

RESEARCH ARTICLE

Epidemiological and Clinical Profiles of Patients with Acute Respiratory Distress Syndrome Admitted to Medical Intensive Care in Qatar: A Retrospective Analysis of the Data Registry for the Year 2015

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ABSTRACT

Background: Although acute respiratory distress syndrome (ARDS) is a common reason for admission to intensive care units, limited information is available about the epidemiological and clinical characteristics of these patients in Middle Eastern countries. Qatar is a high per capita income country with a large multinational expatriate population. Hamad General Hospital is our main tertiary referral center with the largest medical intensive care unit (MICU).

Method: A retrospective cross-sectional study was conducted to extract data from the MICU registry for 101 patients aged > 14 years who were admitted with ARDS from January 2015 to December 2015. **Results:** In 2015, a total of 101 (14.8%) of 682 patients admitted to MICU were diagnosed with ARDS. Males comprised 71.3% and females 28.7%.

The mean age of the study population was 44.96 ± 17.97 years. Community-acquired bacterial and viral pneumonia were the most common reasons for ARDS. Crude mortality rate was 35%. The mean age of survivors was 42.09 ± 13.58 years compared with 50.36 ± 16.84 years of non-survivors ($p = 0.008$). Mortality was associated with increasing age, the Acute Physiologic Assessment and Chronic Health Evaluation II severity score, lower P/F ratio, higher Murray's score, higher PCO_2 , lower pH, and circulatory support with vasopressors. Preexisting comorbidities did not contribute to high mortality. No difference in mortality was noted with higher versus lower positive end expiratory pressure. The prone position was used in 8% of the cases. Twenty-seven (27%) patients had undergone salvage therapy

with extracorporeal membrane oxygenation (ECMO) that resulted in a survival rate of 44%. ARDS was associated with acute renal failure requiring dialysis in 28.7% of the cases, pneumothoraces in 4%, ventilator-associated pneumonia in 7.9%, and central line-associated bloodstream infection in 2%. ARDS led to a prolonged length of stay compared with the average length of stay in MICU.

Conclusion: Community-acquired bacterial and viral pneumonia were the most common causes of ARDS at our center. Critical care outcome correlated with the severity of the disease. ECMO was used as salvage therapy in our center.

Keywords: acute respiratory distress syndrome, pneumonia, extracorporeal membrane oxygenation

BACKGROUND

Epidemiological research in acute respiratory distress syndrome (ARDS) is important to understand the variability in disease presentations, patterns of care, and outcome in different patient populations.¹ Limited data is available regarding the epidemiological and clinical profile of ARDS patients in Middle Eastern countries.

ARDS is a common cause of admission to critical care units. It causes significant morbidity and still carries high mortality.²⁻⁴ A specialized data registry system ensures the uniformity of diagnostic criteria and the detailed documentation of studied variables. Registry data is informative in the study of differences in etiological factors, population characteristics, patterns of clinical care, and resource utilization in different populations. The incidence, clinical course, morbidity, and outcome of ARDS in medical patients have not been previously studied in Qatar, a country that is mostly composed of a multinational expatriate population. Furthermore, the introduction of extracorporeal membrane oxygenation (ECMO) service in 2014 provided a unique perspective of studying the utility of this modality in ARDS management.

MATERIALS AND METHODS

This investigation was a retrospective observational study utilizing the medical intensive care unit (MICU) one-year (2015) registry data at the main tertiary hospital in Qatar. The institution's Medical Research Center approved this study.

Inclusion criteria

All ARDS patients aged > 14 years admitted to MICU during the study period.

Diagnosis of ARDS was based on the Berlin definition for ARDS,² which includes the following:

- Onset over one week or less
- Bilateral opacities consistent with pulmonary edema on computed tomography scan or chest radiograph
- PF ratio < 300 mm Hg with a minimum of 5 cm H₂O positive end-expiratory pressure (PEEP), or continuous positive airway pressure (CPAP)
- Above conditions are not fully explained by cardiac failure or fluid overload

Exclusion criteria

- Patients with respiratory failure who did not fulfill ARDS criteria
- Patients aged ≤ 14 years
- Surgical or trauma patients who were not admitted to MICU

Data were collected using a data collection form and included patients' age, gender, nationality, past major illness (diabetes mellitus, immunosuppression, chronic kidney, liver, pulmonary and heart diseases), clinical disorders precipitating ARDS, length of intensive care stay, mechanical ventilation days, and ICU outcome. Blood biochemistry, arterial blood gases, hematocrit, total leukocyte count, platelet count, blood cultures, procalcitonin levels, chest radiograph, and other variables were noted. The clinical and biochemical variables collected were noted within the first 24 hours of the diagnosis of ARDS and the Acute Physiology and Chronic Health Evaluation (APACHE II) scores were calculated from the above data. The relevant clinical data of the subjects were collected until discharge from the hospital or death. The final diagnosis and outcome were recorded.

Suspected bacterial infections were diagnosed on the basis of increased inflammatory marker levels and procalcitonin levels of > 2.0 ng/mL and confirmed if bacterial cultures were positive. Viral infections were confirmed using viral panel polymerase chain reaction or suspected if procalcitonin levels were low and other causes of ARDS were excluded.

Complications associated with ICU stay that were recorded included circulatory support with vasoactive agents, acute renal failure requiring dialysis, central

line-associated bloodstream infections (CLABSI), pneumothoraces, and ventilator-associated pneumonia (VAP).

Results of the study are presented to show the epidemiological and clinical profiles of survivors and nonsurvivors admitted to MICU with the diagnosis of ARDS.

Statistical analysis: The data is presented as the total number of patients, mean \pm SD for continuous variables, and percentage for categorical variables. Statistical analysis was performed using Student's t-test and chi-square test as appropriate. A p value < 0.05 was considered to be statistically significant.

RESULTS

In 2015, a total of 682 patients were admitted to MICU. Of those, 101 (14.8%) patients met the Berlin diagnostic criteria for ARDS. Differences in epidemiological and clinical variables between survivors and nonsurvivors are presented in Table 1.

With regard to demographic data, local Qatari patients were older (mean age, 49.95 ± 21.67 years) than expatriates (mean age, 42.54 ± 15.30 years) ($p = 0.05$).

The overall survival rate was 65% ($n = 66$). Mortality was significantly higher with increasing mean age,

Table 1. Epidemiological and clinical variables in survivors versus nonsurvivors.

	All (n = 101)	Survivors (n = 66)	Nonsurvivors (n = 35)	p value
Mean age (years \pm SD)	44.96 \pm 17.97	42.09 \pm 13.58	50.36 \pm 16.84	0.008
Gender (n)				0.981
Male	72	47	25	
Female	29	19	10	
Nationality (n)				0.277
Local	33	24	9	
Expatriates	68	42	26	
Comorbidities				
Diabetes mellitus	35	23	12	0.954
Chronic heart disease	8	5	3	0.860
Chronic lung disease	13	9	4	0.752
Immunosuppression	9	6	3	0.930
Chronic liver disease	6	2	4	0.089
APACHE II	21.17 \pm 7.32	17.26 \pm 5.93	28.54 \pm 6.98	0.0001
P/F ratio	97.83 \pm 35.19	103.57 \pm 34.28	86.86 \pm 33.56	0.021
Murray's score	3.22 \pm 0.43	3.149 \pm 0.42	3.34 \pm 0.53	0.049
PCO ₂	50.65 \pm 13.40	46.57 \pm 10.61	58.56 \pm 19.34	0.0001
pH	7.24 \pm 0.12	7.29 \pm 0.20	7.14 \pm 0.15	0.0001
Procalcitonin	40.08 \pm 48.19	28.30 \pm 34.3	64.42 \pm 75.56	0.001
Noninvasive ventilation (n)	20	15	5	0.311
Prone (n)	8	4	4	0.342
Mode of mechanical ventilation (n)				0.311
VAC	78	53	25	
PAC	23	13	10	
Tidal volume (ml)	386.86 \pm 62.36	396.85 \pm 47.63	368.39 \pm 46.25	0.004
PEEP	12.4 \pm 2.75	12.08 \pm 2.48	13 \pm 3.21	0.113
Mechanical ventilation days	14.71 \pm 11.75	11.61 \pm 7.0	20.2 \pm 20.76	0.003
Mean length of stay (days)	17.75 \pm 13.56	15.53 \pm 9.19	21.94 \pm 22.37	0.045
Dialysis (n)	29	12	17	0.103
ECMO (n)	27	12	15	0.095
CLABSI (n)	2	1	1	0.066
VAP (n)	8	2	6	0.013
Pneumothorax (n)	4	2	2	0.645
Circulatory support (n)	81	49	32	0.039

Table 2. Etiology of ARDS.

Etiology	All (n = 101)	Survivors (n = 66)	Nonsurvivors (n = 35)
Viral pneumonia	33	28 (85.0%)	5 (15.0%)
CAP bacterial	36	23 (64%)	13 (36.0%)
Hospital-acquired pneumonia	6	2 (33.0%)	4 (67.0%)
Aspiration pneumonia	5	1 (20%)	4 (80.0%)
Tuberculosis	3	0	3 (100.0%)
Malaria	1	1 (100%)	0
<i>Pneumocystis jiroveci</i> pneumonia	1	1 (100%)	0
Extrapulmonary sepsis	5	2 (40%)	3 (60.0%)
Alveolar hemorrhage	1	1 (100%)	0
Trauma	10	7 (70.0%)	3 (30.0%)

higher APACHE II score, higher procalcitonin levels, higher requirement of vasopressors for circulatory support, lower PO_2/FIO_2 ratio, higher Murray's score, higher PCO_2 , lower pH, and development of VAP. There was no statistically significant difference in mortality in relation to comorbidities, mode of mechanical ventilation, need for dialysis, ECMO support, and CLABSI.

The overall mean tidal volume (TV) prescribed was 386.86 ± 62.36 ml, which was higher than the 362.31 ± 58.69 ml that was calculated based on ideal body weight ($p = 0.0002$). Eleven (11%) patients had a tracheostomy.

The total length of stay for ARDS patients was 17.8 ± 13.6 days, which was significantly higher than the total length of stay of 10.1 ± 11.5 days for the population admitted to MICU ($p < 0.001$).

The causes of ARDS and mortality outcome are shown in Table 2. Community-acquired bacterial and viral pneumonia were responsible for ARDS in around 69% of all cases. Only 10 (10%) trauma patients with ARDS were admitted to MICU, as they required

management for severe respiratory failure with ECMO support.

Approximately 27% of patients required ECMO support (Table 3). Patients with viral pneumonia and trauma had better chances of survival on ECMO than those with other etiologies.

DISCUSSION

Epidemiological registries in ARDS provide valuable sources of information that can improve understanding of the disease, patterns of care, and variables affecting outcome.¹ The current study focused on single-year (2015) data when specific data collection for auditing was planned, and cases were tracked from admission to discharge.

In the current study, 14.8% of all ICU admissions were for ARDS, which is consistent with other published data where incidence varies from 2.5% to 19%.³⁻⁵

A male predominance of 72% in our study is consistent with that reported in other international studies⁶ and is also explained by the overall composition of the Qatari population, which has a

Table 3. ECMO indications and outcome.

Etiology	ECMO	Survival on ECMO
Viral pneumonia	8	6
CAP bacterial	6	1
Aspiration pneumonia	1	0
Tuberculosis	3	0
<i>Pneumocystis Jiroveci</i> pneumonia	1	1
Extrapulmonary sepsis	1	0
Trauma	7	4
Total	27	12

disproportionally higher number of males.⁷ This predominance may represent disproportionately higher risk factors for ARDS development in males than in females. The relatively young mean age in our study population is likely explained by the presence of a population of young expatriate workers in the country. Similar to the results of other studies, older age was associated with a higher mortality rate.⁸

In our study, the crude mortality rate of ARDS patients was 35%, which is not different from that reported in other studies.^{2,3} This result was predicted by a significantly higher APACHE II score of 28.54 ± 6.98 in nonsurvivors compared with an APACHE II score of 17.26 ± 5.93 in survivors.

Diabetes mellitus, immunosuppression, chronic pulmonary, cardiac, and liver diseases are the comorbidities that were assessed in our study (Table 1). There was no statistically significant difference in the outcome of ARDS patients with risk factors and comorbidities when compared with those without any risk factors or comorbidities. On the other hand, as shown in other studies,⁹ increasing mean age, higher APACHE II severity score, lower P/F ratio, higher Murray's score, higher PCO₂, lower pH, higher procalcitonin levels, and VAP, were significantly associated with increased crude mortality.¹⁰

Both the mode of ventilation and higher PEEP were not associated with any mortality benefit in this study. Overall, mean TV was higher than that calculated by the predicted body weight. This has been observed in other studies as well. This observation emphasizes the need to review local data to confirm that there is no disconnect between the theoretical and practical application of evidence-based practices in the ICU.¹¹ Although the prone position is a standard therapy for severe ARDS with mortality benefits,¹² it was performed in only 8% of the cases in 2015. This was likely because of inadequate training and experience of the team in the use of prone position for ARDS in 2015. This highlights the crucial role of education, training, and experience of the respiratory failure care team members in the use of the prone position in ARDS patients. After this observation, multiple educational workshops have been conducted for all ICU team members, and the prone position has become a standard step in the management of appropriate ARDS patients.

The predominant cause for admission in our study was community-acquired pneumonia in 69% of patients.

Patients with community-acquired viral pneumonia had an overall survival rate of 85%, which is similar to 75% survival with ECMO reported in another study.¹³

Although case series have reported ECMO use as salvage therapy for acute respiratory failure in pulmonary tuberculosis (TB),^{14,15} three of our patients who required ECMO as a lifesaving salvage therapy did not survive. This may represent more advanced underlying pulmonary TB in our study. Large-scale studies of pulmonary TB cases with salvage ECMO may better define the role of ECMO in this patient population.

Ten (10%) patients with ARDS secondary to trauma were admitted to the ECMO service in MICU. Four out of the seven (57%) patients requiring ECMO survived. The overall survival reported in other studies for venovenous (VV) ECMO in acute respiratory failure in trauma patients ranges from 50% to 79%.¹⁶

Our study showed that the overall intensive care outcome in VV ECMO in severe ARDS at our center was 44% in 2015, and the Extracorporeal Life Support Organization international report indicates a survival rate of 57% in the corresponding year.¹⁷

This study emphasizes the utility of registry data at an individual center to compare the practice with international standards.

The benefits of this objective data also help evaluate practices that otherwise may not be obvious. This was apparent in our objective data of TV use, which was higher than recommended. Also, prone position data helped us improve our overall practice in this area. Registry data is also useful in securing more resources from local leadership with a relatively major impact on patient care improvement. The limitation of this study is that being a descriptive retrospective study, where part of the data is collected from the medical records, the significance of the observed differences between various clinical variables among survivors and non-survivors could not be assessed. The study did not specifically explore the variability among ARDS secondary to different etiologies. Also, the registry data was limited to ICU stay, and no medium or long-term outcome after ICU discharge was evaluated.

CONCLUSION

Specific ARDS registries provide valuable information on the epidemiology of the disease; factors that affect the outcome; and adherence to standardized, evidence-based care. In our center, bacterial and viral

pneumonia remain the dominant etiologies of ARDS. The outcome of ARDS patients is primarily influenced by the etiology and severity of the disease. Despite the well-recognized importance of low TV strategy and prone position in ARDS, the mean TV used was higher than recommended, and the utilization of prone position remains low. Local data exploration by adopting registries is a useful way to explore the regional differences in ARDS epidemiology and routine clinical care, which may help improve overall outcomes in ARDS patients. This study demonstrates ARDS as an important healthcare problem in Qatar, which requires healthcare authorities to develop preventive strategies and advance its management.

Abbreviations

ARDS: acute respiratory distress syndrome, APACHE II: Acute Physiologic Assessment and Chronic Health Evaluation, CAP: community-acquired pneumonia, ECMO: extracorporeal membrane oxygenation, MICU: medical intensive care unit, PEEP: positive end-expiratory pressure, TB: tuberculosis, VAP: ventilator-associated pneumonia, VV: venovenous

Declaration

No conflict of interest in relation to declare.

Ethics approval and consent to participate

The study was approved by the Medical Research Center of Hamad Medical Corporation-Qatar with the approval reference number of 17061/17.

The Ethics Committee has approved the study and classified as 'exempt' under the Supreme Council of health guidelines.

Consent for publication

Not applicable.

Availability of data and material

The datasets generated and/or analyzed during the current study are not publicly available (as they are part of the data registry of the intensive care unit and are not available externally) but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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The Medical Research Center approved a budget for temporary assignment of a research assistant for three months.

Authors' contributions

- Abdulsalam Saif Ibrahim: Designed the study, supervised data collection, analyzed the data, wrote the study, and completed research submission
- Abdel Raouf Akkari: Contributed to the design, supervised entry, and performed writing and editing
- Tasleem Raza: Contributed to the design and performed writing and editing
- Ibrahim Fawzy Hassan: Contributed to the design and performed writing and editing
- Anzila Akbar: Assessed inclusion and exclusion criteria and contributed to the design, data collection and editing
- Ibrahim Alatoum: Assessed inclusion and exclusion criteria and performed data collection

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REFERENCES

1. Bellani G, Laffey JG, Pham T, Fan E, Brochard L, Esteban A, et al. Epidemiology, patterns of care, and mortality for patients with acute respiratory distress syndrome in intensive care units in 50 countries. *JAMA*. 2016 Feb 23;315(8):788–800. doi:10.1001/jama.2016.0291
2. ARDS Definition Task Force, Ranieri VM, Rubenfeld GD, Thompson BT, Ferguson ND, Caldwell E, et al. Acute respiratory distress syndrome: the Berlin definition. *JAMA*. 2012 Jun 20;307(23):2526–2533. doi:10.1001/jama.2012.5669
3. Summers C, Singh NR, Worpole L, Simmonds R, Babar J, Condliffe AM, et al. Incidence and recognition of acute respiratory distress syndrome in a UK intensive care unit. *Thorax*. 2016 Nov;71(11):1050–1051. doi:10.1136/thoraxjnl-2016-208402
4. Riviello ED, Kiviri W, Twagirumugabe T, Mueller A, Banner-Goodspeed VM, Officer L, et al. Hospital incidence and outcomes of the acute respiratory distress syndrome using the Kigali modification of the Berlin definition. *Am J Respir Crit Care Med*. 2016 Jan 1;193(1):52–59. doi:10.1164/rccm.201503-0584OC

5. Luo J, Yu H, Hu YH, Liu D, Wang YW, Wang MY, et al. Early identification of patients at risk for acute respiratory distress syndrome among severe pneumonia: a retrospective cohort study. *J Thorac Dis.* 2017 Oct;9(10):3979 – 3995. doi:10.21037/jtd.2017.09.20
6. Bhadade RR, de Souza RA, Harde MJ, Khot A. Clinical characteristics and outcomes of patients with acute lung injury and ARDS. *J Postgrad Med.* 2011 Oct-Dec;57(4):286 – 290. doi:10.4103/0022-3859.90077
7. Ministry of Development Planning and Statistics [Internet]. 2016. Analysis of the results of population, housing and establishments census 2015. Doha – Qatar. Available from: https://www.mdps.gov.qa/en/statistics/Statistical%20Releases/General/Census/Outcome_Analysis_of_Census_of_Population_Housing_and_Establishments_2015_en.pdf
8. Kao KC, Hsieh MJ, Lin SW, Chuang LP, Chang CH, Hu HC, et al. Survival predictors in elderly patients with acute respiratory distress syndrome: a prospective observational cohort study. *Sci Rep.* 2018 Sep 7;8(1):13459. doi:10.1038/s41598-018-31811-w
9. Chen W, Ware LB. Prognostic factors in the acute respiratory distress syndrome. *Clin Transl Med.* 2015 Dec;4(1):65. doi:10.1186/s40169-015-0065-2
10. Forel JM, Voillet F, Pulina D, Gacouin A, Perrin G, Barrau K, et al. Ventilator-associated pneumonia and ICU mortality in severe ARDS patients ventilated according to a lung-protective strategy. *Crit Care.* 2012 Dec 12;16(2):R65. doi:10.1186/cc11312
11. Santamaria JD, Tobin AE, Reid DA. Do we practise low tidal-volume ventilation in the intensive care unit? a 14-year audit. *Crit Care Resusc.* 2015 Jun;17(2):108 – 112.
12. Guérin C, Beuret P, Constantin JM, Bellani G, Garcia-Olivares P, Roca O, et al. A prospective international observational prevalence study on prone positioning of ARDS patients: the APRONET (ARDS Prone Position Network) study. *Intensive Care Med.* 2018 Jan;44(1):22 – 37. doi:10.1007/s00134-017-4996-5
13. Jahangirifard A, Hossein Ahmadi Z, Golestani Eraghi M, Tabarsi P, Marjani M, Moniri A, et al. H1N1 influenza patient saved by extracorporeal membrane oxygenation: first report from Iran. *J Tehran Heart Cent.* 2016 Jul 6;11(3):153 – 156.
14. Andresen M, Tapia P, Mercado M, Bugeo G, Bravo S, Regueira T. Catastrophic respiratory failure from tuberculosis pneumonia: survival after prolonged extracorporeal membrane oxygenation support. *Respir Med Case Rep.* 2013 Jul 24;10:19 – 22. doi:10.1016/j.rmcr.2013.06.004
15. Cogliandro V, Lapadula G, Bandera A, Muscatello A, Marcolin R, Abbruzzese C, et al. ECMO: an alternative support for acute respiratory failure caused by tuberculosis? *Int J Tuberc Lung Dis.* 2014 Jul;18(7):879 – 881. doi:10.5588/ijtld.13.0752
16. Bedeir K, Seethala R, Kelly E. Extracorporeal life support in trauma: worth the risks? A systematic review of published series. *J Trauma Acute Care Surg.* 2017 Feb;82(2):400 – 406. doi:10.1097/TA.0000000000001292
17. Makdasi G, Wang I. Extra corporeal membrane oxygenation (ECMO) review of a lifesaving technology. *J Thorac Dis.* 2015 Jul;7(7):E166 – E176. doi:10.3978/j.issn.2072-1439.2015.07.17