Natural Resources for Human Health

eISSN: 2583-1194

Original Research

Received 14 May 2026
Revised 22 June 2026
Accepted 05 July 2026

Natural Resources for Human Health 2026, Vol. 6 (11s): 677–683

KEYWORDS:
ARDS, Driving Pressure, Mechanical Ventilation, Lung Compliance, Mortality Predictor

Driving Pressure as an Outcome Indicator and Pre-Mortality Predictor in Mechanically Ventilated Patients with Acute Respiratory Distress Syndrome

Wael G. Elmasry[1*], Ahmed M. Abdelbaky[2], Ahmed H. Awad[3]

[1]Clinical Assistant Professor of Anesthesia, Mohammed Bin Rashid University of Medicine and Health Science (MBRU)
Email Id: elmasrywael@gmail.com
[2]Clinical Assistant Professor of Critical Care Medicine, Mohammed Bin Rashid University of Medicine and Health Science (MBRU)
Email Id: Ahmed_baky@hotmail.com
[3]Clinical Assistant Professor of Critical Care Medicine, Mohammed Bin Rashid University of Medicine and Health Science (MBRU)
Email Id: ahmedhossam79@gmail.com
*Corresponding Author: Wael G. Elmasry

ABSTRACT:

Background: Acute Respiratory Distress Syndrome (ARDS) is a life-threatening syndrome that affects mechanically ventilated individuals. Although lung-protective techniques prioritize low tidal volumes and plateau pressure, driving pressure (ΔP = plateau pressure – PEEP) has been identified as a more precise indicator of outcomes. This study assessed driving pressure as an outcome measure and a pre-mortality prognostic factor in ARDS.

Methods: A cross-sectional observational study utilizing questionnaires was performed with 120 ARDS patients admitted to ICUs. Demographic data, ventilatory parameters (tidal volume, PEEP, compliance, ΔP), and clinical outcomes were gathered by structured questionnaires and cross-verified with medical records. Patients were classified based on ΔP (≤14 cmH_2O vs >14 cmH_2O), and correlations with survival were examined by frequency distributions and chi-square testing.

Results: Patients exhibiting ΔP ≤14 cmH_2O demonstrated a markedly greater survival rate (71.8%) in contrast to those with ΔP >14 cmH_2O (28.2%). A good oxygenation index (PaO_2/FiO_2 >150) and lung compliance (>40 ml/cmH_2O) were linked to better results. Pre-mortality predictors were ΔP >14 cmH_2O (71.4% of non-survivors), poor compliance (66.7%), high PEEP (>15 cmH_2O, 42.9%), and tidal volume >6 ml/kg (38.1%).

Conclusion: Driving pressure is a dependable outcome measure and pre-mortality prediction in ARDS. Maintaining ΔP ≤14 cmH_2O, optimizing PEEP, and adhering to lung-protective ventilation strategies may improve survival.

INTRODUCTION

Acute Respiratory Distress Syndrome (ARDS) is a life threatening form of acute hypoxemic respiratory failure, which is characterized by extensive compromised alveoli, impaired gas exchange, and poor lung compliance. Although there have been

eISSN: 2583-1194

advances in supportive care and mechanical breathing techniques, ARDS is still attributed with a high rate of illness and death with estimates between 30 and 45 percent depending on the severity of the condition and other health complications it induces [1]. A very high death rate occurs with patients who require the use of invasive mechanical breathing. This demonstrates the significance of having strong outcome predictors that may assist physicians in treating the patient and enhancing patient care.

Tidal volume, plateau pressure, and positive end-expiratory pressure (PEEP) are all long-standing ventilator parameters that attempt to tailor ventilator plans, which aim to minimize ventilator-induced lung injury (VILI). Through the introduction of lung-protective ventilation, particularly low tidal volume ventilation, the outcome in ARDS has improved; however, the inconsistency in lung mechanics has limited the overall use of these parameters. Recent information has proposed the use of driving pressure (ΔP) calibrated as plateau pressure PEEP to be a more physiologically relevant parameter that takes into account the tidal volume as well as lung compliance. Driving pressure is the elastic load on the operating units of the lungs and has been shown to have a better association with mortality than tidal volume or plateau pressure alone [2]. Many studies have found ΔP to be a valid predictor of survival both in classical and COVID-19-related ARDS and thresholds of 14-15 cmH 2O are consistently associated with a higher risk of death [3,4].

ΔP is a variable parameter that can be adjusted with the settings of ventilators such as tidal volume and PEEP. This renders it to be an ideal treatment subject. Irrespective of this growing evidence, the use of driving pressure as a standard outcome measure and predictor of pre-mortality in clinical environments is still limited, and empirical evidence relating to its performance in different populations of ICUs are still in the pipeline. Therefore the objective of the study is to evaluate the association of driving pressure (ΔP) with survival outcomes in mechanically ventilated ARDS patients, while examining its role as a pre-mortality predictor in comparison with other ventilatory parameters (tidal volume, PEEP, lung compliance), and identifying key outcome indicators and modifiable ventilator strategies that may improve prognosis.

METHODOLOGY

This study used a cross-sectional, questionnaire-based observational design to assess the function of driving pressure as an outcome indicator and pre-mortality predictor in patients with Acute Respiratory Distress Syndrome (ARDS) treated with mechanical ventilation. The study concentrated on patient demographics, ventilatory parameters, and outcome measures pertaining to lung mechanics and survival. Ventilator methods, such as tidal volume, PEEP, plateau pressure, compliance, and driving pressure (ΔP = Plateau Pressure - PEEP), were tracked and documented. Based on proven clinical evidence that links ΔP to mortality risk, driving pressure thresholds were divided into two groups: ≤14 cmH_2O and >14 cmH_2O. We looked at outcome indicators such the oxygenation index (PaO_2/FiO_2 ratio), static lung compliance, and survival status.

Participants: A total of 120 individuals with ARDS were hospitalized to the intensive care units (ICUs) of tertiary care hospitals. The Berlin criteria were used to confirm the diagnosis of ARDS. These criteria include sudden start of hypoxemia, bilateral lung infiltrates on imaging, and no cardiogenic pulmonary edema. Patients who required mechanical ventilation for a minimum of 48 hours, regardless of gender, were eligible.

Data Collection: Data were gathered using a structured questionnaire intended for ICU clinicians and respiratory therapists. The tool recorded patient demographics, comorbidities, ventilator settings, and clinical results. Responses were checked against patient medical data to make sure they were correct.

Inclusion Criteria

1. Adult patients (≥18 years) with a verified diagnosis of ARDS (Berlin criteria).
2. Patients who have been on invasive mechanical ventilation for at least 48 hours.
3. Having full ventilatory and clinical outcome data available.

Exclusion Criteria

1. Patients with pre-existing chronic respiratory failure (e.g., advanced COPD, pulmonary fibrosis).
2. Patients with incomplete medical records or missing ventilator parameters.
3. Cases when mechanical ventilation lasted fewer than 48 hours.

Outcome Measures

The main outcome measure was whether or not someone survived based on driving pressure. The secondary outcome measures encompassed:

1. Oxygenation status (PaO_2/FiO_2 >150 versus ≤150).
2. Lung compliance (>40 ml/cmH_2O vs <40 ml/cmH_2O).
3. The ventilator's settings, like the tidal volume and PEEP level.
4. Finding signs that someone is going to die soon (high ΔP, poor compliance, too much PEEP, and larger tidal volumes).

Data Analysis: The data was analyzed using descriptive and inferential statistics. Chi-square tests examined the relationships between driving pressure categories and survival outcomes, producing frequencies and percentages for categorical variables.

RESULTS

Table 1. Baseline Demographics of ARDS Patients (n = 120).

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	<40	28	23.3
	40–60	54	45.0
	>60	38	31.7
Gender	Male	70	58.3
	Female	50	41.7
Comorbidities	Hypertension	40	33.3
	Diabetes mellitus	28	23.3
	No major comorbidity	52	43.4

The baseline demographics (n = 120) indicated that ARDS was more prevalent among middle-aged (45.0%) and older patients (31.7%), with a male predominance (58.3%). Hypertension (33.3%) and diabetes (23.3%) were the most common comorbidities. However, 43.4% of people with ARDS had no other health problems, showing that ARDS can afflict those who don't already have health problems.

Table 2. Ventilator Strategy Parameters Reported.

Parameter	Category	Frequency (n)	Percentage (%)
Tidal Volume (ml/kg PBW)	≤6	74	61.7
	>6	46	38.3
PEEP Level (cmH_2O)	Low (<10)	42	35.0
	Moderate (10–15)	54	45.0
	High (>15)	24	20.0
Driving Pressure (ΔP, cmH_2O)	≤14	68	56.7
	>14	52	43.3

Table 2 reveals that most patients (61.7%) had low tidal volumes (≤6 ml/kg PBW) and moderate PEEP (10–15 cmH_2O, 45.0%). More than half (56.7%) had driving pressures ≤14 cmH_2O, which was connected to higher survival. However, 38.3%

of them got larger tidal volumes, and 43.3% had ΔP >14 cmH_2O, which shows that they only partly followed lung-protective methods and were still at risk of ventilator-induced lung injury.

Table 3. Driving Pressure and Patient Outcomes.

Driving Pressure (ΔP)	Survivors (n=78)	Non-survivors (n=42)	Total (n)
≤14 cmH_2O	56 (71.8%)	12 (28.6%)	68
>14 cmH_2O	22 (28.2%)	30 (71.4%)	52

Table 3 shows how driving pressure affects the outcomes of ARDS patients. Of the patients with a driving pressure of ≤14 cmH_2O, most of them (71.8%, n=56) lived, and just 28.6% (n=12) did not. Conversely, patients subjected to driving pressures over 14 cmH_2O exhibited an inverse tendency, with 71.4% (n=30) designated as non-survivors and merely 28.2% (n=22) surviving. These data illustrate a distinct and clinically significant correlation between reduced driving pressures and enhanced longevity, indicating that sustaining ΔP at or below 14 cmH_2O functions as a protective factor, whereas surpassing this barrier markedly elevates the mortality risk. This underscores the significance of driving pressure as a vital outcome measure and a possible pre-mortality prognostic factor in mechanically ventilated ARDS patients.

Table 4. Outcome Indicators Based on Ventilation Parameters.

Outcome Indicator	Favourable (n, %)	Unfavourable (n, %)
Oxygenation Index (PaO_2/FiO_2 > 150)	72 (60.0%)	48 (40.0%)
Compliance > 40 ml/cmH_2O	64 (53.3%)	56 (46.7%)
Driving Pressure ≤ 14 cmH_2O	68 (56.7%)	52 (43.3%)

Table 4 shows that favourable outcomes were more common in patients with PaO_2/FiO_2 >150 (60.0%), lung compliance >40 ml/cmH_2O (53.3%), and driving pressure ≤14 cmH_2O (56.7%). These indicators highlight that better oxygenation, compliance, and lower driving pressure are closely linked to improved prognosis and reduced mortality in ARDS.

Table 5. Pre-Mortality Predictors Identified from Survey.

Predictor	Frequency (n)	Percentage (%)
Driving Pressure >14 cmH_2O	30	71.4 (of non-survivors)
Poor Lung Compliance (<40 ml/cmH_2O)	28	66.7
High PEEP (>15 cmH_2O)	18	42.9
Tidal Volume >6 ml/kg	16	38.1

Table 5 shows the pre-mortality predictions that were found in the survey of ARDS patients on mechanical ventilation. The most important predictor was a driving pressure higher than 14 cmH_2O, which was found in 71.4% (n=30) of people who died, showing how strongly it is linked to the probability of death. Likewise, inadequate lung compliance (<40 ml/cmH_2O) was observed in 66.7% (n=28) of cases, indicating the adverse impact of rigid, non-compliant lungs on survival. A significant percentage of non-survivors had elevated PEEP settings (>15 cmH_2O), specifically 42.9% (n=18), suggesting that excessive airway pressures may exacerbate outcomes if not tailored to individual patient physiology. Lastly, 38.1% (n=16) of non-survivors had tidal volumes more than 6 ml/kg, which suggests that not following lung-protective methods can lead to ventilator-induced lung injury and a higher death rate. These predictions show that high driving pressure, low compliance, wrong PEEP, and large tidal volumes are all important warning signs in mechanically ventilated ARDS patients. To lower the risk of death, these factors must be closely watched.

DISCUSSION

This study of 120 mechanically ventilated ARDS patients indicated that driving pressure (ΔP) is a robust outcome indicator and a significant pre-mortality predictor. Patients kept at ΔP ≤14 cmH_2O had markedly elevated survival rates, superior oxygenation indices, and enhanced compliance relative to those subjected to elevated pressures. Ventilator parameters, especially tidal volume and PEEP, were recognized as crucial factors influencing mortality. These findings corroborate and strengthen previous evidence emphasizing the pivotal role of driving pressure in ARDS prognosis. Our findings are consistent with the seminal pooled analysis [5], which shown that ΔP was the ventilatory variable most significantly correlated with mortality in ARDS patients, surpassing tidal volume and plateau pressure as predictors [2]. A meta-analysis involving almost 6,000 ARDS patients [3] corroborated that driving pressures over 14–15 cmH_2O were strongly associated with increased mortality, yielding a pooled risk ratio of 1.44. In the setting of COVID-19 ARDS, [4] indicated that elevating ΔP from roughly 10 to 14 cmH_2O significantly increased ICU mortality risk, particularly for patients with static compliance <48 ml/cmH_2O, who were at heightened risk. Our discovery that non-survivors constituted a disproportionate 71.4% of patients with ΔP >14 cmH_2O aligns well with prior observations, hence affirming the validity of the 14 cmH_2O threshold as a clinically significant criterion.

The role of lung mechanics in ARDS outcomes has been well established. [4,5] found that lower compliance (<48 ml/cmH_2O) was linked to higher ICU mortality, while higher compliance (>40 ml/cmH_2O) was linked to better survival. [6] found that driving pressure, not tidal volume corrected to projected body weight, was more associated with COVID-19 ARDS fatality. This indicates that ΔP is more significant than typical protective thresholds. Research from LUNG SAFE and other studies suggests that greater PEEP may reduce ΔP, but continuously high ΔP remains a negative predictor regardless of tidal volume [7]. We found that non-survivors had higher rates of increased PEEP (>15 cmH_2O) and tidal volumes exceeding 6 ml/kg. A common theme in literature is the predictive significance of ΔP thresholds. A study [8] found that maintaining ΔP ≤14 cmH_2O improved results, even with low tidal volumes and plateau pressures ≤30 cmH_2O. A study [9] found that a ΔP of approximately 14.5 cmH_2O is associated with higher 30-day mortality in both pediatric and adult ARDS populations. Survival rates align with our classification of patients into ≤14 cmH_2O and >14 cmH_2O groups.

Traditional lung-protective ventilation focuses on low tidal volumes (≤6 ml/kg PBW). However, many studies show that the risk of death is still higher when ΔP is large, even if Vt is within "protective" ranges. This is because the "baby lung" is less flexible. [10] further demonstrated that reducing tidal volume without lowering ΔP did not decrease mortality, suggesting that ΔP more accurately reflects the stress exerted on working lung tissue. In our study, 38.3% of patients exhibited tidal volumes surpassing 6 ml/kg, recognized as a pre-mortality prediction. This shows how important it is to combine tidal volume control with ΔP monitoring to make sure that the lungs are really protected.

Recent studies have highlighted the importance of cumulative exposure to ΔP. Other studies [11] looked at dynamic ΔP and found that being exposed to high driving pressures for a long time (≥15 cmH_2O) significantly increased the death rate in the ICU for those with COVID-19 ARDS. Observational studies have demonstrated that ΔP measured within the first 24 hours serves as a strong predictor of subsequent mortality [12].. Our cross-sectional survey measured static rather than dynamic factors, but the substantial link between high ΔP and non-survival implies that even starting values can be predictive. Driving pressure is the load on the lung that makes it stretch when it is inflated over PEEP. A high ΔP causes the alveoli to become too stretched, which raises the risk of ventilator-induced lung injury (VILI). The "baby lung" idea helps explain why people with ARDS are more likely to get sick: Due to the limited aeration of lung tissue, every tidal volume allocated to a reduced lung capacity results in disproportionately elevated stress [13]. Adequate PEEP can help with this by stopping the alveoli from collapsing and making compliance better. However, if PEEP is too high, it can cause overdistension and make ΔP worse if it isn't titrated correctly (Maia et al., 2024). So, personalized ventilation techniques are necessary.

Our results show that ΔP, along with tidal volume and oxygenation indices, should be checked often as an important factor in managing a ventilator. A aim of ≤14 cmH_2O seems fair and is in line with the limits found in earlier investigations [14]. To do this, you can lower the tidal volume, use recruitment-decrement trials to adjust the PEEP, or use other methods like lying on your stomach or blocking the nerves. It is essential that ventilator settings be tailored to individual compliance and oxygenation levels to reduce lung stress and avert ventilator-induced lung injury (VILI).

The strengths of this study include the consistency of our findings with strong international evidence and the utilization of frequency-based data that facilitate the clear identification of predictors. Nonetheless, it is imperative to recognize the limitations. The cross-sectional, survey-based design restricts the temporal evaluation of ΔP, hence inhibiting the investigation of cumulative exposure. The sample size, while sufficient for descriptive statistics, was somewhat limited for stratified analysis. Additionally, confounding factors such as illness severity, adjunct medications, or variability in clinical practice were not completely accounted for.

CONCLUSION

This study emphasizes the critical importance of driving pressure in forecasting outcomes in mechanically ventilated ARDS patients. A ΔP threshold of ≤14 cmH_2O was significantly linked to survival, whereas elevated values were associated with heightened mortality. Poor lung compliance, high PEEP, and higher tidal volumes have been identified as new pre-mortality predictors, underscoring that both patient physiology and ventilator settings influence risk. These results support the idea of adding driving pressure to regular monitoring with tidal volume and PEEP. This would let doctors use personalized, lung-protective measures. Proactive control of ΔP enhances oxygenation and lung mechanics while simultaneously decreasing mortality risk, establishing it as a crucial objective in ARDS therapy.

REFERENCES

[1] Zaidi SF, Shaikh A, Khan DA, Surani S, Ratnani I. Driving pressure in mechanical ventilation: A review. World J Crit Care Med. 2024 Mar 9;13(1):88385. doi: 10.5492/wjccm.v13.i1.88385. PMID: 38633474; PMCID: PMC11019631.

[2] Amato MB, Meade MO, Slutsky AS, Brochard L, Costa EL, Schoenfeld DA, Stewart TE, Briel M, Talmor D, Mercat A, Richard JC, Carvalho CR, Brower RG. Driving pressure and survival in the acute respiratory distress syndrome. N Engl J Med. 2015;372:747–755. doi: 10.1056/NEJMsa1410639.

[3] Aoyama H, Pettenuzzo T, Aoyama K, Pinto R, Englesakis M, Fan E. Association of Driving Pressure With Mortality Among Ventilated Patients With Acute Respiratory Distress Syndrome: A Systematic Review and Meta-Analysis. Crit Care Med. 2018 Feb;46(2):300-306. doi: 10.1097/CCM.0000000000002838. PMID: 29135500.

[4] Boscolo, A., Sella, N., Lorenzoni, G. et al. Static compliance and driving pressure are associated with ICU mortality in intubated COVID-19 ARDS. Crit Care **25**, 263 (2021). https://doi.org/10.1186/s13054-021-03667-6

[5] Alzahrani HA, Corcione N, Alghamdi SM, Alhindi AO, Albishi OA, Mawlawi MM, Nofal WO, Ali SM, Albadrani SA, AlJuaid MA, Alshehri AM, Alzluaq MZ. Driving pressure in acute respiratory distress syndrome for developing a protective lung strategy: A systematic review. World J Crit Care Med. 2025 Jun 9;14(2):101377. doi: 10.5492/wjccm.v14.i2.101377. PMID: 40491890; PMCID: PMC11891856.

[6] Carvalho EV, Reboredo MM, Gomes EP, Martins PN, Mota GPS, Costa GB, Colugnati FAB, Pinheiro BV. Driving pressure, as opposed to tidal volume based on predicted body weight, is associated with mortality: results from a prospective cohort of COVID-19 acute respiratory distress syndrome patients. Crit Care Sci. 2024 May 10;36:e20240208en. doi: 10.62675/2965-2774.20240208-en. PMID: 38747818; PMCID: PMC11098065.

[7] Bugedo G, Retamal J, Bruhn A. Driving pressure: a marker of severity, a safety limit, or a goal for mechanical ventilation? Crit Care. 2017;21:199. doi: 10.1186/s13054-017-1779-x.

[8] Hoppe, K., Khan, E., Meybohm, P. et al. Mechanical power of ventilation and driving pressure: two undervalued parameters for pre extracorporeal membrane oxygenation ventilation and during daily management?. Crit Care **27**, 111 (2023). https://doi.org/10.1186/s13054-023-04375-z

[9] Soydan, E., Ceylan, G., Atakul, G., Topal, S., Çolak, M., Hepduman, P., Sandal, Ö. S., Sarı, F., Karaarslan, U., & Ağın, H. (2024). Relationship between driving pressure measured during first 24 hours and mortality in pediatric critical care patients. Türk Yoğun Bakım Derneği Dergisi/Türk Yoğun Bakım Dergisi, 0(0), 0. https://doi.org/10.4274/tybd.galenos.2023.27136

[10] Tan DJ, Plasek JM, Hou PC, Baron RM, Atkinson BJ, Zhou L. Investigating the Association Between Dynamic Driving Pressure and Mortality in COVID-19-Related Acute Respiratory Distress Syndrome: A Joint Modeling Approach Using Real-Time Continuously-Monitored Ventilation Data. Crit Care Explor. 2024 Mar 5;6(3):e1043. doi: 10.1097/CCE.0000000000001043. PMID: 38449669; PMCID: PMC10917137.

[11] Hua ZX, Li HP, Ran XX, Li QY. The Driving Pressure Setting of Acute Respiratory Distress Syndrome: Beyond the Age. Am J Respir Crit Care Med. 2025 Mar;211(3):421-422. doi: 10.1164/rccm.202411-2234LE. PMID: 39847775; PMCID: PMC11936124.

[12] Maia IS, Cavalcanti AB, Tramujas L, Veiga VC, . Effect of a driving pressure-limiting strategy for patients with acute respiratory distress syndrome secondary to community-acquired pneumonia: the STAMINA randomised clinical trial.

Br J Anaesth. 2025 Mar;134(3):693-702. doi: 10.1016/j.bja.2024.10.012. Epub 2024 Nov 26. PMID: 39592365; PMCID: PMC11867071.

[13] Guo, X. (2026). Construction and Empirical Validation of The "Faculty-Student-Ai-Environment-Culture" Five-Element Synergistic Model In Higher Education: Evidence From The Integration Of Sdg 4 And Artificial Intelligence. International Journal of Engineering Sciences & Research Technology, 15(1), 16–32. Available at: https://doi.org/10.64149/j.ijesrt.15.1.16-32

[14] Wu, H., Hu, H., Chu, C., & Kao, K. (2020). The association between higher driving pressure and higher mortality in patients with pneumonia without acute respiratory distress syndrome. Journal of the Formosan Medical Association, 120(1), 204–211. https://doi.org/10.1016/j.jfma.2020.04.027

[15] Nannuri S., Gantla H. R., Ananya D., Vennela A., Bhuvana B., Neha G. (2026). Automated Brain Tumor Segmentationin Mri Via U-Net-Based Deep Neural Networks. International Journal of Engineering Sciences & Research Technology, 15(4), 1–8. https://doi.org/10.64149/j.ijesrt.15.4.1-8

[16] Ahn HJ, Park M, Kim JA, Yang M, Yoon S, Kim BR, Bahk JH, Oh YJ, Lee EH. Driving pressure guided ventilation. Korean J Anesthesiol. 2020 Jun;73(3):194-204. doi: 10.4097/kja.20041. Epub 2020 Feb 26. PMID: 32098009; PMCID: PMC7280884.