The Review Of
DIABETIC
STUDIES
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Acute Respiratory Distress And Complications In Hospitalized Patients: Integrated Patient Safety And Care Pathways

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Abstract:

Background: Acute Respiratory Distress Syndrome (ARDS) is a severe, life-threatening form of acute lung injury characterized by diffuse alveolar damage, refractory hypoxemia, and high mortality among critically ill patients. Despite advances in supportive care and mechanical ventilation strategies, ARDS continues to represent a major challenge in critical care medicine due to its complex pathophysiology, diverse etiologies, and frequent association with multiorgan failure.
Aim: This article aims to provide a comprehensive overview of ARDS with emphasis on its etiology, epidemiology, pathophysiology, clinical presentation, diagnostic evaluation, management strategies, complications, and long-term outcomes, while highlighting patient safety and integrated care pathways in hospitalized patients.
Methods: A narrative, integrative review approach was adopted. Current diagnostic frameworks, epidemiological data, and evidence-based management practices were analyzed, with particular focus on the Berlin definition, lung-protective ventilation strategies, adjunctive therapies, and multidisciplinary care principles.
Results: ARDS remains prevalent among ICU patients, especially those with sepsis or severe pneumonia, with mortality strongly correlated to disease severity. Lung-protective ventilation, prone positioning, conservative fluid management, and early identification of underlying causes significantly improve outcomes. However, survivors frequently experience prolonged functional, psychological, and rehabilitative challenges.
Conclusion: ARDS requires early recognition, standardized diagnostic criteria, and an individualized, multidisciplinary treatment approach to reduce mortality and long-term morbidity. Continued research into preventive and disease-modifying strategies is essential.

Keywords: Acute respiratory distress syndrome; Hypoxemia; Mechanical ventilation; Critical care; Lung-protective strategies.

Introduction:

Acute respiratory distress syndrome represents a severe and rapidly evolving form of diffuse inflammatory lung injury that develops in critically ill patients and is associated with substantial morbidity and mortality. The condition is defined clinically by profound impairment in gas exchange, radiographic evidence of widespread pulmonary infiltrates, and an abrupt onset that reflects an underlying systemic or pulmonary insult. At the structural level, ARDS is characterized by extensive damage to the alveolar–capillary barrier, including injury to the pulmonary capillary endothelium and the alveolar epithelium. This disruption leads to increased vascular permeability, alveolar flooding with protein-rich fluid, loss of functional surfactant, and collapse of alveolar units, all of which contribute to severe hypoxemia that is often refractory to conventional oxygen therapy. From a temporal perspective, ARDS is an acute syndrome that typically manifests within seven days of a known clinical insult such as severe infection, aspiration, trauma, or systemic inflammation. The clinical course is marked by rapidly progressive respiratory failure accompanied by bilateral pulmonary infiltrates visible on chest radiography or computed tomography. A defining feature of ARDS is the absence of left atrial hypertension or other evidence suggesting cardiogenic pulmonary edema as the primary cause of respiratory compromise. This distinction is critical, as the pathophysiological mechanisms and therapeutic approaches differ substantially between non-cardiogenic and cardiogenic forms of pulmonary edema [1][2].

The contemporary diagnostic framework for ARDS is based on the Berlin definition, which provides standardized criteria to enhance diagnostic accuracy and clinical consistency. According to this definition, ARDS is identified by an acute onset of respiratory symptoms, bilateral lung opacities that cannot be fully explained by pleural effusions, lobar collapse, or pulmonary nodules, and respiratory failure not attributable to cardiac dysfunction or fluid overload. In addition, the severity of oxygenation impairment is quantified using the ratio of arterial oxygen tension to the fraction of inspired oxygen, with a PaO_2/FiO_2 ratio below 300 mm Hg confirming the diagnosis. The Berlin definition further requires the presence of a minimum level of positive airway pressure, specified as positive end-expiratory pressure or continuous positive airway pressure of at least 5 cm H_2O, thereby acknowledging the role of ventilatory support in accurately assessing oxygenation status. This definition represents a refinement of earlier classification systems, particularly the American–European Consensus Conference criteria, by eliminating the term acute lung injury and consolidating the spectrum of disease under a single diagnostic entity with graded severity. The removal of invasive hemodynamic measurements, such as pulmonary artery wedge pressure thresholds, reflects a shift toward more practical and widely applicable diagnostic criteria while maintaining clinical rigor. These changes have improved the feasibility of diagnosis across diverse clinical settings and have facilitated more uniform enrollment of patients in clinical trials [1][2].

As ARDS progresses, significant alterations in pulmonary vascular physiology commonly occur. Hypoxic pulmonary vasoconstriction, endothelial dysfunction, and microvascular thrombosis contribute to increased pulmonary vascular resistance, which may lead to the development of pulmonary hypertension. These hemodynamic changes impose an additional burden on the right ventricle and can precipitate right-sided heart failure, further complicating the clinical course. The interaction between impaired gas exchange, altered pulmonary mechanics, and vascular dysfunction underscores the systemic nature of ARDS and its impact beyond the lungs. Despite advances in supportive care and a deeper understanding of its pathophysiology, ARDS continues to be associated with high mortality rates, particularly among patients with severe disease or multiple organ dysfunction. Current management strategies remain largely supportive and focus on lung-protective mechanical ventilation, optimization of oxygenation, and treatment of the underlying cause. Effective disease-modifying therapies remain limited, and outcomes are often determined by the severity of the initial insult and the patient's overall physiological reserve. Consequently, ARDS remains a major challenge in critical care medicine and a focus of ongoing clinical and translational research aimed at reducing its substantial global burden [1][2].

Etiology

Acute respiratory distress syndrome arises from a wide range of clinical conditions that initiate a systemic or localized inflammatory response, ultimately resulting in diffuse lung injury. The etiology of ARDS is traditionally divided into pulmonary and extrapulmonary causes, reflecting whether the initial insult directly affects lung tissue or originates from a distant site. Direct pulmonary triggers include infectious pneumonia and aspiration of gastric contents, both of which cause immediate epithelial injury and alveolar inflammation. These insults disrupt the integrity of the alveolar–capillary membrane, allowing inflammatory cells and protein-rich fluid to accumulate within the alveolar spaces, thereby impairing gas exchange and lung compliance. Extrapulmonary causes of ARDS are equally significant and frequently associated with a more diffuse inflammatory response. Conditions such as sepsis, major trauma, massive blood transfusion, near drowning, drug overdose, fat embolism, inhalation of toxic substances, and acute pancreatitis can precipitate ARDS without an initial lung-focused injury. In these settings, circulating inflammatory mediators activate pulmonary endothelial cells, leading to increased vascular permeability and secondary lung damage. This systemic inflammatory cascade represents a central mechanism through which extra-thoracic illnesses and injuries culminate in acute lung injury and respiratory failure [3].

Efforts to identify individuals at risk for developing ARDS have led to the development of lung injury prediction and prevention scores. These tools demonstrate value in identifying patients with a low likelihood of progression to ARDS, thereby aiding clinical reassurance and risk stratification. However, elevated scores have limited predictive accuracy for identifying patients who will ultimately develop the syndrome, underscoring the complexity and multifactorial nature of ARDS pathogenesis [1]. Several patient-related and clinical factors further modify the risk of ARDS. Advanced age is associated with reduced physiological reserve and an exaggerated inflammatory response, increasing vulnerability to lung injury. Female sex has been identified as a potential risk factor in some populations, possibly reflecting hormonal or immunological influences. Lifestyle factors such as cigarette smoking and chronic alcohol consumption predispose individuals to epithelial dysfunction and impaired immune defense within the lungs. Surgical procedures, particularly aortic vascular and cardiovascular surgery, are associated with systemic inflammation and ischemia–reperfusion injury, both of which can precipitate ARDS. Neurological insults such as traumatic brain injury, as well as conditions including pancreatitis, pulmonary contusion, and severe infectious pneumonia, further amplify inflammatory signaling and pulmonary vulnerability. Certain medications, including radiation therapy, chemotherapeutic agents, and amiodarone, have also been implicated due to their direct or indirect toxic effects on lung tissue [2].

Epidemiology

Acute respiratory distress syndrome represents a significant public health burden due to its high incidence among critically ill patients and its substantial contribution to intensive care unit mortality. In the United States, population-based estimates indicate that the incidence of ARDS ranges between 64.2 and 78.9 cases per 100,000 person-years, underscoring the frequency with which this syndrome is encountered in acute care settings. These figures reflect not only the prevalence of severe underlying illnesses such as sepsis and pneumonia but also improved recognition and application of standardized diagnostic criteria in clinical practice [3][4]. At the time of diagnosis, ARDS exhibits considerable heterogeneity in disease severity. Approximately one quarter of patients are initially classified as having mild ARDS, while the remaining three quarters present with moderate or severe forms of the syndrome. Importantly, disease severity is not static. Longitudinal observations demonstrate that nearly one third of patients who initially meet criteria for mild ARDS subsequently progress to moderate or severe disease, highlighting the dynamic nature of the condition and the need for early identification and close clinical monitoring [3][4].

Within the critical care environment, ARDS accounts for a substantial proportion of respiratory failure cases. Epidemiological data suggest that 10 to 15 percent of all patients admitted to intensive care units fulfill diagnostic criteria for ARDS during their hospitalization. The prevalence is even higher among patients requiring invasive mechanical ventilation, with up to 23 percent meeting established definitions of the syndrome. This strong association with ventilatory support reflects both the severity of hypoxemic respiratory failure in ARDS and the central role of mechanical ventilation in its management [5]. Trends in ARDS-related mortality have shown gradual improvement over time, likely reflecting advances in supportive care, particularly the adoption of lung-protective ventilation strategies. A comprehensive review of the literature identified a steady annual reduction in mortality of approximately 1.1 percent between 1994 and 2006. Despite this encouraging trend, the overall burden of death remains considerable. When data from multiple studies are pooled, the average mortality rate for ARDS remains high at approximately 43 percent [6][7]. Mortality risk correlates closely with disease severity at presentation. Reported death rates increase progressively from 27 percent in mild ARDS to 32 percent in moderate disease and reach approximately 45 percent in patients with severe ARDS. These gradients emphasize the prognostic importance of early severity stratification and reinforce the ongoing need for improved preventive and therapeutic strategies across all stages of the syndrome.

Pathophysiology

Acute respiratory distress syndrome reflects a common pathological response of the lungs to a wide spectrum of direct and indirect insults. Regardless of the initiating etiology, ARDS follows a relatively consistent sequence of pathological events that evolve over time and culminate in severe impairment of respiratory function. The disease process typically progresses through overlapping phases, beginning with acute injury to the alveolar–capillary interface, followed by a proliferative phase associated with partial recovery of lung architecture, and, in some patients, a subsequent fibrotic phase that marks the resolution of acute inflammation and the transition toward chronic structural remodeling. The initial exudative phase is characterized by widespread injury to both pulmonary epithelial and endothelial cells. This cellular damage is mediated by intense inflammatory activation, resulting in the release of cytokines, recruitment of neutrophils, and activation of coagulation pathways. These processes promote apoptosis and necrosis of structural lung cells and disrupt the integrity of the alveolar–capillary barrier. As vascular permeability increases, protein-rich fluid and inflammatory debris leak into the alveolar spaces, leading to alveolar edema and the formation of hyaline membranes. The accumulation of fluid and proteins within the alveoli interferes with normal surfactant function and promotes alveolar collapse, thereby reducing effective gas exchange and causing refractory hypoxemia. As the acute inflammatory response begins to subside, many patients enter a proliferative phase marked by gradual improvement in lung function. During this stage, type II alveolar epithelial cells proliferate and differentiate in an effort to restore the damaged epithelial lining, while endothelial repair and reabsorption of alveolar fluid contribute to partial recovery of oxygenation. However, the extent of healing varies widely and depends on the severity and duration of the initial insult as well as ongoing mechanical and inflammatory stressors [8].

A defining feature of ARDS pathophysiology is the heterogeneous distribution of lung injury. The disease does not affect the lungs uniformly; instead, certain regions, particularly the dependent and basal areas, tend to be more severely involved than nondependent regions. This uneven involvement results in marked regional differences in lung compliance and ventilation. Such heterogeneity has important clinical implications, as mechanical ventilation strategies may differentially affect injured and relatively preserved alveoli. Interventions such as increased positive end-expiratory pressure can enhance alveolar recruitment and improve oxygen diffusion in collapsed or fluid-filled regions, yet they may also expose less affected areas to overdistension, increasing the risk of volutrauma and atelectrauma [8]. In advanced or unresolved cases, ongoing inflammation and abnormal repair mechanisms lead to excessive deposition of extracellular matrix and collagen, resulting in pulmonary fibrosis. This fibrotic remodeling further stiffens the lungs, exacerbates ventilation–perfusion mismatch, and increases pulmonary vascular resistance. Ultimately, the combined effects of impaired gas exchange, reduced lung compliance, and elevated pulmonary arterial pressures define the physiological derangements characteristic of ARDS and contribute to the development of pulmonary hypertension and right ventricular strain [9].

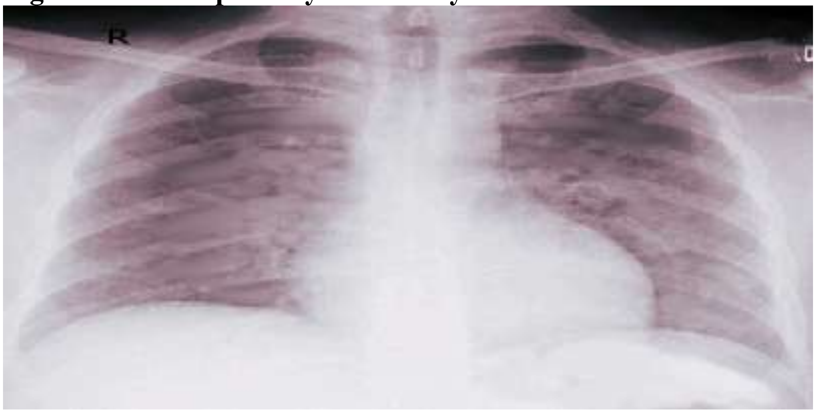
Histopathology

The histopathological features of acute respiratory distress syndrome reflect the underlying disruption of the alveolar–capillary barrier and the intense inflammatory response that characterizes this condition. Examination of affected lung tissue most consistently demonstrates prominent alveolar edema within involved regions of the lung, representing a direct consequence of increased vascular permeability. Injury to type I pneumocytes, which normally form the thin epithelial lining essential for efficient gas exchange, plays a central role in this process. Concurrent damage to the pulmonary vascular endothelium further compromises barrier integrity, allowing plasma proteins, inflammatory cells, and erythrocytes to leak into the alveolar airspaces. As protein-rich fluid accumulates within the alveoli, additional structural abnormalities become evident. Alveolar hemorrhage may be observed, reflecting severe endothelial disruption and capillary injury. Pulmonary capillary congestion and interstitial edema are also common findings, contributing to increased lung weight and reduced compliance. One of the classic microscopic hallmarks associated with ARDS is the formation of hyaline membranes, which consist of fibrin, cellular debris, and plasma proteins lining the alveolar walls. These membranes interfere with oxygen diffusion and are indicative of diffuse alveolar damage. Despite their frequent association with ARDS, these histological alterations are not pathognomonic. Similar patterns of diffuse alveolar damage can be identified in other acute lung injuries of varying etiologies, underscoring the nonspecific nature of the microscopic findings. Consequently, histopathology alone is insufficient for a definitive diagnosis of ARDS and must be interpreted in conjunction with clinical presentation, radiographic findings, and physiological criteria [8].

History and Physical

Acute respiratory distress syndrome typically presents with rapidly progressive respiratory symptoms that evolve over a short period following an identifiable precipitating event. Patients commonly develop dyspnea and hypoxemia within 6 to 72 hours of the initial insult, with clinical deterioration occurring swiftly and often necessitating admission to the intensive care unit. The escalating severity of respiratory failure frequently requires endotracheal intubation and mechanical ventilation to maintain adequate oxygenation and prevent life-threatening hypoxia. A detailed clinical history is essential and should focus on identifying the underlying condition responsible for triggering the syndrome, as early recognition of the causative factor has important implications for management and prognosis. In patients who are able to communicate during the early stages of illness, the initial complaint is often mild shortness of breath or increased effort with breathing. This early phase may progress rapidly, and within 12 to 24 hours, respiratory distress typically intensifies, characterized by marked air hunger and an inability to maintain oxygenation despite supplemental oxygen therapy. In many cases, the precipitating cause is readily apparent, such as severe pneumonia or systemic sepsis. In other situations, particularly when the trigger is less obvious, careful questioning of the patient or family members becomes crucial. Inquiry into recent infections, aspiration events, trauma, drug exposures, environmental inhalants, or other acute illnesses may provide critical diagnostic clues. Physical examination findings are dominated by signs of respiratory compromise. Tachypnea and labored breathing are common and reflect the increased work of respiration. Use of accessory muscles and nasal flaring may be evident as respiratory failure progresses. Systemic manifestations often accompany respiratory findings and vary according to the severity of hypoxemia and the presence of associated organ dysfunction. Central or peripheral cyanosis may be observed due to inadequate arterial oxygenation, while tachycardia frequently develops as a compensatory response to hypoxia. Altered mental status, ranging from agitation to reduced consciousness, may also be present and reflects impaired cerebral oxygen delivery. Despite the administration of high concentrations of inspired oxygen, patients with ARDS often demonstrate persistently low oxygen saturation, underscoring the severity of gas exchange impairment. Auscultation of the chest typically reveals inspiratory crackles, most commonly at the lung bases, although diffuse rales may be heard throughout the lung fields as the disease advances. These findings, when integrated with the clinical history and temporal progression, strongly support the diagnosis of acute respiratory distress syndrome [6][7][8][9].

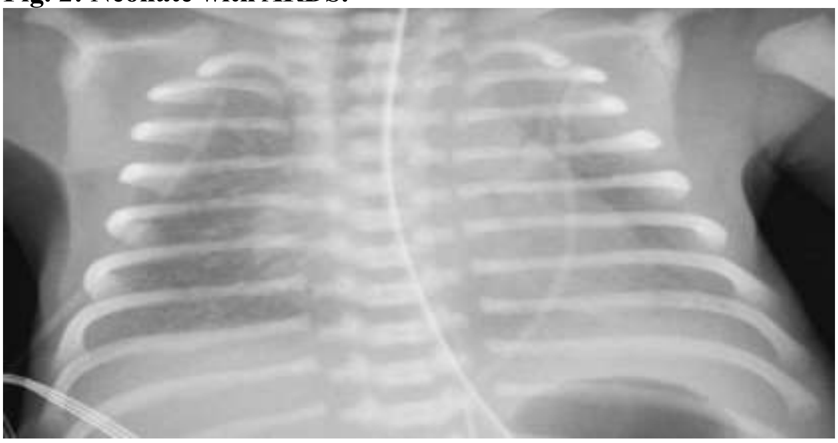
Fig. 1: Acute Respiratory Distress Syndrome.



Evaluation

The evaluation of acute respiratory distress syndrome is centered on the application of well-established clinical, radiographic, and physiological criteria that collectively support an accurate diagnosis and guide subsequent management. ARDS is defined by an acute onset of respiratory failure accompanied by bilateral pulmonary infiltrates identified on chest radiography or computed tomography, provided that these findings are not fully explained by cardiac pathology or fluid overload. A central diagnostic component is the assessment of oxygenation impairment using the ratio of arterial oxygen tension to the fraction of inspired oxygen. A PaO_2/FiO_2 value below 300 mm Hg confirms the presence of ARDS and reflects the severity of gas exchange dysfunction. Based on the degree of hypoxemia, ARDS is further stratified into mild, moderate, and severe categories. Mild disease is characterized by a PaO_2/FiO_2 ratio greater than 200 mm Hg but not exceeding 300 mm Hg, moderate disease by values greater than 100 mm Hg and up to 200 mm Hg, and severe disease by a ratio of 100 mm Hg or less. This severity classification has important prognostic implications, as increasing disease severity is associated with higher mortality rates and fewer ventilator-free days, emphasizing the clinical relevance of early and accurate stratification. Advanced imaging techniques may provide additional diagnostic clarity in selected cases. Computed tomography of the chest is particularly useful when complications such as pneumothorax, pleural effusion, barotrauma, or mediastinal lymphadenopathy are suspected. CT imaging can help distinguish true pulmonary infiltrates from extrapulmonary processes and offers a more detailed assessment of the distribution and extent of lung involvement.

Fig. 2: Neonate with ARDS.



Differentiating ARDS from cardiogenic pulmonary edema is a critical component of the evaluation process. Assessment of left ventricular function aids in excluding congestive heart failure as the primary cause of respiratory failure or in determining the contribution of cardiac dysfunction to the clinical picture. This assessment may be performed using invasive hemodynamic measurements obtained through pulmonary artery catheterization or, more commonly, through noninvasive modalities such as transthoracic echocardiography, thoracic bioimpedance, or pulse contour analysis. Given the lack of demonstrated outcome benefit and potential risks, the routine use of pulmonary artery catheters is generally discouraged in favor of noninvasive approaches. In selected cases, bronchoscopy may be indicated to evaluate suspected pulmonary infections and to obtain specimens for microbiological culture [2]. Additional laboratory and imaging studies are tailored to the suspected underlying cause of the inflammatory process leading to ARDS and to the frequent presence of multiorgan dysfunction. Renal, hepatic, and hematologic involvement is common, necessitating ongoing monitoring through comprehensive laboratory testing. Clinically indicated evaluations include complete blood count with differential, metabolic and electrolyte panels, markers of tissue perfusion such as blood lactate, coagulation studies, and cardiac biomarkers including troponin and creatine kinase-MB. These investigations support a comprehensive assessment of disease severity, guide supportive care, and facilitate early detection of complications [10][11][12].

Treatment / Management

The management of acute respiratory distress syndrome is primarily supportive, focusing on optimizing oxygenation, minimizing further lung injury, and addressing the underlying cause of the condition. Core principles include reducing intrapulmonary shunting, enhancing oxygen delivery, limiting oxygen consumption, and preventing additional injury to the lungs. Mechanical ventilation remains the cornerstone of therapy for most patients, with careful attention to ventilatory strategies that minimize the risk of ventilator-associated lung damage. Supportive measures also include judicious fluid management to avoid overload, provision of nutritional support, and vigilant monitoring until clinical improvement is achieved [1][13]. Mechanical ventilation must be carefully tailored to prevent exacerbation of alveolar injury. High tidal volumes, elevated plateau pressures, and repeated alveolar collapse can induce volutrauma, barotrauma, and atelectrauma, respectively, worsening lung injury. Lung-protective ventilation, as outlined by the NIH-NHLBI ARDS Clinical Network protocol, recommends tidal volumes of 4 to 8 mL/kg of ideal body weight, plateau pressures below 30 cm H_2O, SpO_2 targets of 88% to 95%, and careful adjustment of positive end-expiratory pressure (PEEP) based on oxygenation needs. In some cases, modifications such as inverse inspiratory-to-expiratory ratios may be necessary to achieve adequate oxygenation [1][13]. Adjunctive ventilatory strategies include airway pressure release ventilation and high-frequency oscillatory ventilation, particularly in pediatric populations. Noninvasive modalities, such as CPAP, BiPAP, proportional-assist ventilation, and high-flow nasal cannula, may benefit patients with mild to moderate ARDS, but timely escalation to invasive ventilation is critical if respiratory failure progresses. Techniques to reduce barotrauma, such as minimizing tidal volume and PEEP, adjusting inspiratory times, and decreasing flow rates, support safer mechanical ventilation and improve patient outcomes.

Improving lung compliance enhances oxygenation and reduces ventilatory pressures. Neuromuscular blockade administered early in the disease course has been shown to improve ventilator-free days and, in some studies, 90-day survival, though recent trials suggest that lighter sedation strategies may yield comparable outcomes. Attention must also be given to reversible contributors to decreased compliance, including pneumothorax, hemothorax, thoracic compartment syndrome, and intraabdominal hypertension [13][14]. Nonventilatory measures such as prone positioning have demonstrated significant benefits in oxygenation and lung recruitment, particularly when patients are maintained in the prone position for at least eight hours per day. Conservative fluid management after initial resuscitation reduces pulmonary edema, while extracorporeal membrane oxygenation (ECMO) serves as a salvage therapy in refractory hypoxemia, although mortality benefits remain unproven [15][16][17][18]. Additional supportive care includes tailored nutritional strategies, targeting moderate hyperglycemia, prophylaxis for deep venous thrombosis and stress ulcers, central venous access for monitoring and medication delivery, skin care, and mobilization once stable. Pharmacologic interventions such as glucocorticoids may be considered in select patients with steroid-responsive conditions, early refractory moderate to severe ARDS, or specific inflammatory etiologies but are generally avoided in prolonged or less severe disease due to potential adverse outcomes [19][20][21]. Overall, ARDS management requires a multidisciplinary, individualized approach that integrates lung-protective ventilation, supportive care, and targeted interventions aimed at the underlying cause, while minimizing further pulmonary injury and systemic complications.

Differential Diagnosis

The differential diagnosis of acute respiratory distress syndrome encompasses a spectrum of pulmonary conditions that can mimic its clinical, radiographic, and physiological features. Cardiogenic pulmonary edema is frequently considered, as it presents with bilateral infiltrates and hypoxemia; however, it is typically associated with elevated left atrial pressures and responds to diuretic therapy. Exacerbations of interstitial lung disease and acute interstitial pneumonia share similarities with ARDS, including diffuse alveolar damage and impaired oxygenation, yet these conditions often have a subacute onset and identifiable chronic interstitial changes on imaging. Diffuse alveolar hemorrhage and acute eosinophilic lung disease may present with hemoptysis or peripheral eosinophilia, which can help distinguish them from ARDS. Organizing pneumonia and cryptogenic organizing pneumonia may also mimic ARDS but usually demonstrate patchy consolidation with relative preservation of lung function. Bilateral infectious pneumonia, pulmonary vasculitis, and disseminated malignancy can also produce diffuse infiltrates and hypoxemia, requiring careful history, laboratory assessment, imaging, and occasionally tissue sampling to clarify the diagnosis. Accurate differentiation from these entities is essential because treatment strategies and prognostic outcomes vary significantly from ARDS [22].

Prognosis

The prognosis of ARDS has improved considerably over recent decades, though it remains a condition with substantial morbidity and mortality. Historically, mortality rates were as high as 30% to 40% until the 1990s. Advances in mechanical ventilation strategies, early identification of precipitating conditions, and timely antimicrobial therapy have contributed to a significant reduction in deaths, with contemporary mortality estimates ranging from 9% to 20%, although rates are higher in older patients. The primary causes of mortality continue to be sepsis and multiorgan failure rather than isolated respiratory compromise. Survivors often face prolonged hospitalization, substantial weight loss, and persistent muscle weakness, resulting in functional impairments. Cognitive deficits from hypoxic episodes may persist for months, affecting quality of life. Pulmonary function frequently recovers almost completely, yet many patients experience exertional dyspnea and decreased exercise tolerance, requiring extended rehabilitation and adaptation to a new baseline functional status [23].

Complications

ARDS management and its underlying pathology are associated with multiple complications, often stemming from both the disease process and its intensive supportive measures. Mechanical ventilation can precipitate barotrauma due to elevated positive end-expiratory pressures, and prolonged ventilatory support may necessitate tracheostomy. Post-extubation complications include laryngeal edema and subglottic stenosis. Patients are also at heightened risk for nosocomial infections, including pneumonia, line sepsis, and urinary tract infections, as well as antibiotic-resistant organisms. Prolonged immobility contributes to deep venous thrombosis and muscle wasting, while systemic hypoxia can compromise renal function. Long-term psychological sequelae, including post-traumatic stress disorder, are common among survivors, highlighting the necessity for multidisciplinary post-ICU care.

Postoperative and Rehabilitation Care

Recovery from ARDS frequently involves tracheostomy and percutaneous endoscopic gastrostomy placement to facilitate ventilator weaning and nutritional support. Nutritional management is critical, with enteral or parenteral feeding recommended based on gastrointestinal function, often emphasizing high-fat, low-carbohydrate diets for their anti-inflammatory effects. Physical activity is essential, including frequent repositioning to prevent pressure injuries and thromboembolic events, and early mobilization when feasible. Comprehensive rehabilitation requires coordinated interprofessional care, including intensivists, pulmonologists, respiratory therapists, dietitians, pharmacists, nurses, physical therapists, and mental health professionals. Patient education and family involvement are essential to support adherence, prevent complications, and facilitate recovery. Preventive strategies focus on fluid management, aspiration prevention, and lung-protective ventilation, though no specific measures can entirely prevent ARDS onset. Survivors require ongoing support to regain functional status and adapt to residual limitations in exercise capacity and daily activities [24][25].

Conclusion:

Acute Respiratory Distress Syndrome remains a leading cause of morbidity and mortality in critically ill hospitalized patients, reflecting its aggressive clinical course and complex underlying biology. Although improvements in intensive care practices—particularly lung-protective mechanical ventilation—have contributed to declining mortality rates, ARDS continues to exert a substantial clinical and healthcare burden. The syndrome arises from diverse pulmonary and extrapulmonary insults that converge on a shared pathway of diffuse alveolar damage, severe hypoxemia, and impaired lung compliance. Accurate diagnosis using standardized criteria, such as the Berlin definition, is essential to guide early management and prognosis. Treatment remains largely supportive, emphasizing careful ventilatory strategies, prone positioning, conservative fluid management, and prompt treatment of the underlying cause. Advanced therapies, including neuromuscular blockade and extracorporeal membrane oxygenation, may be considered in selected refractory cases. Beyond the acute phase, ARDS survivors frequently experience prolonged physical debility, psychological sequelae, and reduced quality of life, underscoring the importance of comprehensive rehabilitation and long-term follow-up. Multidisciplinary collaboration across critical care, respiratory therapy, nursing, nutrition, and rehabilitation services is vital to optimize patient safety and recovery. Ultimately, ARDS management requires an integrated care pathway that balances life-saving interventions with strategies to minimize long-term complications and improve functional outcomes, while ongoing research remains crucial to identify effective disease-modifying treatments.

References:

1. Gajic O, Dabbagh O, Park PK, Adesanya A, Chang SY, Hou P, Anderson H 3rd, Hoth JJ, Mikkelsen ME, Gentile NT, Gong MN, Talmor D, Bajwa E, Watkins TR, Festic E, Yilmaz M, Iscimen R, Kaufman DA, Esper AM, Sadikot R, Douglas I, Sevransky J, Malinchoc M, U.S. Critical Illness and Injury Trials Group: Lung Injury Prevention Study Investigators (USCIITG-LIPS). Early identification of patients at risk of acute lung injury: evaluation of lung injury prediction score in a multicenter cohort study. American journal of respiratory and critical care medicine. 2011 Feb 15:183(4):462-70. doi: 10.1164/rccm.201004-0549OC.
2. Wang Y, Zhang L, Xi X, Zhou JX, China Critical Care Sepsis Trial (CCCST) Workgroup. The Association Between Etiologies and Mortality in Acute Respiratory Distress Syndrome: A Multicenter Observational Cohort Study. Frontiers in medicine. 2021:8():739596. doi: 10.3389/fmed.2021.739596.
3. Zambon M, Vincent JL. Mortality rates for patients with acute lung injury/ARDS have decreased over time. Chest. 2008 May:133(5):1120-7. doi: 10.1378/chest.07-2134.
4. Shrestha GS, Khanal S, Sharma S, Nepal G. COVID-19: Current Understanding of Pathophysiology. Journal of Nepal Health Research Council. 2020 Nov 13:18(3):351-359. doi: 10.33314/jnhrc.v18i3.3028.
5. Bellani G, Laffey JG, Pham T, Fan E, Brochard L, Esteban A, Gattinoni L, van Haren F, Larsson A, McAuley DF, Ranieri M, Rubenfeld G, Thompson BT, Wrigge H, Slutsky AS, Pesenti A, LUNG SAFE Investigators, ESICM Trials Group. 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.
6. Sedhai YR, Yuan M, Ketcham SW, Co I, Claar DD, McSparron JI, Prescott HC, Sjoding MW. Validating Measures of Disease Severity in Acute Respiratory Distress Syndrome. Annals of the American Thoracic Society. 2021 Jul:18(7):1211-1218. doi: 10.1513/AnnalsATS.202007-772OC.
7. Sharma NS, Lal CV, Li JD, Lou XY, Viera L, Abdallah T, King RW, Sethi J, Kanagarajah P, Restrepo-Jaramillo R, Sales-Conniff A, Wei S, Jackson PL, Blalock JE, Gaggar A, Xu X. The neutrophil chemoattractant peptide proline-glycine-proline is associated with acute respiratory distress syndrome. American journal of physiology. Lung cellular and molecular physiology. 2018 Nov 1:315(5):L653-L661. doi: 10.1152/ajplung.00308.2017.
8. Huang D, Ma H, Xiao Z, Blaivas M, Chen Y, Wen J, Guo W, Liang J, Liao X, Wang Z, Li H, Li J, Chao Y, Wang XT, Wu Y, Qin T, Su K, Wang S, Tan N. Diagnostic value of cardiopulmonary ultrasound in elderly patients with acute respiratory distress syndrome. BMC pulmonary medicine. 2018 Aug 13:18(1):136. doi: 10.1186/s12890-018-0666-9.
9. Vieillard-Baron A, Schmitt JM, Augarde R, Fellahi JL, Prin S, Page B, Beauchet A, Jardin F. Acute cor pulmonale in acute respiratory distress syndrome submitted to protective ventilation: incidence, clinical implications, and prognosis. Critical care medicine. 2001 Aug:29(8):1551-5
10. Chen WL, Lin WT, Kung SC, Lai CC, Chao CM. The Value of Oxygenation Saturation Index in Predicting the Outcomes of Patients with Acute Respiratory Distress Syndrome. Journal of clinical medicine. 2018 Aug 8:7(8):. doi: 10.3390/jcm7080205.
11. Rawal G, Yadav S, Kumar R. Acute Respiratory Distress Syndrome: An Update and Review. Journal of translational internal medicine. 2018 Jun:6(2):74-77. doi: 10.1515/jtim-2016-0012.
12. Cherian SV, Kumar A, Akasapu K, Ashton RW, Aparnath M, Malhotra A. Salvage therapies for refractory hypoxemia in ARDS. Respiratory medicine. 2018 Aug:141():150-158. doi: 10.1016/j.rmed.2018.06.030.
13. Guérin C, Reignier J, Richard JC, Beuret P, Gacouin A, Boulain T, Mercier E, Badet M, Mercat A, Baudin O, Clavel M, Chatellier D, Jaber S, Rosselli S, Mancebo J, Sirodot M, Hilbert G, Bengler C, Richecoeur J, Gainnier M, Bayle F, Bourdin G, Leray V, Girard R, Baboi L, Ayzac L, PROSEVA Study Group. Prone positioning in severe acute respiratory distress syndrome. The New England journal of medicine. 2013 Jun 6:368(23):2159-68. doi: 10.1056/NEJMoa1214103.
14. National Heart, Lung, and Blood Institute PETAL Clinical Trials Network, Moss M, Huang DT, Brower RG, Ferguson ND, Ginde AA, Gong MN, Grissom CK, Gundel S, Hayden D, Hite RD,

Hou PC, Hough CL, Iwashyna TJ, Khan A, Liu KD, Talmor D, Thompson BT, Ulysse CA, Yealy DM, Angus DC. Early Neuromuscular Blockade in the Acute Respiratory Distress Syndrome. The New England journal of medicine. 2019 May 23:380(21):1997-2008. doi: 10.1056/NEJMoa1901686.

15. National Heart, Lung, and Blood Institute Acute Respiratory Distress Syndrome (ARDS) Clinical Trials Network, Wiedemann HP, Wheeler AP, Bernard GR, Thompson BT, Hayden D, deBoisblanc B, Connors AF Jr, Hite RD, Harabin AL. Comparison of two fluid-management strategies in acute lung injury. The New England journal of medicine. 2006 Jun 15:354(24):2564-75
16. Brodie D, Bacchetta M. Extracorporeal membrane oxygenation for ARDS in adults. The New England journal of medicine. 2011 Nov 17:365(20):1905-14. doi: 10.1056/NEJMct1103720.
17. Combes A, Hajage D, Capellier G, Demoule A, Lavoué S, Guervilly C, Da Silva D, Zafrani L, Tirot P, Veber B, Maury E, Levy B, Cohen Y, Richard C, Kalfon P, Bouadma L, Mehdaoui H, Beduneau G, Lebreton G, Brochard L, Ferguson ND, Fan E, Slutsky AS, Brodie D, Mercat A, EOLIA Trial Group, REVA, and ECMONet. Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome. The New England journal of medicine. 2018 May 24:378(21):1965-1975. doi: 10.1056/NEJMoa1800385.
18. Yang P, Formanek P, Scaglione S, Afshar M. Risk factors and outcomes of acute respiratory distress syndrome in critically ill patients with cirrhosis. Hepatology research : the official journal of the Japan Society of Hepatology. 2019 Mar:49(3):335-343. doi: 10.1111/hepr.13240.
19. Annane D, Pastores SM, Rochwerg B, Arlt W, Balk RA, Beishuizen A, Briegel J, Carcillo J, Christ-Crain M, Cooper MS, Marik PE, Umberto Meduri G, Olsen KM, Rodgers S, Russell JA, Van den Berghe G. Correction to: Guidelines for the diagnosis and management of critical illness-related corticosteroid insufficiency (CIRCI) in critically ill patients (Part I): Society of Critical Care Medicine (SCCM) and European Society of Intensive Care Medicine (ESICM) 2017. Intensive care medicine. 2018 Mar:44(3):401-402. doi: 10.1007/s00134-018-5071-6.
20. Rodrigo C, Leonardi-Bee J, Nguyen-Van-Tam J, Lim WS. Corticosteroids as adjunctive therapy in the treatment of influenza. The Cochrane database of systematic reviews. 2016 Mar 7:3():CD010406. doi: 10.1002/14651858.CD010406.pub2.
21. Anand R, McAuley DF, Blackwood B, Yap C, ONeill B, Connolly B, Borthwick M, Shyamsundar M, Warburton J, Meenen DV, Paulus F, Schultz MJ, Dark P, Bradley JM. Mucoactive agents for acute respiratory failure in the critically ill: a systematic review and meta-analysis. Thorax. 2020 Aug:75(8):623-631. doi: 10.1136/thoraxjnl-2019-214355.
22. Gadre SK, Duggal A, Mireles-Cabodevila E, Krishnan S, Wang XF, Zell K, Guzman J. Acute respiratory failure requiring mechanical ventilation in severe chronic obstructive pulmonary disease (COPD). Medicine. 2018 Apr:97(17):e0487. doi: 10.1097/MD.0000000000010487.
23. Chiumello D, Coppola S, Froio S, Gotti M. What's Next After ARDS: Long-Term Outcomes. Respiratory care. 2016 May:61(5):689-99. doi: 10.4187/respcare.04644.
24. Villar J, Schultz MJ, Kacmarek RM. The LUNG SAFE: a biased presentation of the prevalence of ARDS! Critical care (London, England). 2016 Apr 25:20(1):108. doi: 10.1186/s13054-016-1273-x.
25. Bos LD, Cremer OL, Ong DS, Caser EB, Barbas CS, Villar J, Kacmarek RM, Schultz MJ, MARS consortium. External validation confirms the legitimacy of a new clinical classification of ARDS for predicting outcome. Intensive care medicine. 2015 Nov:41(11):2004-5. doi: 10.1007/s00134-015-3992-x.