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Evaluation of Patients with Acute Respiratory Distress Syndrome Followed on Mechanical Ventilator in a Tertiary Pediatric Intensive Care and the Factors That May Be Associated with Death in These Patients

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What is already known on this topic?

- *Pediatric acute respiratory distress syndrome (PARDS) is a diffuse and noncardiogenic acute lung injury that develops due to increased permeability of the alveolo-capillary membrane and affects both lungs. Elimination of the cause of PARDS and mechanical ventilation (MV) is the mainstay of treatment for patients with severe PARDS. Pressure-controlled or volume-controlled MV mode can be used. There are many factors associated with mortality in these patients.*

What this study adds on this topic?

- *Despite advances in follow-up and management, mortality due to PARDS is still high. Mechanical ventilation duration, length of stay in pediatric intensive care unit, PIPmax, PEEP max, breath rate. max, mortality scores, aspartate aminotransferase levels, lactate dehydrogenase levels, and pH levels associated with mortality are recorded. To the best of our knowledge, the results of this study have shown for the first time that application of alternate MV may reduce mortality rates in PARDS patients.*

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ABSTRACT

Objective: We aimed to evaluate the clinical, demographic, and laboratory characteristics of the patients followed up with pediatric acute respiratory distress syndrome in our pediatric intensive care unit and to determine the factors that have an effect on the outcomes.

Materials and Methods: The medical records of 40 patients with acute respiratory distress syndrome who were followed up on mechanical ventilators in the pediatric intensive care unit of Adıyaman University were retrospectively scanned. From the medical records, the demographic data, clinical features, and laboratory characteristics were recorded.

Results: Eighteen of the patients were female and 22 were male. The mean age was 45.25 ± 56.63 months. A total of 27 (67.5%) of the patients were classified as pulmonary and 13 (32.5%) as extrapulmonary acute respiratory distress syndrome. Sixteen (40%) patients were followed in pressure-controlled mode only, 2 (5%) patients in volume-controlled mode only, and 22 (55%) patients in alternate modes. A total of 17 (42.5%) patients died. The median pediatric index of mortality, pediatric index of mortality-II, pediatric risk of mortality, and pediatric logistic organ dysfunction score values of the surviving patients were significantly lower than the dead patients. Median aspartate aminotransferase (P = .003) and lactate dehydrogenase (P = .008) values were found to be significantly higher in patients who died, while median pH values (P = .049) were found to be lower. The median length of stay in pediatric intensive care unit and duration of mechanical ventilators were significantly shorter in patients who died. Also, the median pediatric index of mortality, pediatric index of mortality-II, pediatric risk of mortality, and pediatric logistic organ dysfunction values of pulmonary acute respiratory distress syndrome patients were significantly lower than those of extrapulmonary acute respiratory distress syndrome patients.

Conclusion: Despite advances in follow-up and management, mortality due to acute respiratory distress syndrome is still high. Mechanical ventilator duration, length of stay in pediatric intensive care unit, some mechanical ventilator parameters, mortality scores, and laboratory tests were associated with mortality. Alternatively, mechanical ventilator applications may reduce mortality rates.

Keywords: Acute respiratory distress syndrome, mechanical ventilation, outcome, pediatric, prognostic factors

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INTRODUCTION

Acute respiratory distress syndrome (ARDS) is a diffuse and noncardiogenic acute lung injury that develops due to increased permeability of the alveolo-capillary membrane and affects both lungs. The main pathology is the presence of a diffuse inflammatory process affecting both lungs. First in 1967, ARDS was defined by the common features of physiological, pathological, and radiological findings in some of the patients followed up for respiratory failure.[1] Acute respiratory distress syndrome was redefined and classified with the Berlin criteria published in 2012 as mild, moderate, and severe.[2] Finally, at the "Pediatric Acute Lung Injury Consensus Conference" (PALICC) held in 2015, the definition of pediatric ARDS (PARDS) based on oxygenation index was made.[3]

Although researches on ARDS in the pediatric population are not as sufficient as in the adult patient population, they are increasing gradually. Sepsis, pneumonia, malignancy, burns, and shock are the most common causes of ARDS in the pediatric age group.[4] Although elimination of the cause of PARDS is the mainstay of treatment, mechanical ventilation (MV), permissive hypercapnia, high-frequency oscillatory ventilation, nitric oxide, and extracorporeal membrane oxygenation are of great importance in the treatment.[5]

Today, PARDS is still considered a common and important clinical problem worldwide, with a high mortality and morbidity rate. Although there are few studies,[6] there is not enough data in the literature about PARDS experiences in our country. The main aim of the study was to determine the factors associated with mortality in PARDS patients who badly needed MV support. This study also aimed to contribute to the epidemiological data by discussing the demographic, clinical, and laboratory characteristics of these patients.

MATERIALS AND METHODS

Design and Setting

A total of 10 beds and 10 mechanical ventilators were available (2 Avea, 5 Engstrom CareStation, 1 Hamilton Galileo, and 2 Hamilton C-2) in our PICU.

We retrospectively evaluated the medical records of patients who were mechanically ventilated in the PICU due to PARDS during a follow-up period between January 1, 2013, and December 31, 2018. The population of the study consisted of patients between the ages of 1 month and 18 years. Newborn babies were excluded from the study because the neonatal intensive care unit was separated. Patients with mild and moderate ARDS who received high-flow nasal cannula oxygenation (Fisher Paykel Airvo 2) support without MV were excluded from the study.

From the medical records, demographic data (age and sex), clinical features (diagnosis of hospitalization, intensive care scores, ARDS occurrence time, ARDS etiology, ARDS severity, MV parameters, duration of follow-up on MV, treatments applied, length of stay (LOS) and outcomes), and laboratory characteristics (blood gas analysis, hemogram, and biochemical test results) were recorded.

The MV parameters of all patients were recorded as initial values and the maximum values during the follow-up. The recorded MV parameters were mode, tidal volume (TV), positive end-expiratory pressure (PEEP), peak inspiratory pressure (PIP), breath rate, and fractional oxygen concentration (FiO_2). Some patients who were followed up with the pressure-controlled mode were switched to volume-controlled mode to protect the lung at pressures above 35 cmH_2O. The MV mode of these patients was considered alternate mode. In these patients, the volume-controlled mode was used to provide a TV of 4-5 mL/kg when the compliance fell too low, and the pressure-controlled mode was switched again when the compliance increased (Figure 1).

Pediatric index of mortality (PIM), pediatric index of mortality-II (PIM-II), and pediatric risk of mortality (PRISM) scores were calculated for all patients within the first 24 hours of intensive care admission. In addition, pediatric logistic organ dysfunction (PELOD) scoring was calculated for patients with organ failure.

Definitions

Patients were diagnosed with ARDS using the Berlin Criteria until June 2015. After this date, the diagnosis was made using the Pediatric Acute Lung Injury Consensus Conference criteria.[2,3]

Diseases that cause direct lung damage such as pneumonia, aspiration of gastric contents, drowning, severe chest trauma, toxic gas inhalation, and pulmonary embolism were determined as pulmonary ARDS. Sepsis, shock, severe non-thoracic trauma, drug intoxication, and burns were determined as extrapulmonary ARDS.[7]

The criteria of the International pediatric sepsis consensus conference held in 2005 were used for the diagnosis of pediatric sepsis and septic shock.[8]

Multiple organ dysfunction syndrome (MODS) was defined as the simultaneous occurrence of dysfunction in 2 or more organs.[9] We grouped patients with organ system failure as follows: respiratory, cardiac, hematologic, neurologic, renal,

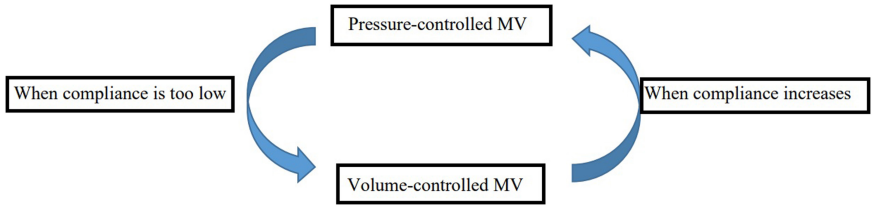

Figure 1. Use of alternately MV mode. MV, mechanical ventilation.

and hepatic; patients could qualify for one or more of these categories.

Statistical Analysis

The Statistical Package for the Social Sciences version 21 for Windows 10.0 program (IBM Corp.; Armonk, NY, USA) was used for statistical analysis during the study. The conformity of the variables to the normal distribution was examined by histogram graphics and the Shapiro–Wilk test. Fisher's exact test and Pearson's chi-square test were used to determine possible statistically significant differences between the categorical variables and expressed as frequency (percentage). An Independent Student's *t*-test was used to compare continuous parametric variables and was expressed as mean ± standard deviation. The Mann–Whitney *U* test was used to compare continuous non-parametric variables and expressed as median (minimum-maximum). $P < .05$ was considered statistically significant.

Ethics Committee Approval

Ethics committee approval was received for this study from the ethics committee of Adıyaman University (2019/9-33).

RESULTS

Demographic Features

During the study period, 3034 patients were followed up in the PICU and 759 (25%) of these patients received MV. Among the patients who received MV, 40 (5.2%) patients diagnosed with ARDS were included in the study (Table 1). The median age of patients was 20.50 months (range 1-187 months). A total of 18 (45%) of the patients were female and 22 (55%) were male. There was no statistical difference between age groups and sex ($P = .611$).

Clinical Features

The most common hospitalization diagnosis was pneumonia (40%). The reason for PARDS was pulmonary in 27 (67.5%) and extrapulmonary in 13 (32.5%) patients. A total of 2 (5%) of the patients had moderate ARDS, and 38 (95%) had severe ARDS. There was no significant relationship between sex and ARDS type ($P = .751$). The median PIM score of the patients was 19.5% (interquartile range (IQR): 13-40), the median PIM-II score was 37% (IQR: 29-45.5), the median PRISM score was 29 (IQR: 23.5-33), and the median PELOD score was 22.5 (IQR: 21-30). It was observed that the median PIM, PIM-II, PRISM, and PELOD values of pulmonary ARDS patients were significantly lower than extrapulmonary ARDS patients (Table 2).

Sixteen (40%) patients were followed in pressure-controlled mode, 2 (5%) patients in volume-controlled mode, and 22 (55%) in alternate mode. The median value of the initial FIO_2 was 70% (range: 30-100), the median value of the initial PIP was 20 cmH_2O (range: 11-32), the median value of the initial breath rate was 30/min (range: 18-45), the median value of the initial PEEP was 5 cmH_2O (range: 5-10), and the median value of the initial TV was 7.5 mL/kg (range: 6-10). During follow-up, most of these parameters were increased. It was observed that the maximum PIP value was increased to 50 cmH_2O, the PEEP value was increased to 15 cmH_2O, the breath rate was increased to 60/min, the FiO_2 value was increased to 100%, and the TV was increased to 10 mL/kg. There was no significant relationship between pulmonary and extrapulmonary ARDS patients in terms of initial and maximum MV parameters.

Table 1. Some Clinical, Demographic, and Laboratory Characteristics of Patients

Age (Months)	**Male, n (%)**	**Female, n (%)**
0-36	14 (60.87)	9 (39.13)
37-108	5 (55.56)	4 (44.44)
109-144	1(25.0)	3 (75.0)
145-216	2 (50.0)	2 (50.0)
The reason for PARDS	**Pulmonary**	**Extrapulmonary**
n (%)	27 (67.5)	13 (32.5)
Severity of PARDS	**Moderate**	**Severe**
n (%)	2 (5)	38 (95)
Mortality scores	**Median**	**Min-max**
PIM (%)	19.5	7-64
PIM-II (%)	37	17-92
PRISM	29	19-47
PELOD	22.5	11-51
Laboratory parameters	**Median**	**Min-max**
White blood cell (10^3/μL)	10.77	(0.46-35.20)
Hemoglobin (g/dL)	10.17	(4.22-16.51)
Hematocrit (%)	31.03	(14.25-53.10)
Platelet count ($\times10^3$ mm^3)	214.8	(5.59-689.70)
Urea (mg/dL)	17.50	(5-205)
Creatinine (mg/dL)	0.42	(0.23-2.89)
AST (IU/L)	60	(10-4202)
ALT (IU/L)	36	(6-1794)
Total creatine kinase (IU/L)	67	(13-6174)
Lactate dehydrogenase (mg/dL)	709	(251-6000)
pH	7.21	(6.89-7.46)
PCO_2 (mmHg)	60.45	(32.50-98.80)
HCO_3 (mEq/L)	22.10	(7.1-40.0)

ALT, alanine aminotransferase; AST, aspartate aminotransferase; HCO_3, serum bicarbonate level; PCO_2, carbon dioxide partial pressure; PELOD, pediatric logistic organ dysfunction; PIM, pediatric index of mortality; PRISM, pediatric risk of mortality.

Life-saving therapies such as prone position (6 patients), surfactant (2 patients), and high-frequency oscillation (HFO) ventilation (1 patient) were applied. While 4 patients benefited from the prone position, there was no response in the patients given surfactant and HFO ventilation support. There was no possibility to perform ECMO in our hospital.

Laboratory Features

The laboratory results of the patients are summarized in Table 1 When laboratory results were compared according to ARDS etiologies, median urea ($P = .001$) and creatinine ($P = .002$) values were found to be significantly higher in extrapulmonary ARDS patients; median pH ($P = .013$) and HCO_3 ($P = .023$) values were found to be significantly lower in these patients.

Outcomes

The median value of the LOS in the PICU was 17.5 days (range: 2-179). The median duration of MV was 276.5 hours (range: 26-3840). There were no significant differences between

Table 2. Comparison of Mortality Scores and Laboratory Parameters for Pulmonary and Extrapulmonary ARDS Patients

Parameters	Pulmonary ARDS Median (Min-Max)	Extrapulmonary Median (Min-Max)	*P*
Mortality scores			
PIM (%)[a]	17.00 (7-63.5)	27.25 (14.3-57.3)	**.046***
PIM-II (%)[a]	32.05 (17.3-91.5)	49.60 (38.2-53.4)	**.001***
PRISM[b]	27.3 ± 6.6	37.0 ± 6.8	**.001***
PELOD[a]	21 (11-32)	41 (30-51)	**<.001***
Laboratory parameters			
Urea (mg/dL)[b]	26.46 ± 37.58	57 (27-144)	**.008***
Creatinine (mg/dL)[b]	0.51 ± 0.4	0.78 (0.39-2.89)	**.008***
AST (IU/L)[a]	50.00 (10-4202)	163.50 (24-4402)	.210
ALT (IU/L)[a]	32.50 (6-1268)	46.50 (7-1794)	.919
CK (IU/L)[a]	64.00 (13-6174)	297.00 (257-310)	.245
LDH (mg/dL)[a]	739.50 (251-6000)	709.00 (545-2449)	.395
pH[a]	7.23 (6.92-7.46)	7.11 (6.89-7.24)	**.013**
CO_2 (mmHg)[b]	62.12 ± 18.74	72.25 ± 23.08	.199
HCO3 (mEq/L)[b]	23.95 ± 7.06	16.90 ± 6.30	**.014***
WBC (10^3/μL)[b]	13.46 ± 8.88	12.28 ± 7.57	.732
HGB (g/dL)[b]	10.45 ± 2.32	9.65 ± 3.86	.452
HTC (%)[b]	31.36 ± 6.94	29.79 ± 10.35	.609
PLT (×10^3 mm^3)[b]	273.06 ± 188.76	177.53 ± 140.86	.189

ALT, alanine aminotransferase; AST, aspartate aminotransferase; Hb, hemoglobin; HCO_3, serum bicarbonate level; HTC, hematocrit; LDH, lactate dehydrogenase; PCO_2, carbon dioxide partial pressure; PELOD, pediatric logistic organ dysfunction; PIM, pediatric index of mortality; PLT, platelet count; PRISM, pediatric risk of mortality; WBC, white blood cells count.
[a]Mann–Whitney *U* test expressed as median (min-max).
[b]Independent Student's *t*-test expressed as median ± standard deviation.
*$P < .05$.

pulmonary and extrapulmonary ARDS patients for the median LOS in the PICU ($P = .08$) and the duration of MV ($P = .287$).

A total of 17 (42.5%) patients died. The factors that may affect survival were examined in detail (Table 3). There was no significant association between demographic characteristics and survival. Similarly, there was no significant relationship between ARDS etiology and death ($P = .25$). It was observed that the survival rate was higher in patients using alternate mode. However, this difference could not reach statistical significance with a borderline *P* value ($P = .058$) in comparison with other groups. Despite there being no significant relationship between initial MV parameters and survival, the maximum PIP, PEEP, and breath rate values were significantly higher in the patients who died. The median PIM ($P \leq .01$), PIM-II ($P = .004$), PRISM ($P = .045$), and PELOD ($P = .045$) scores values of the surviving patients were significantly lower than those who died. The median aspartate aminotransferase (AST) ($P = .003$) and lactate dehydrogenase (LDH) ($P = .008$) values were found to be significantly higher in patients who died, while the median pH values ($P = .049$) were found to be lower. The median LOS in PICU and duration of MV were significantly shorter in patients who died. Although the mortality rate is higher in extrapulmonary PARDS patients, the difference was not statistically significant ($P = .25$).

When the co-morbid conditions of the patients were examined, it was seen that 7 patients had cerebral palsy, 3 patients had neurodegenerative metabolic disease, 1 patient had epilepsy, and 1 patient had immunodeficiency. It is a sentence written to detail the diagnoses of patients who died from patients with co-morbid conditions. There was a considerable prolongation of LOS in PICU for surviving patients (range 23-107 days).

DISCUSSION

When the studies on pediatric ARDS were carefully examined, it was emphasized in many studies that ARDS frequency was high in boys, but this difference was not statistically significant.[4,10,11] In addition, it was stated there was no significant relationship between age and sex in those studies. In our study, in accordance with the literature, it was seen that the majority of the patients were boys and there was no significant relationship between sex and age groups. It was also observed that there was no significant relationship between demographic characteristics and mortality.

Hospitalization diagnoses of PARDS patients in the literature, although highly variable rates are given, mostly consist of pulmonary ARDS causes. Khemani et al[4] reported that pneumonia (62.9%), sepsis (19.2%), aspiration (8.5%), and trauma (3.8%) were the most common PARDS risk factors. In another study, pneumonia (34.9%), sepsis (26.7%), and respiratory syncytial virus-related infection (19.8%) were the most common causes of PARDS.[10] Erickson et al[12] reported that bacterial and viral pneumonia were the most common causes of direct lung injury, while nonpulmonary sepsis was the most common cause of indirect lung injury. In our study, the most common hospitalization diagnosis was found to be pneumonia, consistent with the literature.

In the decisions taken at the PALICC conference, no mode recommendations were made for MV support of PARDS patients.[3] Similarly, in a comprehensive meta-analysis, it was emphasized that there is not enough data on whether pressure-controlled ventilation and volume-controlled ventilation modes have superiority over each other.[13] Rappaport et al[14] reported that there was no significant relationship between MV modes and mortality. Similarly, in our study, no significant relationship was found between MV modes and mortality ($P = .058$). Although statistically not significant, the survival rate (72.7%) was found to be higher in patients followed by alternate modes in our study.

Although the decisions taken at the PALICC conference did not express clear values for the initial MV settings for PARDS patients, it was recommended to apply high PEEP to keep the low TV for patients.[3] A study evaluating children managed with PEEP lower than recommended by the ARDSNet PEEP/FiO_2 reported that PARDS managed with lower PEEP relative to FiO_2 than recommended by the ARDSNet model had higher mortality.[15] Gan et al[6] reported that nonsurvivors in both pulmonary PARDS and extrapulmonary PARDS groups had higher PIP, PEEP, and FiO_2 compared with survivors. Although no significant difference was found between median MV parameters

Table 3. Evaluation of the Factors That May Have an Impact on Outcomes

Parameters	Survivals Median (Min-Max)	Nonsurvivals Median (Min-Max)	*P*
MV duration (hours)[a]	432 (68-3840)	170 (26-461)	**<.001***
LOS (days)[a]	24 (7-179)	8 (2-30)	**<.001***
MV parameters[#]			
FiO_2 (%)[b]	64 ± 22	75 ± 22	.132
PIP (cmH_2O)[b]	20 ± 4	19 ± 6	.689
PIP max (cmH_2O)[b]	24 ± 4	34 ± 10	**<.001***
Breath rate[a]	30 (18-45)	35 (20-40)	.161
Breath rate (max)[a]	40 (25-55)	40 (30-60)	**.026**
PEEP (cmH_2O)[a]	5 (5-10)	5 (5-8)	.570
PEEP.max (cmH_2O)[a]	8 (5-12)	10 (8-15)	**.001***
Mortality scores*			
PIM (%)[a]	14.2 (7-48)	27.5 (13.2-63.5)	**<.001***
PIM-II (%)[a]	29.3 (17.3-52.3)	39.7 (28.7-91.5)	**.004***
PRISM[b]	26.9 ± 6.0	32.47 ± 8.49	**.020***
PELOD[a]	21 (11-51)	30 (21-51)	**.039***
Laboratory values*			
WBC ($10^3/\mu L$)[b]	14.02 ± 8.90	12.14 ± 8.20	.501
Hb (g/dL)[b]	9.97 ± 2.28	10.72 ± 3.12	.383
HTC (%)[b]	30.39 ± 6.81	31.94 ± 8.72	.530
PLT ($\times 10^3$ mm^3)[b]	263.86 ± 191.07	240.56 ± 175.60	.695
Urea (mg/dL)[b]	36.30 ± 50.36	36.02 ± 28.61	.900
Creatinine (mg/dL)[b]	0.64 ± 0.63	0.58 ± 0.38	.704
AST (IU/L)[a]	42 (10-4202)	138 (35-4202)	**.002***
ALT (IU/L)[a]	27 (6-1268)	49 (7-1794)	.401
CK (IU/L)[a]	64 (13-297)	150 (39-6174)	.548
LDH (mg/dL)[a]	518 (251-6000)	980.5 (545-4499)	**.007***
PH[a]	7.26 (6.9-7.46)	7.15 (6.89-7.39)	**.048***
PCO_2 (mmHg)[b]	63.43 ± 20.20	65.10 ± 19.80	.796
HCO_3 (mEq/L)[b]	24.09 ± 7.67	20.44 ± 6.70	.125
PARDS etiology [c]	**n (%)**	**n (%)**	
Pulmonary	20 (62.5)	12 (37.5)	.250
Extrapulmonary	3 (37.5)	5 (62.5)	
Demographic characteristics	**n (%)**	**n (%)**	
Mean age (months)[b]	55.2 ± 59.9	31.8 ± 50.5	.182
Sex [c]			
Male	15 (68.2)	7 (31.8)	.131
Female	8 (44.4)	10 (55.6)	
MV modes [c]			
Volume-controlled	1 (50.0)	1 (50)	**.058**
Pressure-controlled	6 (37.5)	10 (62.5)	
Alternately modes	16 (72.7)	6 (27.3)	

ALT, alanine aminotransferase; AST, aspartate aminotransferase; CK, total creatine kinase; FiO_2, fractional oxygen concentration; Hb, hemoglobin; HCO_3, serum bicarbonate level; HTC, hematocrit; LDH, lactate dehydrogenase; LOS, length of stay in PICU; MV, mechanical ventilation; PEEP, positive end-expiratory pressure; PELOD, pediatric logistic organ dysfunction; PIM, pediatric index of mortality; PIP, peak inspiratory pressure; PLT, Platelet count; PRISM, pediatric risk of mortality; WBC, white blood cells counts.
[a]Mann–Whitney *U* test expressed as median (min-max).
[b]Independent Student's *t*-test expressed as median ± standard deviation.
[c]Pearson chi-square and Fisher exact test expressed as n (%).
*$P < .05$.
[#]Initial values and the maximum values during the follow-up.

and mortality in our study, PIP.max, breath rate.max, PEEP.max values were found to be significantly higher in patients who did not survive.

There are many studies in the literature examining the relationship between mortality and mortality scores in ARDS patients. In almost all of these studies, it was stated that there was a significant relationship between mortality and these scores. Gan et al[7] reported that PIM-2 and PELOD scores were significantly higher in extrapulmonary ARDS compared to pulmonary ARDS. In addition, while PELOD was associated with mortality in both ARDS types, PIM-2 was found to be significantly associated with mortality in pulmonary ARDS. Dahlem et al[16] found that PIM and PRISM scores were associated with mortality, and PRISM score was independently associated with mortality. In another study, it was stated that there was a significant relationship between PRISM-3 and PELOD scores and mortality.[17] In our study, PIM, PIM-II, PRISM, and PELOD values were found to be significantly higher in patients who died. In addition, PIM, PIM-II, PRISM, and PELOD values were found to be significantly higher in the extrapulmonary ARDS group compared to the pulmonary ARDS group. This may be due to the greater prevalence of extrapulmonary organ involvement in extrapulmonary ARDS.

Depending on the organs involved in both pulmonary and extrapulmonary ARDS patients, some pathological values may be detected in laboratory tests. Studies have revealed that patients with extrapulmonary ARDS had a greater proportion of organ dysfunction compared with pulmonary ARDS.[16] Zhang and Ni[18] stated that there is a significant relationship between platelet count, bilirubin, potassium, bicarbonate, pH, and mortality. Bersten et al[19] reported that pH and PCO_2 are significantly associated with mortality. In our study, as the number of organs involved increased, pathological laboratory results were found to be more consistent with the literature. It was observed that many laboratory parameters did not show normal distribution, and there were significant differences between the maximum and minimum values (Table 2). Urea and creatinine values were found to be significantly higher and pH and HCO3 values were found to be significantly lower in extrapulmonary ARDS patients compared to pulmonary ARDS patients. Also, median AST and LDH values were found to be significantly higher and median pH values were lower in patients who died. These situations can be explained by the greater proportion of patients who developed MODS in the nonsurvival group.

In the literature, very different numbers have been reported about the LOS in PICU, MV duration, and mortality rates of the patients. A multicenter study reported that the median LOS in PICU was 18 days, the median MV duration was 11.5 days, and the overall PICU mortality was 26%.[10] Again, in the multicenter PARDIE study, the overall mortality was reported as 17% and 33% in severe patients.[4] Gan et al[7] reported that patients in the extrapulmonary PARDS group had higher mortality (48.8%) compared with the pulmonary PARDS group. Also, the median MV duration was 8 days, median PICU duration was 11 days, in this study. Bellani et al[20] reported that the mortality rate was 42.9% for those with severe ARDS. Also, the median LOS in PICU was 10 (5-20) days, median MV duration was 8 (4-16) days in their study. Dahlem et al[16] reported that the median MV duration was 6.5 days, 7 days, and 4 days for all patients, survivors, and

nonsurvivors, respectively. Also, the mortality rate was 31.4% in their study. Considering that only ARDS patients requiring MV were included in the study, the mortality rate was found to be compatible with the literature. However, the median MV duration and LOS in PICU time were longer than others. In addition, the LOS in PICU was significantly prolonged in patients who survived. Similarly, Dahlem et al[16] observed that although mortality was higher in extrapulmonary ARDS patients in our study, it was not statistically significant. We think that this situation is related to the small number of extrapulmonary ARDS patients.

Our study has several limitations. The main limitation of this study is that it is a retrospective single-center study. We had to exclude 2 medical records due to incomplete data, and the relatively small sample size limits the study's statistical power.

CONCLUSION

Despite advances in follow-up and management, mortality due to PARDS is still high. The duration of MV, LOS in PICU, PIPmax, PEEP max, breath rate.max, mortality scores, AST levels, LDH levels, and pH levels were associated with mortality. In co-morbid cases, the risk of mortality increases, and the length of hospital stay is prolonged. Clinical and laboratory features are more severe in patients with extrapulmonary PARDS. Alternatively, MV applications may reduce mortality rates. Sharing experiences on this count will contribute to increasing success in PARDS management and outcomes.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Adıyaman University (2019/9-33).

Informed Consent: Written informed consent was not obtained from patients due to the retrospective design of the study.

Peer-review: Externally peer-reviewed.

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