

Diagnosis and Management of Acute Respiratory Distress Syndrome: A Systematic Review

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Received: 04 December 2022 / Received in revised form: 12 March 2023, Accepted: 15 March 2023, Published online: 19 March 2023

Abstract

A growing number of research on management and diagnostic strategies in respiratory distress syndrome have been undertaken; nevertheless, there is no clear consensus on the prognosis among those patients. The goal of this systematic review was to consolidate current data on the management and diagnosis of patients with respiratory distress syndrome. The authors began by recognizing the important examination proof that spots light on the management and diagnosis of respiratory distress syndrome. We led electronic writing look in the accompanying data sets: Ovid Medline (2015 to present), Ovid Medline Daily Update, Ovid Medline in process and other non-filed references, Ovid Embase (2015 to present), The Cochrane Library (latest issue) and Web of Science. Just examinations in the English language will be incorporated. The precise selection was acted in close collaboration with a clinical examination curator. In all included studies the management was done at ICU and the diagnosis was done through chest x-ray and CT scans. The design was a retrospective study and prospective cohort study. The causes of ARDS varied among studies. Community-acquired pneumonia was the most common cause. One study included infants with ARDS. Other studies included ARDS in COVID-19 patients. The ICU stay length ranged from 11 to 21 days. The death occurred among several patients. ARDS management focuses primarily on supportive care, lung-protective ventilation, and reducing the type of iatrogenic lung injury, and extracorporeal life support is the last resort for patients who continue to deteriorate despite these supportive treatments.

Keywords: Respiratory distress syndrome, Community-acquired pneumonia, Intensive care units, Respiratory failure, Pulmonary ventilation

Introduction

Unanticipated respiratory horror issue (ARDS) is a possibly lethal kind of respiratory dissatisfaction depicted by serious, certain, burnable lung hurt (Fan *et al.*, 2018), which causes broadened alveolar fine weakness and the improvement of non-hydrostatic

pneumonic edema. Clinically, ARDS is portrayed by serious hypoxia and respiratory misery; patients regularly advance to respiratory disappointment, requiring conspicuous mechanical ventilation in the crucial idea unit (ICU). The chance of death is great. ARDS can be accomplished by various diseases, including pneumonia, extrapulmonary sepsis or septic shock, injury, and pancreatitis. Despite understanding thoughts on ARDS care (Fan *et al.*, 2017; Griffiths *et al.*, 2019; Papazian *et al.*, 2019), immense generally speaking change in association continues, and proof openings drive forward, strikingly concerning ARDS related with COVID-19 (Ashbaugh *et al.*, 1967; Bellani *et al.*, 2016). Taking into account late clinical practice proposals, we report on the end and treatment of ARDS for generalist clinicians (Saaty & Aljadani, 2021; Sadeghi *et al.*, 2021).

Serious respiratory horror issue (ARDS) was first depicted in 1967 as a clinical condition portrayed by the phenomenal beginning of tachypnea, hypoxemia, and loss of lung consistency because of different updates; the principal portrayal saw that ARDS was not receptive to ordinary and standard respiratory treatment philosophies (Ashbaugh *et al.*, 1967; Florina *et al.*, 2022). This disease is seen by inescapable lung fuel, which prompts the movement of pneumonic edema. The outrageous season of ARDS is depicted morphologically by far and wide alveolar annihilation (Fan *et al.*, 2018). Formal ARDS interesting measures were not widely settled until the American-European Consensus Conference (AECC) in 1994 (Bernard *et al.*, 1994). The AECC models coordinate the presence of noncardiogenic, two-sided enters on chest radiographs, as well as the setback of left atrial hypertension. The presence of hypoxemia was evaluated utilizing the degree of vein oxygen halfway strain to part of inhaled new live into oxygen (Pao₂/FiO₂), with a Pao₂/FiO₂ of 200 mm Hg pivotal for ARDS confirmation. Two or three issues hampered the AECC definition, including the deficiency of an imparted season of beginning, massive interobserver fluctuation of the chest radiograph, and the necessity for pneumonic course catheterization to hinder left atrial hypertension (Fan *et al.*, 2018).

The LUNG SAFE examination found contrasts in the utilization of proof-based drugs for ARDS among European focuses (Bellani *et al.*, 2016). Barely any mediations are kept up with by unprecedented affirmation, yet gigantic forward hops in the association of the burden, broadly in ventilation, have been achieved during the most recent twenty years. These were then coordinated into clinical practice recommendations (Fan *et al.*, 2017; Griffiths *et al.*, 2019; Papazian *et al.*, 2019). **Figure 1** sums up an expected method for managing and directing ARDS patients.

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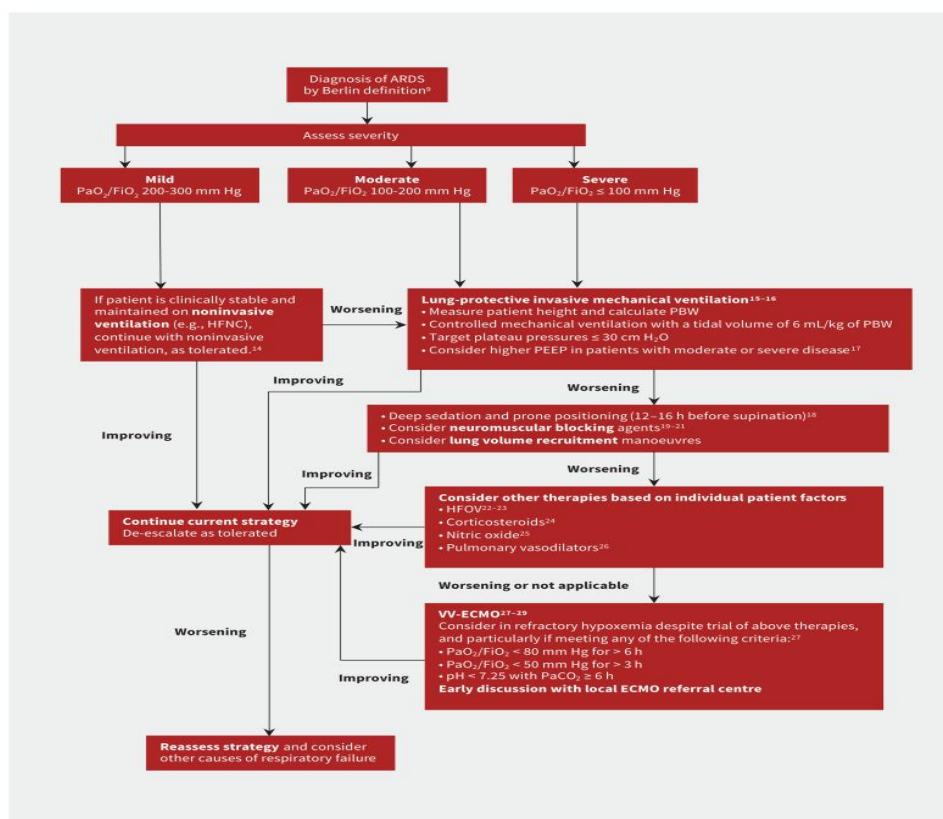


Figure 1. Suggested treatment algorithm showing risk stratification and tiered approach to therapy for patients with acute respiratory distress syndrome (ARDS). Note: HFNC = high-flow nasal cannula, HFOV = high-frequency oscillatory ventilation, PEEP = positive end-expiratory pressure, PBW = predicted body weight, VV-ECMO = venovenous extracorporeal membrane oxygenation.

Materials and Methods

Review Question

This review seeks to spotlight the latest updates on the management and diagnostic methods of acute respiratory distress syndrome. The specific review questions to be addressed are:

1. What are the management approaches for acute respiratory distress syndrome?
2. What are the different diagnostic methods for acute respiratory distress syndrome?
3. What is the outcome of patients with acute respiratory distress syndrome?

Searches

We began with recognizing the important examination proof that spots light on the latest updates on the management and diagnostic methods of acute respiratory distress syndrome. We led electronic writing look in the accompanying data sets: Ovid Medline (2015 to present), Ovid Medline Daily Update, Ovid Medline in process and other non-filed references, Ovid Embase (2015 to present), The Cochrane Library (latest issue) and Web of Science. Just examinations in the English language will be incorporated. The precise selection was acted in close collaboration with a clinical examination curator.

Also, the bibliographies of any qualified articles recognized were checked for extra references, and reference looks were done for all included references utilizing the ISI Web of Knowledge.

We considered “published” articles to be compositions that showed up in peer-reviewed journals. Articles present in grey literature were excluded from our review.

Types of Studies to be Included

We included articles covering how to coordinate different review plans in an orderly review of seeks the latest updates on the management and diagnostic methods of acute respiratory distress syndrome. We did exclude articles only depicting the management and outcome of ARDS patients.

We concentrated on the latest updates on the management and diagnostic methods of acute respiratory distress syndrome. We included articles depicting sample sizes and articles that planned to sum up their outcomes to the populace which the test was drawn from. Case series and case reports were excluded from our search. Studies from all areas all over the world were incorporated with a focus on studies from the Kingdom of Saudi Arabia

Participants

The systematic review included examinations with tests of the general population who had respiratory distress syndrome or

articles discussing the guidelines for the management of respiratory distress syndrome.

Searching Keywords

For every data set, looking through was led by utilizing a mix of the accompanying keywords: (respiratory distress OR intensive care unit OR respiratory failure OR mechanical ventilation OR Kingdom of Saudi Arabia OR systematic review).

We included examinations enrolling members in everyone as well as clinical settings. Studies were incorporated assuming they revealed management and diagnostic methods of respiratory distress syndrome. No comparator or control test size is required in the review to be incorporated.

Studies Selection Process

All list items were brought into an EndNote record. Two analysts evaluated titles and abstracts for their likely pertinence.

One reviewer freely screened titles and abstracts from the search and any articles that report the management and diagnosis of ARDS among patients. We gained the full text of articles that possibly meet the eligibility criteria.

There was no geographical limit on the included studies. Just published articles in the English language will be incorporated.

Outcomes

Primary Outcome

To spotlight management strategies and diagnostic methods of respiratory distress syndrome.

Secondary Outcome

To evaluate the clinical outcome of patients with respiratory distress syndrome.

Information Extraction, (Choice and Coding)

Information was extracted from the included articles utilizing an electronic information extraction structure on Microsoft Access programming. Two reviewers freely extracted information, utilizing a standard information extraction structure that was created by the survey creators with the end goal of the review. The extraction structure incorporated the accompanying data:

1. Publication subtleties: title, authors, journal name and year and city, distribution, the country in which the review was led, sort of distribution, and wellspring of financing.
2. Study subtleties: concentrate on the plan (cross-sectional, cohort, case-control), settings (clinical or population-based), concentrate on transience (planned or review), patients' enlistment techniques (successive or non-continuous), the

geographical area, year of information assortment and reaction rate, qualification (consideration and avoidance rules), name of appraisal tool(s), approval of evaluation tool(s).

3. Study members' subtleties: number of people reviewed/examined, population qualities including mean age (SD), gender distribution, relationship status, and demographic data.

Data Management

Descriptive statistics are employed and relevant data are extracted from eligible studies and presented in tables. We then presented a narrative synthesis of the summary of the management and diagnosis among ARDS patients.

Results and Discussion

A total of 2148 studies were identified in the search, all of them were assessed for eligibility, and 43 articles were included in this review (**Figure 2**). Of the 43 articles, all of them were published journal articles. Studies that were published in peer-reviewed journals were eligible for screening. However, 21 studies were excluded at the beginning of screening because they were published in non-English language. 10 studies were addressing respiratory distress syndrome as a pathophysiology without addressing the management or diagnostic approaches. Furthermore, 4 studies were published in journals not listed in the databases we searched. Finally, 8 studies were included so that authors could extract all required data from abstracts or full texts. There were 5 of these studies in the Kingdom of Saudi Arabia (KSA) and 3 articles in other countries (Farsi & Alaidaroos, 2022). In the current analysis, we involved 8 studies. All of them the management was done at ICU (Corrêa *et al.*, 2015; Kao *et al.*, 2015; Mahmoud *et al.*, 2016; Alfarwati *et al.*, 2019; Ahmed *et al.*, 2020; Aleanizy *et al.*, 2021; Alharbi *et al.*, 2022; Shi *et al.*, 2022) and the diagnosis was done through chest x-ray and CT scans (Corrêa *et al.*, 2015; Kao *et al.*, 2015; Mahmoud *et al.*, 2016; Alfarwati *et al.*, 2019; Ahmed *et al.*, 2020; Aleanizy *et al.*, 2021; Alharbi *et al.*, 2022; Shi *et al.*, 2022). The design was a retrospective study in studies (Mahmoud *et al.*, 2016; Alfarwati *et al.*, 2019; Ahmed *et al.*, 2020; Aleanizy *et al.*, 2021; Alharbi *et al.*, 2022; Shi *et al.*, 2022) and a prospective cohort study in (Corrêa *et al.*, 2015; Kao *et al.*, 2015). The causes of ARDS varied among studies. Community-acquired pneumonia was prevalent in (Corrêa *et al.*, 2015; Kao *et al.*, 2015; Mahmoud *et al.*, 2016; Shi *et al.*, 2022). One study included infants with ARDS (Alfarwati *et al.*, 2019). Other studies (Aleanizy *et al.*, 2021; Alharbi *et al.*, 2022) included ARDS in COVID-19 patients. The ICU stay length ranged from 11 to 21 days. Death occurred among several patients as presented in **Table 1** (Abujamel, 2022). There were many risk factors identified among patients with ARDS as presented in the forest plot figure (**Figure 3**).

Table 1. Characteristics of studies included in the review

Author	Year	Country	Design	Population	Sample size	ARDS patients	Cause of ARDS	Management	Hospitalization length	Outcome
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Mahmoud <i>et al.</i>	2016	KSA	Retrospective study	Adults	350	350	Community-acquired pneumonia (339) TB (11)	ICU management	21.4 days	Death (7)
Ahmed <i>et al.</i>	2020	KSA	Retrospective study	Adults	68	38	H1N1 infection (13) Fibrosis (13) Pneumonia (12)	ICU management	,	Death (29)
Alfarwati <i>et al.</i>	2019	KSA	Retrospective study	Infants	59	59	Low birth weight Cesarean section Premature rupture of membranes	Neonatal ICU management	,	Death (3)
Alharbi <i>et al.</i>	2022	KSA	Retrospective study	Adults with COVID-19	809	255	COVID-19	ICU management	11.1 days	Death (64)
Aleanizy <i>et al.</i>	2021	KSA	Retrospective study	Adults with COVID-19	1026	103	COVID-19	ICU management	20 days	Death (23)
Corrêa <i>et al.</i>	2015	Brazil	Prospective cohort study	Adults with respiratory failure	462	26	Community-acquired pneumonia (10) Cardiogenic pulmonary edema (4) Acute COPD (8) Others (4)	ICU management	12 days	death (5)
Kao <i>et al.</i>	2015	Taiwan	Prospective cohort study	Adults	3002	296	Community-acquired ARDS (70) Hospital-acquired ARDS (83) ICU-acquired ARDS (143)	ICU management	18 days	Death (155)
Shi <i>et al.</i>	2022	China	Retrospective study	Adults	529	179	Pneumonia	ICU management	,	,

Table 2. Summary of mechanical ventilation interventions for the acute respiratory distress syndrome (ARDS) and recommendations from the clinical practice guidelines of the American Thoracic Society (ATS), European Society of Intensive Care Medicine (ESICM), Society of Critical Care Medicine (SCCM), Société de réanimation de langue Française (SRLF) and Intensive Care Society (ICS)

Intervention	ARDS severity	Rationale	Strength of recommendation		
			ATS/ESICM/SCCM (Fan <i>et al.</i> , 2017)	SRLF (Papazian <i>et al.</i> , 2019)	ICS (Griffiths <i>et al.</i> , 2019)
Low tidal volumes (4–8 mL/kg predicted body weight)	Any	Mechanical ventilation may potentiate acute lung injury, and lower tidal volumes may mitigate VILI	Strong recommendation for routine use	Strong agreement for routine use	Strong recommendation for routine use
Lower inspiratory pressures (plateau pressure < 30 cm H ₂ O)	Any	Increased plateau pressures may contribute to VILI, even with appropriate tidal volumes	Strong recommendation for routine use	Strong agreement for routine use	Strong recommendation for routine use
Higher PEEP instead of lower PEEP	Moderate/severe	Higher PEEP may optimize alveolar recruitment, and acts to decrease intrapulmonary shunt and reduce the risk of VILI	Conditional recommendation for routine use	Strong agreement for routine use	Weak recommendation for routine use
Prone positioning	Severe	Prone positioning improves lung recruitment, primarily in dependent regions, and therefore increases end-expiratory lung volume, improves ventilation–perfusion matching and decreases VILI	Strong recommendation for routine use (> 12 h per day)	Strong agreement for routine use (in patients with Pao ₂ /FiO ₂ < 150 mm Hg; 16 consecutive hours)	Strong recommendation for routine use (> 12 h per day)
High-frequency oscillatory ventilation	Moderate/severe	Method of ventilation that provides very small tidal volumes at higher mean airway pressures, therefore minimizing tidal stress and strain	Strong recommendation against routine use	Strong agreement against routine use	Strong recommendation against routine use
Recruitment manoeuvres	Any	Recruitment manoeuvres (i.e., transient elevations in applied airway pressures) may reduce atelectasis and increase end-expiratory lung volume by opening collapsed alveoli	Conditional recommendation for routine use	Strong agreement against routine use	No recommendation on the basis of poor evidence at the time of guideline development

VV-ECMO	Severe	Extracorporeal oxygenation and removal of carbon dioxide can replace the function of diseased lungs in ARDS, and allow for minimal ventilator settings to reduce incidence of VILI	No recommendation on the basis of poor evidence at the time of guideline development	Strong agreement for use in severe ARDS with $Pao_2/FiO_2 < 80$ or in cases of refractory hypoxemia	Weak recommendation for use in selected patients
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Note: PEEP = positive end-expiratory pressure, VILI = ventilator-induced lung injury, VV-ECMO = venovenous extracorporeal membrane oxygenation.

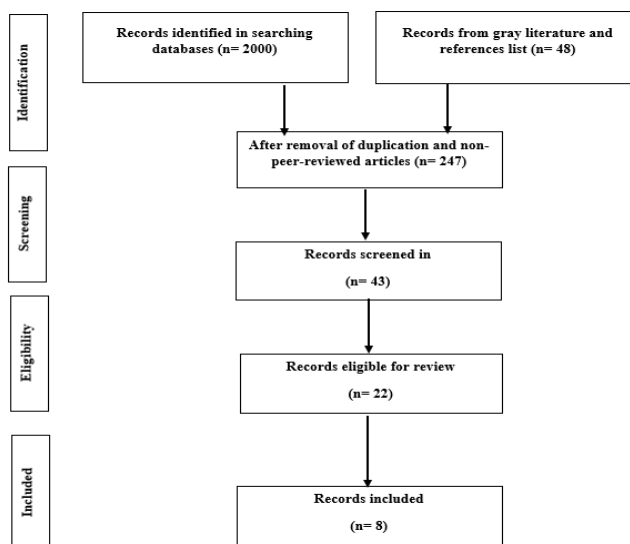


Figure 2. Flow chart of the selection process

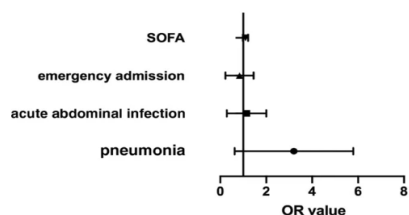


Figure 3. Forest plot for risk factors of the severity of ARDS

The Berlin standard was used in the LUNG SAFE Apparat Attendee Assessment to screen ARDS patients from 459 ICUs in 50 countries in five country areas (Bellani *et al.*, 2016) 10.4 percent of all ICU clearances were controlled by ARDS, and 23.4 percent of patients required mechanical ventilation in this assessment. Pneumonia, extrapulmonary contamination, target, and injury were the most commonly seen explanations for ARDS. The central duration of mechanical acquisition in patients with ARDS was 8 days (interquartile range 416). Admissions were critical, with 39.6 percent of patients brazenly failing practice, and admissions increased with ARDS authenticity (34.9 percent, 40th3 percent, and 46.1 percent of frail, moderate, and unhealthy weight patients independently making headlines in clinical concentration). Persist and survivors face animal panic (Cochi *et al.*, 2016).

ARDS survivors have underlying areas and deficiencies that persist up to 5 years after hospital discharge, resulting in reduced disability and less impairment in physical activity (Herridge *et al.*, 2003; Herridge *et al.*, 2011). In addition, survivors show a slowdown in the psychological, psychological, and monetary consequences of ARDS (Herridge *et al.*, 2011). The preparation

for the treatment of ARDS is lung-protective mechanical ventilation (Bhavysari *et al.*, 2023; Choudhary *et al.*, 2023; Nwankwo *et al.*, 2023; Sarangi *et al.*, 2023). **Table 2** summarizes the proposed clinical rules for mechanical relaxation. The main goal is to limit the ventilation driven by the fan. Lung injury is an iatrogenic form of lung injury that progresses to perturbation and is associated with additional shocking consequences in critically ventilated patients (Slutsky & Ranieri, 2013).

Just as had overcome insane mechanical stress (p. Beast Transmission Volume) converts to an explosive response (i.volutrauma), can spread by spreading and cause frustration in distant organs (e.g. biotrauma). Randomized evaluations have shown that ventilation of ARDS patients with reduced drive volumes corresponding to the expected body weight and loads worked reliably with significantly lower adversity rates (Amato *et al.*, 1998; Acute Respiratory Distress Syndrome Network, 2000). Lung-controlled ventilation is given to prevent possible hypercapnia and acidosis, which may persist if sensitive (Acute Respiratory Distress Syndrome Network, 2000).

Existing evidence suggests that the most basic levels of positive end-expiratory tension are observed in patients with moderate to insane ARDS (Bellani *et al.*, 2017). Being aware of higher positive end-expiratory tension could reduce repetitive alveolar rupture and associated shear damage in the lungs. Positive end-expiratory tension can affect hemodynamics and cause pulmonary hypertension. This treatment has proven compelling in people with moderate to unresponsive ARDS (Briel *et al.*, 2010). Different methods to control the increasing ventilation, e.g. B. oscillating

ventilation with high reps, have not become established (Ferguson *et al.*, 2013), and considerations have questioned their further use in ARDS patients (Bellani *et al.*, 2017). In individuals with moderate ARDS, simple ventilation should be attempted anyway; likely, individuals with more difficult conditions will not help (Bellani *et al.*, 2017). In a recent meta-review, high-flow nasal cannula oxygen therapy was shown to limit the need for intubation and mechanical ventilation in patients with incredible hypoxemic respiratory confusion but did not reduce mortality (Rochweg *et al.*, 2019).

In 2020, the COVID-19 pandemic propelled ARDS to the pinnacle of the chart. Improvement in ARDS because of extreme COVID-19 became (and is) normal, and it's far uncertain whether or not COVID-19-associated ARDS contained a reserve fraction of various styles of ARDS and whether or not a restore method distinct became needed (Fan *et al.*, 2020). Early revelations (Navas-Blanco & Dudaryk, 2020) cautioned planned non-compulsory remedies for COVID-19-associated ARDS. Two distinct general rankings for ARDS were provided in sufferers with COVID-19: kind H, represented with the aid of using excessive prolongation of suction, excessive air flow/perfusion rate, excessive lung weight, and excessive alveolar recruitment (dependable in traditional extreme ARDS) and kind L, represented with the aid of using unacceptable numbers for relative parts (Gattinoni *et al.*, 2020).

A few specialists speculated that maximum sufferers with COVID-19-associated ARDS might before everything gift with kind L characteristics, with a pair converting to kind H, and that clinicians have to keep in mind early intubation in sufferers with kind L ARDS, in addition offering that those sufferers may want to preserve thru better streaming volumes without the threat of ventilator-impelled lung damage (Gattinoni *et al.*, 2020; Navas-Blanco & Dudaryk, 2020).

Be that because it might also add, popular stress or volume-allocated air flow has been assisting ARDS care, and new ventilatory strategies might also additionally probably benefit the ground. To begin, flight direction stress launch air flow (APRV) is a stress manipulation machine of respiration that has been proven to decrease ventilator-instigated lung harm. Rather than endeavoring to broaden the lung to perfect lung volumes with the aid of using beating heartbreaking consistency with better strains, this approach conflictly breakdowns the lungs ("launch") from an extra unmistakable stage of constant positive flying direction stress. APRV may want to limit ventilator-instigated lung harm on an essential stage with the aid of using assisting predictable pressures at veritable levels. However, every other randomized author determined that APRV had a crucial impact on ARDS fulfillment rates, with decreased mechanical breathing time and period of life withinside the ICU whilst separated from volume-managed air flow with protection, that is pulmonary correlated (Zhou *et al.*, 2017). Further medical reviews of APRV brains are needed. Another interesting location of evaluation is the capability for lung damage from self-damage to the lung (P-SILI). Despite the sturdy physiological clarity, there may be a loss of human manipulation to recognize P-SILI (Tobin *et al.*, 2020). In a prime stage, the dangers of P-SILI may be decreased with the aid of using controlling breathing motion and attempt with neuromuscular tape,

sedation, or laboratory assistance. It is accurate now inadequate regarding affirmation that diminishing breathing attempts and power is hooked up with more made accomplishes ARDS sufferers (Spinelli *et al.*, 2020).

Finally, at the same time as VV-ECMO is precious for sufferers with over-the-pinnacle ARDS for whom the popular concept is failing, extracorporeal carbon dioxide clearing is one extra type of extracorporeal lifestyle assist that can be primary withinside the courting of moderate-to-severe ARDS (Del Sorbo *et al.*, 2014). There is a wagered of hypoventilation in sufferers getting mechanical air flow with fantastically low streaming volumes, attaining hypercapnia and acidosis. By supplying an extracorporeal method for slashing down carbon dioxide, extracorporeal carbon dioxide clearing can allow quite low streaming volumes. Not with the aid of using any stretch like VV-ECMO, this technique makes use of extra diffused catheters, but there are essential dangers associated with it, maximum extraordinarily depleting (Boyle *et al.*, 2018). In individuals with mild ARDS, the extracorporeal release of carbon dioxide can be interrupted and lead to annoying confusion. The essential clinical elements to explore its richness are underway (Archana *et al.*, 2022; Emekekwe *et al.*, 2022; Jallepalli *et al.*, 2022; Mane *et al.*, 2022).

Conclusion

Intense respiratory misery disorder is a kind of respiratory capture brought about by pneumonia, sepsis, injury, or goal. The level of hypoxemia in ARDS is related to an expanded gamble of death. ARDS the board centers principally around strong consideration, lung-defensive ventilation, and diminishing the kind of iatrogenic lung injury, and extracorporeal life support is the final retreat for patients who keep on falling apart regardless of these steady medicines. Intense respiratory pain condition related to COVID-19 seems, by all accounts, to be the same as customary ailments, and current prescriptions ought to keep on being the backbone of therapy.

Acknowledgments: None

Conflict of interest: None

Financial support: None

Ethics statement: None

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