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Original Research Article

Study of clinical profile of acute respiratory distress syndrome in pneumonia and outcome in intensive care unit

Aniket Deshmukh*, Anita Paritekar

Department of Medicine, RCSM GMC & CPR Hospital, Kolhapur, Maharashtra, India

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***Correspondence:**
Dr. Aniket Deshmukh,
E-mail: dr.aniket16@gmail.com

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ABSTRACT

Background: ARDS is a progressive inflammatory lung injury in patients with hypoxemic respiratory failure. Aspiration pneumonia and pneumonia are the most common cause of ARDS in direct lung injury whereas sepsis is the most common cause of ARDS in Indirect lung injury.
Methods: This was observational study conducted in Intensive care unit, Department of Medicine, CPR Hospital, Kolhapur, Maharashtra for 6 months from 1 June to 30 November 2023 in 41 patients.
Results: Most common cause of ARDS secondary to pneumonia, in this study population is bacterial pneumonia, followed by viral and parasitic infections. Average day of hospital stay for bacterial pneumonia is 13 days and 11 and 10 days for viral and parasitic infections respectively. For bacterial pneumonia mortality was 36%, for viral pneumonia was 37% and parasitic pneumonia was 33.33%. Out of 41 patients,16 patients were in mild ARDS with the SOFA score range of 2 to 5 and 12 patients were in moderate ARDS with SOFA score range of 6 to 9 and 12 patients were in severe ARDS with SOFA score range of 12 to 14.
Conclusions: With our study we would like to conclude that sofa score is a good predictor of mortality in c/o ARDS patients in ICU setting. Patients who had sofa score of equal or more than 9 and who were in the category of moderate to severe ARDS, had poorer outcomes and high mortality rate.

Keywords: Acute respiratory distress syndrome, Pneumonia, SOFA score

INTRODUCTION

Patients with hypoxemic respiratory failure may develop ARDS, a progressive inflammatory lung damage. According to the American-European Consensus Conference[1], patients are identified by abrupt respiratory failure refractory to oxygen supply, bilateral lung infiltrates, and reduced lung compliance in the absence of heart failure. ARDS can be brought on by both medical and surgical factors.[2] ARDS has a significant death rate and is caused by numerous direct and indirect lung damage. Mortality rates in India's northern, southern, and western regions are, respectively, 47.8 %, 36.6 %, and 57%.[3] While sepsis is the most frequent cause of ARDS in indirect lung injury, aspiration pneumonia and pneumonia are the most frequent causes of ARDS in direct lung injury. Other tropical infection-related causes of ARDS include leptospirosis, malaria, and dengue.[2,4] Early management of a critical team in the areas of intensive invasive monitoring, sepsis control, and the need for ventilator assistance such prone ventilation is advantageous and can occasionally improve the patient's fate in ARDS because it is linked to a high death rate.[5] A complex and integrated reaction of local and systemic variables results in ARDS. Endothelial injury and neutrophilic activation from diffuse alveolar damage result in non-cardiogenic pulmonary edema and atelectasis.[6] Acute cryptogenic pneumonia, which is often

rare, can sometimes be confused with ARDS because the main differential diagnosis of ARDS includes cardiogenic pulmonary oedema, acute eosinophilic pneumonia, and acute interstitial pneumonia. There are also co-occurring extra pulmonary ARDS causes, which can manifest at the beginning of the illness.[7] Most ARDS patients benefit from non-invasive ventilation, which may or may not be necessary depending on the clinical or laboratory findings. This research aimed to study clinical profile of acute respiratory distress syndrome in pneumonia and outcome in intensive care unit. This study objectives were to determine the various etiologies of acute respiratory distress syndrome, to study prognosis of acute respiratory distress syndrome in pneumonia, and to evaluate the duration of hospital stay in discharged patient.

METHODS

Study design and place

This was observational study conducted in Intensive care unit, Department of Medicine, CPR Hospital, Kolhapur, Maharashtra for 6 months from 1 June to 30 November 2023 in 41 patients. Approval taken from institutional ethical committee for the study. Informed verbal consent was taken from patients.

Sampling

It was done by simple random sampling.

Study population

Total 41 ARDS patients admitted in medicine ICU fulfilling inclusion criteria.

Inclusion criteria

Patients fulfilling the BERLIN criteria for acute respiratory distress syndrome, any case of severe acute respiratory infection were included.

Exclusion criteria

Patients <18 years of age, polytrauma, cardiogenic pulmonary edema, poisoning cases, acute pancreatitis were excluded.

Study tool

1) Detailed history from patients and reliable informants, 2) Clinical Examination (BP, GCS), 3) Chest x ray, 4) CBC (platelet count), RFT (serum creatinine), LFT (serum bilirubin), 5) Arterial blood gas analysis and calculating Pao2/fio2 ratio and categorizing into mild, moderate and severe category of ARDS, 6) Sputum routine microscopy and culture sensitivity, 7) Viral panel RTPCR, 8) Fever profile, 9) Rapid malaria antigen test.

Procedure

After taking IEC approval study was started. 41 patients of ARDS admitted in medicine ICU fulfilling berlins criteria (using pao2/fio2 value and chest x-ray findings) except the exclusion criteria were selected randomly. Patients are classified on the basis history, clinical features, reports of sputum culture sensitivity, RTPCR panel and fever profile as bacterial, viral and parasitic pneumonia. After clinically assessing the patient, SOFA score was calculated using MAP, GCS, platelet count, serum creatinine, serum bilirubin levels.

Berlins criteria and SOFA score used for the study are mentioned below.

Table 1: BERLINS criteria.

Timing	Within 1 week of known clinical insult or new worsening respiratory symptoms
Chest imaging	Bilateral opacities not fully explained by effusions, lobar or lung collapse or nodules
Origin of edema	Respiratory failure not explained by cardiac failure or fluid overload. Need objective assessment (Echocardiography) to exclude hydrostatic edema if no risk factor present
Oxygenation	
Mild	Pao2/fio2 : 200- 300 mm hg , with PEEP or CPAP >= 5 cm of water
Moderate	Pao2/fio2 : 100-200 mm hg , with PEEP or CPAP >= 5 cm of water
Severe	Pao2/fio2 :<100 mm hg, with PEEP or CPAP >= 5 cm of water

Table 2: The sequential organ failure assessment (SOFA) score.

System	0	1	2	3	4
Respiration pao2/fio2, mmHg	>400	300-400	200-300	100-200	<100
Platelets lakhs/cumm	1.5	<1.5	<1	<0.5	<0.2
Liver (billirubin, mg/dl)	<1.2	1.2-1.9	2-5.9	6-11.9	>12
CNS, GCS score	15	13-14	10-12	6-9	<6
Renal (creatinine, mg/dl)	<1.2	1.2-1.9	2-3.4	3.5-4.9	>5
Cardiovascular MAP (mm hg) ionotrope in ug/kg/min	>70	<70	Dopamine <5 or dobutamine of any dose	Dopamine 5.1-15 or norepinephrine <0.1	Dopamine >15 norepinephrine >0.1

Statistical analysis

IBM SPSS version 20 is used for analysis. Chi-square test and for smaller frequencies fishers exact test of statistical analysis is used.

RESULTS

As shown in Figure 1, in our study most common age group affected with ARDS secondary to pneumonia is between age of 31-50 years affecting 17 patients followed by age group of 51-70 with 13 patients, followed by 8 patients between age of 18 to 30 years and 3 patients of more than 70 years.

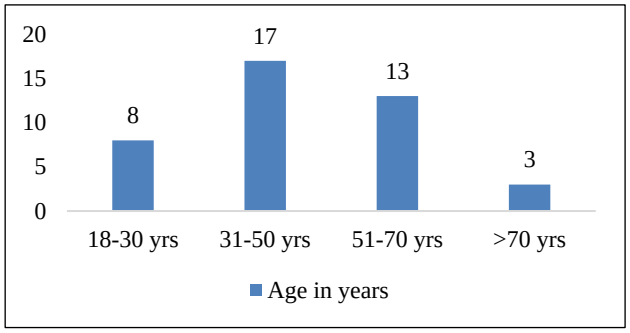

Figure 1: Age distribution.

As shown in Figure 2, in our study males were affected more with ARDS secondary to pneumonia as compared to females (18 vs 13 patients).

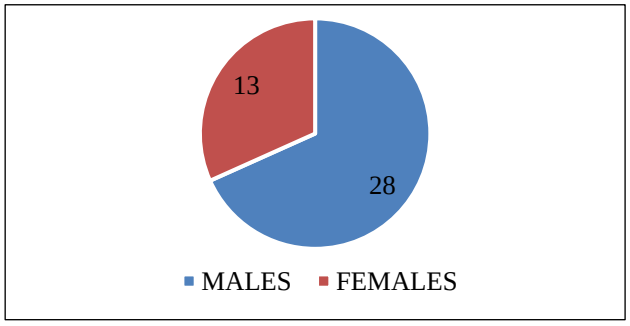

Figure 2: Gender distribution.

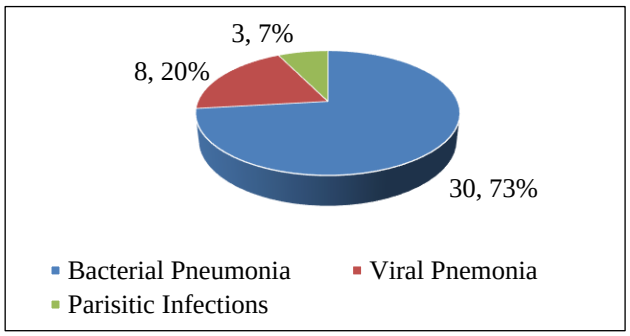

Figure 3: Etiology of pneumonia.

In our study, as shown in Figure 3, most common cause of ARDS in our study was bacterial pneumonia affecting 30 patients contributing to 73% of all affected patients followed by viral and parasitic infections contributing to 20% and 7% respectively.

As shown in Figure 4, out of 41 patients studied 26 patients of ARDS i.e. 63% patients died and 15 patients i.e. 37% patients were cured and got discharged.

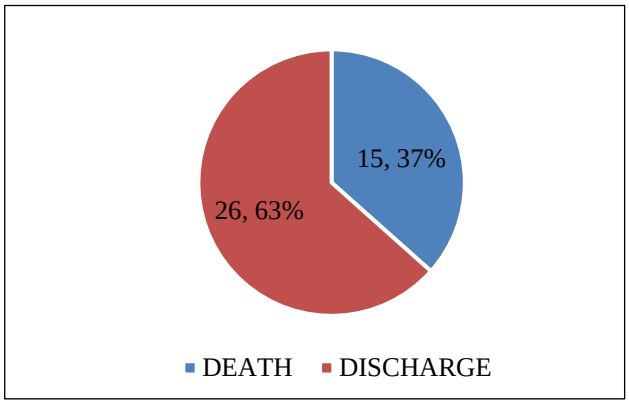

Figure 4: Outcome of patients.

As shown in Figure 5, in our study average duration of hospital stay was maximum in case of bacterial pneumonia, it was 13 days, 11 days in case of viral pneumonia, 10 days in case of parasitic infections (malaria).

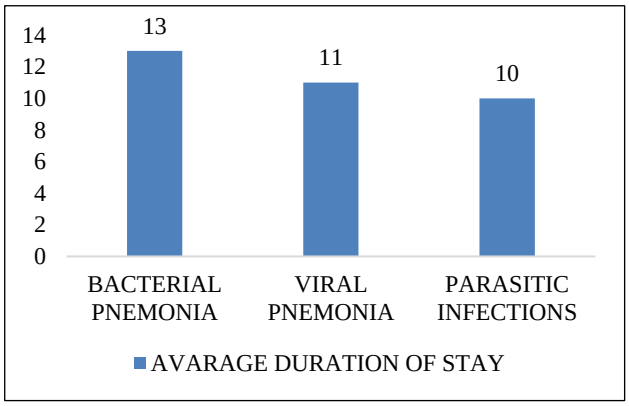

Figure 5: Average duration of stay.

As shown in Figure 6, out of 41 patients, 16 patients were in mild ARDS (pao2/fio2 200-300) category of berlins criteria and SOFA score was 2 in 7 patients, 3 in 6 patients and 5 in 3 patients. 13 patients had moderate ARDS (pao2/fio2 100-200), SOFA score was 6 in 4 patients, 7 in 5 patients, 8 in 3 patients and 9 in 1 patient. 12 patients had severe ARDS (pao2/fio2 <100), SOFA sore in this category was 12 in 5 patients, 13 in 3 and 14 in 4 patients.

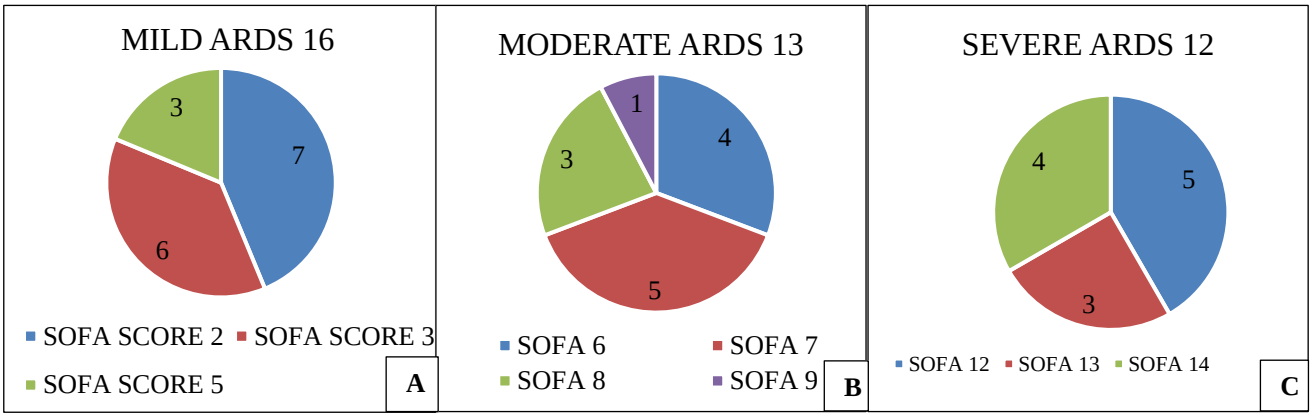

Figure 6 (A-C): Severity of ARDS and SOFA score.

Table 3 and 4 summarizes outcome of ARDS patients i.e. discharged and death of patients according to severity of ARDS and type of pneumonia.

Table 3: Good prognosis: discharged 26 patients.

	Mild ARDS	Moderate ARDS	Severe ARDS
Bacterial	14	5	0
Viral	2	3	0
Parasitic	1	1	0

Table 4: Poor prognosis: death 15 patients.

	Mild ARDS	Moderate ARDS	Severe ARDS
Bacterial	0	3	8
Viral	0	1	2
Parasitic	0	0	1

Most of discharged patients were in mild to moderate ARDS category and had good outcome but patients in severe ARDS category had poor outcomes. Out of total 15 deaths, 4 patients were of moderate ARDS and 11 were of severe ARDS.

DISCUSSION

ARDS is a progressive inflammatory lung injury in patients with hypoxemic respiratory failure. Patients are detected by acute respiratory failure refractory to oxygen supply, bilateral lung infiltrates with decreased lung compliance in absence of cardiac failure according to the American-European Consensus Conference.[1] Medical and surgical causes both contribute to cause ARDS.[2] ALI/ARDS results from various direct/indirect lung injuries and have a high mortality rate. Northern, South and Western parts of India have mortality rates of 47.8%, 36.6% and 57% accordingly.[3] Aspiration pneumonia and pneumonia are the most common cause of ARDS in Direct lung injury whereas sepsis is the most common cause of ARDS in Indirect lung injury. Malaria, dengue, leptospirosis are some other causes of ARDS due to infections in the tropical region.[4]

In our study we found that most common age group affected with ARDS is between 31 to 50 years and this group had maximum deaths. The study done by Rashid et al, in which the mean age for non-recovered patients was higher (49.08±16.57 years) than the recovered patients (44.41±14.53 years).[8] Moreover, age greater than 60 years appeared to be an independent predictor of non-recovery in our group of patients. Similarly, numerous studies across the world observed that advanced age is an independent predictor of non-recovery or mortality in ARDS patients. Also male domination was observed in studies from Pakistan, India, and other parts of the world. Being a male gender significantly affected the non-recovery.[9] Findings were observed in other studies, in which it is observed that being a male gender is a risk factor for non-recovery or mortality among ARDS patients.[10] This was comparable with our study in which males were affected more with ARDS as compared to females (68% vs 32%) and mortality was higher amongst males.

Acute respiratory distress syndrome (ARDS) and pneumonia are closely correlated in the critically ill patient. Whereas ARDS is often complicated by nosocomial pneumonia, pulmonary infection is also the most frequent single cause of ARDS. The prevalence of pneumonia during the course of ARDS seems to be particularly high, but whether persons with ARDS are more susceptible to pneumonia or simply have more risk factors remains unknown because of methodological limitations. Recent research suggests that host factors have a major bearing on the development of ARDS. To date, sepsis seems to be the principal link between pneumonia and ARDS.[11] The individual role of specific pathogens for the development of ARDS is difficult to assess, because prospective studies are missing. Respiratory viruses have received particular attention, but this review suggests that infections with coronavirus and avian influenza virus (H5N1) are associated with a high incidence of ARDS. In cases with known risk etiologies for severe pneumonias, such as *Streptococcus*

pneumoniae and/or *Pseudomonas aeruginosa* infections, the sequence pneumonia => sepsis => ARDS is quite obvious and is not considered to be noteworthy.[12] Markowicz et al compared 134 patients with ARDS with 744 patients without ARDS and found that nonfermenting, gram-negative bacteria caused significantly more cases of pneumonia among patients with ARDS.[13] Mortality rates were comparable between the 2 groups, but the incidence of pneumonia increased with time on mechanical ventilation. In cases of pneumonia due to *P. aeruginosa*, specific cytotoxic mediators may explain the high rate of lung injury during infection .

In study done by Rabagliati et al, the prevalence of viral pneumonia was 9% (31 of 338 persons), and the prevalence of mixed viral and/or bacterial pneumonia was 18% (61 of 338 persons). Influenza A was by far the most common viral etiology, and the annual prevalence showed a seasonal pattern.[14] It seemed that persons with mixed infections were at increased risk to progress to sepsis or septic shock; however, data on ARDS were not provided in this study. Also, in this observational study he did not provide this information for their cohort of 55 hospitalized patients with influenza, but stated that 18 (33%) of 55 patients had pneumonia and that only 1 patient died. In the clinical description of 10 cases of H5N1 infection in Vietnam, ARDS is not explicitly mentioned, but severe respiratory failure was present in 9 of 10 cases, bilateral pulmonary infiltrates “occurred,” and mortality was 80%, indicating that the criteria for ARDS may have been fulfilled in a high percentage of patients.[15] Parasitic infection with pulmonary involvement in immunocompetent patients may be regarded as a rare disease. Malaria due to infection with *Plasmodium falciparum* is, however, noted remarkably often in the literature as being associated with ARDS. Losert et al reviewed 104 patients admitted to the hospital with malaria, of whom 66% had *P. falciparum* infections, and 7 of these were admitted to the intensive care unit.[16] In our study, most common cause of ARDS was bacterial pneumonia affecting 30 patients contributing to 73% of all affected patients followed by viral and parasitic infections mainly malaria contributing to 20% and 7% respectively.

The severity of ARDS is classified into categories of mild, moderate, and severe, depending on the degree of hypoxemia. Patients with moderate-to-severe ARDS require invasive mechanical ventilation (IMV) and have a poor prognosis. [17]

In our study out of 41 patients studied 26 patients of ARDS i.e. 63% patients died and patient who died were in severe ARDS category and 15 patients i.e. 37% patients were cured and got discharged were in mild to moderate category.

ARDS patients may require ventilation for long periods of time. On average this is seven to 14 days. In a study Chinh et al, the median length of stay in a local hospital was 8 days for non-survivors and 17 days for survivors (p<0.001). The duration of hospitalization (p<0.001) and MV (p<0.001) were significantly shorter in non-survivors than in survivors. A total 70.8% of non-survivors died within 7 days of admission to the central hospital, and all non-survivors died within 28 days of hospital admission.[18]

In our study average duration of hospital stay was maximum in case of bacterial pneumonia, it was 13 days, 11 days in case of viral pneumonia, 10 days in case of parasitic infections (malaria). Out of 15 died patients, 11 were of bacterial pneumonia, 3 of viral pneumonia and 1 patient of ARDS secondary to malaria infection. Out of 15 died patients, 4 were in moderate ARDS and 11 were in severe ARDS category.

In 1996, Vincent et al introduced the SOFA scoring system that was initially designed to sequentially assess the severity of organ dysfunction in patients who were critically ill from sepsis.[19] It is a scoring tool to evaluate organ dysfunction, using six organ system reproducible variables that measure disease severity during an intensive care unit (ICU) stay.[20] Since the early 1990s, the SOFA score has become an integrated tool to predict mortality in patients with multi-organ failure in the ICU.[21] Hence is being widely employed in critical care units worldwide for monitoring acute morbidity. In a study done Fayed et al, a SOFA score from 0 to 1 is associated with 100% survival, while a SOFA score greater than 11 is associated with 100% mortality. Incidence of mortality increases in SOFA scores between 6 and 11 compared to the original SOFA score. SOFA score 6-7 is associated with 35% mortality compared to 20% in the original SOFA score.

In our study we found that Out of 41 patients ,16 patients were in mild ARDS (pao2/fio2 200-300) category of berlins criteria and SOFA score was 2 in 7 patients, 3 in 6 patients and 5 in 3 patients. 13 patients had moderate ARDS (pao2/fio2 100-200), SOFA score was 6 in 4 patients, 7 in 5 patients, 8 in 3 patients and 9 in 1 patient. 12 patients had severe ARDS (pao2/fio2 <100), SOFA sore in this category was 12 in 5 patients, 13 in 3 and 14 in 4 patients. This is suggestive of higher SOFA score of more than 9 is seen in moderate and severe ARDS patients who had poor outcome. This study was comparable with the study done by Vincent et al.

It is important to note that these observations are based on small sample size and may not be generalised to large population.

CONCLUSION

With our study we would like to conclude that sofa score is a good predictor of mortality in c/o ARDS patients in ICU setting. Patients who had sofa score of equal or more than 9 and who were in the category of moderate to

severe ARDS, had poorer outcomes and high mortality rate.

Early management of ARDS in the intensive care units, sepsis control with appropriate antibiotics and timely intervention like use of invasive and non invasive ventilation as and when indicated can improve the patient's fate and improve overall outcome.

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

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