mean LIS was 2.76 (+1.8), the mean MODS was 9 (+ 2) and the mean APACHE II score was 28 (+3).¹⁴ In the study by Herridge et al the median MODS score on first day was 10 for non-survivors. In our study, MODS, LIS, APACHE score were seen as significant predictors mortality on day of admission to our ICU.²⁵ We also saw that a MODS of >4, LIS >2 and APACHE II >12 had higher association with mortality. The mean score in non-survivors were as follows: MODS 5.3, LIS 2.3 and APACHE II 17.6. These scoring systems were equally effective in predicting mortality in ALI/ARDS due to tropical diseases. It is also noteworthy that the scores predicting mortality in our study are in a much lower range that in any of the other studies. The SOFA score was not found to be useful in predicting the outcome. It should be noted that we used the score only during assessment of the patients on the first day of admission in our ICU. The mean P/f ratio in survivors was 208 and 167 in non-survivors in our study. However no significant difference has been found in the P/f ratio in survivors and non-survivors in other studies.^{14,24}

CONCLUSION

ALI/ARDS is a devastating clinical condition associated with a high mortality. The mortality is highest in the 25-60 years age group and less in the <25 years age group. The mortality is more in males. Commonest etiological conditions leading to ALI/ARDS are pneumonia and tropical diseases including malaria, leptospirosis and dengue. The commonest co-morbid conditions seen in ALI/ARDS patients are respiratory diseases like COPD, hypertension, diabetes, HIV and ischemic heart disease. These conditions do not affect the prognosis of the patient.

The shorter the duration between onsets of symptoms especially cough and presentation to the hospital the better the outcome of ALI/ARDS. The commonest non-pulmonary organ dysfunctions are hematological the mortality is significant. The scoring systems, MODS, LIS and APACHE II are good indicators of the outcome of this condition. They are useful in tropical diseases as well. A shorter duration of mechanical ventilation is associated with better survival. The mortality is the highest in the first 24 hours of mechanical ventilation.

ACKNOWLEDGEMENTS

Authors would like to acknowledge statistician Mrs. Sucharita Suresh for her invaluable contribution.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Chabukswar P, Baviskar J. Study of etiology and scoring system in acute lung injury and acute respiratory distress syndrome patients. *Int J Adv Med* 2018;5:854-8.