

## Acute Respiratory Failure Occurs When the Normal Physiological Function of the Lungs is Reduced

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### Abstract

The causes of respiratory failure are diverse, and one of them can be a condition known as Acute Respiratory Distress Syndrome (ARDS). ARDS is a condition in which both lung wings are injured and inflamed due to the action of various agents, due to which their normal physiological function - delivery of oxygen and removal of carbon dioxide from the body - is reduced. Violation of the physiological function of the lungs leads to a decrease in the level of oxygen in the blood. In certain conditions, people with ARDS need to maintain their breathing mechanically using an assisted breathing device or ventilator. This type of treatment is called mechanical ventilation. Assisted breathing with mechanical ventilation is the basis of standard treatment for patients with ARDS.

**Keywords:** Acute respiratory failure; VILI; ECMO; Diagnosis; Management; Health

### Introduction

Respiratory diseases are a major cause of sickness and death in older patients [1]. As individual ages, the alveoli have a misfortune of flexibility. This condition makes it harder to breathe in oxygen and to breathe out carbon dioxide. More seasoned patients ordinarily have a decreased lung capacity,

which implies they don't trade as much discuss with each breath as they did when they were more youthful. Also, the muscles related with breath ended up weaker with age. This condition makes it harder for more seasoned individuals to hack, which makes them more helpless to an assortment of respiratory diseases. There are two major sorts of respiratory diseases: inveterate respiratory maladies and intense respiratory diseases.

Patients with constant obstructive aspiratory illness may live with this condition for numerous a long times. They call for EMS (Emergency Medical Services) help when a few sort of alter in their life causes them to involvement shortness of breath. A cold or other respiratory disease can disturbed their ordinary balance and result in a therapeutic crisis.

Intense respiratory diseases can strike a quiet rapidly. Pneumonia could be a common irresistible infection in more seasoned patients. Since numerous more seasoned patients have a debilitated resistant framework, they are particularly helpless to pneumonia. Pneumonia regularly kills more seasoned individuals. Minor side effects can get to be a major ailment in a brief period of time. A doctor ought to look at any more seasoned quiet that has blockage and a conceivable fever.

Acute respiratory infections extend from self-limited conditions such as uncomplicated upper respiratory infections (URI, common cold) to genuine life-threatening conditions such as pneumonia [2]. URIs and acute bronchitis are among the foremost common reasons for visits in walking care; they account for critical morbidity and absenteeism from work and school. The larger part of anti-microbial endorsed in walking settings is for respiratory tract infections. The rash utilize of antimicrobial operators is exorbitant, causes unfavourable sedate impacts such as the runs and seldom more serious infections, and makes an environment for creating resistance. Subsequently, suitable treatment of intense respiratory tract diseases has gotten to be a challenge to the clinician.

Bacterial or viral pathogens can attack the respiratory tract and develop quickly and forcefully. The physiological reactions to viral or bacterial pathogens in respiratory tract diseases tend to be comparable, resulting in comparative signs and symptoms. It is critical to be mindful that the larger part of colonized bacteria found within the respiratory tract don't cause any issues for people with ordinary resistant frameworks, until there's a breakdown within the safe framework. For illustration, a critical extent of children is colonized by *Streptococcus pneumoniae*, the driving cause of pneumonia, otitis media, and bacteraemia. However *S. pneumoniae* microscopic organisms tend not to cause illness in people with ordinarily working resistant frameworks; treating children with anti-microbial, hence, to kill *S. pneumoniae* has been successful in anticipating sickness.

### ARF

ARF (Acute Respiratory Failure) could be a state where the body falls flat to preserve satisfactory gas exchange [3]. There are two types: types I and II. In type I ARF, the persistent encompasses a moo oxygen level (hypoxia) and a normal carbon dioxide level. In type II, there's hypoxia once more, but the carbon dioxide level is high (hypercarbia). Hypoxia comes about in less oxygenated blood travelling to the cleared out side of the heart (shunting). This condition could be a major cause of organ disappointment and passing

within the basic care ranges. ARF can be caused by aspiratory and non-pulmonary conditions.

Common pulmonary conditions include the following:

- Pneumonia, lung tumors, cardiac and non-cardiac pneumonic edema, COPD, and airways obstructions.

Non-pulmonary conditions that result in ARF include the following:

- Pneumothorax, pleural effusions, neuromuscular disorders (myasthenia gravis, poliomyelitis), peripheral and spinal issues (tetanus, trauma), and CNS problems (head trauma and drug overdose).

The interpretation and application of estimations must continuously be guided by the clinical context [4]. Different shapes and stages of intense respiratory disappointment require to some degree diverse needs: in early ARDS, near consideration must be taken to maintain a strategic distance from tall inspiratory exertion to restrain VILI and P-SILI. Alterations to ventilation and sedation to get a low level of inspiratory exertion ought to be actualized as early as conceivable to avoid myotrauma.

It remains questionable whether it is conceivable to attain a worthy level of respiratory exertion amid the intense stage of ailment and this remains a key area for clinical examination. For the display, clinicians ought to endeavour to be mindful of understanding respiratory exertion and appreciate the potential benefits and hurts of controlling respiratory exertion amid intense respiratory failure.

### Nature

ARF of hypoxemic nature can be tended to with MV (Mechanical Ventilation) but may not be fundamental [5]. It is common for specialists to resolve ARF with Non-Invasive Positive Weight Ventilation (NPPV) or customary MV, but securing the airway and starting MV has significant complications. Moreover, delayed MV increments the frequency of ventilator-associated pneumonia, basic sickness polyneuropathy, and ICU (intensive care unit) morbidity and mortality.

Instead, on the off chance that the patient's condition permits adequate time, endeavours may be made to maximize all restorative alternatives some time recently

considering intubation. For instance, supplemental oxygen treatment should be maximized. Supplemental oxygen in overabundance of 70% oxygen can be provided without the utilize of a ventilator. Nasal cannula, venturi cover, fractional, non-rebreather, and complex discuss capture high-flow frameworks can be set up to convey tall FiO<sub>2</sub>. In occasions where aviation route resistance is expanded such as COPD (Chronic Obstructive Pulmonary Disease) or asthma or in upper airway obstructive scenarios such as postextubation stridor, heliox (70:30 or 80:20 mixtures) may facilitate delivery of supplemental oxygen.

Of course, dynamic hypoxic failure will lead to ventilatory disappointment auxiliary to fatigue. ARF of an essential ventilator clutter may be overseen with near perception within the ICU and NPPV. NPPV has the advantage of moving forward tidal volume and miniature ventilation whereas conveying tall FiO<sub>2</sub> without the ventilator circuitry but may be of constrained utilize in a few neuromuscular clutters. Relative contraindications to NPPV incorporate decreased mental status and capacity to clear discharges since NIV (Non-Invasive ventilation) still requires that a patient keep up his or her own airway.

Still, when there's concern for the patient's capacity to preserve his or her airway, the essential objective is to ensure and keep up the airway and conventional endotracheal intubation and ordinary MV ought to be utilized. The choice to intubate and give MV ought to not be the primary treatment choice but ought to never be postponed and permit for an uncontrolled clinical situation on the off chance that avoidable. MV ought to continuously be respected as a temporizing degree whereas the underlying cause of respiratory failure is addressed.

### ARDS

Acute Respiratory Distress Syndrome (ARDS) shows as acute-onset (<7 days), hypoxic respiratory failure with reciprocal lung invades regularly due to a clear accelerating figure. The alveolar injury and aggravation can be of alveolar beginning (e.g. pneumonia) or endothelial/systemic in beginning (e.g. acute pancreatitis) [6]. Over the past three decades there have been various endeavours to characterize

ARDS. The 2012 Berlin definition was approved based on hypoxemia and bilateral aspiratory penetrates in over 4000 patients. The Berlin definition stipulates an onset of less than 7 days that the persistent is ventilated with PEEP (Positive End-Expiratory Weight) at least at 5 cm H<sub>2</sub>O, which it can be analyzed within the nearness of cardiac failure. It also includes, for the primary time, chest CT (computed tomography) as an elective frame of imaging for lung penetrates.

The standards of administration of intense respiratory disappointment include revival, conclusion, and treatment of the fundamental disease. Lung defensive mechanical ventilation and the shirking of liquid over-burden are essential to the effective administration of ARDS. Patients with serious hypoxemia can be overseen with early short-term utilize of neuromuscular blockade, inclined position ventilation, or extracorporeal membrane oxygenation. The utilized of breathed in nitric oxide is seldom shown and both beta2-Agonists and late corticosteroids ought to be avoided. In spite of the recent progresses, mortality from ARDS remains greater than 30%.

### VILI

Classically, four components of Ventilator-Induced Lung Harm (VILI) have been portrayed: barotrauma, volutrauma, atelectrauma, and biotrauma [7].

Barotrauma and volutrauma happen when tall weight in the previous case and tall volume within the last mentioned are utilized to ventilate an understanding. These conditions are related and lead to the same clinical signs: alveolar break, pneumothorax, pneumomediastinum, or/and subcutaneous emphysema. Indeed when "macroscopic injuries" are not detected, barotrauma and volutrauma can still lead to alveolar wall burst, expanded edema, haemorrhage, and fiery penetrates. It isn't the aviation route weight per se that is destructive to the lung, but the weight over the total lung, called transpulmonary weight. Transpulmonary weight is calculated as aviation route weight short pleural weight, this final assessed utilizing oesophageal weight as a surrogate.

In expansion to cases of impeded chest divider mechanics, transpulmonary weight also has incredible relevance during

helped ventilation in a suddenly breathing persistent. For example, one patient can be totally supported by the ventilator with a given sum of weight and another can create the same weight utilizing the respiratory muscles: the two patients will have the same tidal volume since they create the same transpulmonary pressure, even in spite of the fact that the airway pressure is significantly distinctive.

An atelectrauma is caused by the monotonous opening and closing (or collapse/recruitment) of the alveoli amid the respiratory cycle. In a sound lung, this wonder isn't display, but within the nearness of edema and aggravation, such as amid the intense respiratory trouble disorder (ARDS), the physiologic strengths that keep the alveoli open are impeded by the weight of the inflamed parenchyma and surfactant consumption.

During any provocative handle within the body, there is enactment of proinflammatory cytokines. Within the lungs, this prepare is amplified by mechanical ventilation, which advances harm by physically damaging the alveolar structure, expanding the weight of the parenchyma, and spreading the illness indeed to solid lung parenchyma and distal organs.

Separated from the classic mechanism of VILI, other components can contribute to harm the lung during mechanical ventilation. Based on Computed Tomography (CT) looks, ARDS lungs are isolated into circulated air through, ineffectively circulated air through and non-aerated zones, proposing that an inhomogeneous review of illness characterizes this disorder. For this reason, the mechanical reliance of the respiratory unit in debilitated lung will create nearby strengths that can extend the parenchyma and contribute to VILI, due to contrasts in thickness and aggravation. VILI isn't as it were capable for harm in an as of now aroused lung but is additionally capable for starting a fiery prepare indeed in sound lungs.

### **P-SILI**

Over the top respiratory drive might advance lung damage through a few components [8]. Within the nonattendance of (severe) respiratory muscle shortcoming, tall respiratory drive leads to energetic inspiratory endeavours, resulting in

damaging lung distending pressures. Especially in patients with intense respiratory disappointment, expansive inspiratory endeavours could result in worldwide and regional over-dissention of alveoli and cyclic recruitment of collapsed lung ranges, due to an inhomogeneous and temporal transmission of push and strain (so-called P-SILI; understanding self-inflicted lung harm). Expansive endeavours may cause “pendelluft”: discuss redistributes from nondependent to subordinate lung districts, indeed some time recently begin of mechanical insufflations, and thus without a alter in tidal volume. Intemperate respiratory drive may overwhelm lung-protective reflexes (e.g., Hering-Breuer inflation-inhibition reflex), which in turn leads to tall tidal volumes and advances encourage lung damage and irritation. In expansion, huge inspiratory endeavours might result in negative weight pneumonic edema, particularly in patients with lung damage and/or capillary spills. As such, a tall respiratory drive is potentially hurtful in suddenly breathing mechanically ventilated patients with lung damage. Applying and keeping up a lung-protective ventilation methodology (i.e., moo tidal volumes and moo level weights) is challenging in these patients and may frequently lead to the advancement of patient-ventilator dyssynchronies, such as double-triggering and breath stacking, again leading to tall tidal volumes and expanded lung stress. Furthermore, maintaining low plateau weights and low tidal volumes do not guarantee lung protective ventilation in patients with tall respiratory drive.

### **ECMO**

Being connected as a protect measure, the wishes and inclinations of the patients can once in a while be accessed directly since they are for the most part debilitated when ECMO (Extracorporeal layer oxygenation) is being shown [9]. In addition, indeed in the event that of sound intellect, time weight would block most of them from a satisfactory risk-benefit assessment required for a substantial educated assent handle.

When assent cannot be gotten and ECMO will be connected as a protect treatment for intense respiratory disappointment, it is as a rule advocated expressing that “doctors ought to

give therapeutic treatment that's in the patient's best interface and is immediately fundamental to spare life or avoid significant disintegration within the patient's health". This approach accept that "once the clinical circumstance has been stabilized, a formal, on the off chance that review, assent dialog can be held with the choice of pulling back the life-sustaining mediations or treatments being given full thought in case reliable with the patient's already communicated preferences". But indeed in case assent seem finally be gotten straightforwardly from the persistent, it has to be kept in intellect from the starting that "retrospective" in this setting might cruel after weeks or indeed months of broad ICU treatment.

Satisfactory and substantial progress orders, that would offer assistance direct decision-making, are not as regularly accessible as required and elucidating the patient's assumed will by talking with the of kinfolk is often troublesome or outlandish in an intense circumstance. Hence, the talk to put an obtrusive and expensive helpful method is as a rule made beneath the assumption that clinical disintegration and potential passing don't speak to a sensible alternative. As in numerous crisis circumstances, at that point, the compulsory handle for getting educated assent, guaranteeing the patient's independence, may get overruled by time imperatives owed to the urgency of the decision-making.

In rundown, educated assent to set up ECMO for intense respiratory disappointment, based on an independent well-informed decision, is ordinarily impossible to attain. Even surveying the patient's assumed will through the following of family is - beneath most circumstances - barely achievable as the full run of results actuated by the start of ECMO in a convenient way is troublesome to get a handle on.

### Diagnosis

An accurate diagnosis is key to direct early prognostication, institution of suitable treatment, and start of fundamental steady care [10]. Recognizing and anticipating the reversibility of the fundamental cause is a vital figure in choosing the require for checking, exchange for ICU confirmation and inevitably the choice for intubation. This

too ought to take into thought the oncologic diagnosis, pending medications and fundamental prognosis. A wide range of differential conclusion ought to be kept in thought, counting irresistible and non-infectious causes and the plausibility of double diseases or concomitant infections/non-infectious etiologies. In patients with pulmonary invades, research facility ponders got to be considered in light of the sort and degree of immunosuppressant. The work-up may incorporate a arrangement of non-invasive serum and sputum microbiologic tests (sputum societies, actuated sputum for *P. jirovecii*, CMV serum assessment, serum galactomannan, nasopharyngeal swab for viral polymerase chain response, etc.); imaging modalities (Computed Tomography [CT] thorax, echocardiography in case cardiogenic pneumonic edema is considered) and conceivable BAL for assist microbiologic assessment in the event that no determination has been yielded. The schedule and forthright utilize of BAL in hypoxic oncologic immunocompromised patients with undetermined lung invades is disputable. Clashing prove exists encompassing its security in patients with tall oxygen prerequisites (possibly precipitating endotracheal intubation); in any case, prove has illustrated that given the debatable symptomatic surrender, a technique of to begin with seeking after non-invasive tests may be justified within the suitable populace. There may exist a subset of patients for whom the require for BAL as a starting demonstrative technique is justified at a prior time point (e.g., to run the show out outward compression or pneumonic haemorrhage, or to run the show out contaminations with possibly poisonous treatment profiles).

At long last, despite a broad symptomatic work up, roughly 13% to 40% of oncologic patients have undiscovered acute respiratory failure. Undiscovered intense respiratory failure is related with a more regrettable prognosis. It remains hazy whether it may be an infection substance inside itself or mysterious infectious/non-infectious etiology not fittingly distinguished. The part of lung biopsy has been considered in this populace within the setting of intense respiratory failure or ARDS, but, given the immunosuppressed state,

visit thrombocytopenia, chance of bronchopleural fistula in light of positive weight ventilation, and dreariness and mortality with the strategy; it isn't sought after regularly.

### Management

The standards of management of intense respiratory failure are those of revival, with diagnosis and treatment of the particular fundamental cause, whereas moreover giving strong care to preserve oxygenation and prevent further harm [6]:

- **Revive, analyze, and treat as clinically pertinent:**
  - a. Revive. Regulate oxygen to treat hypoxemia. Actualize sepsis bundle.
  - b. Diagnosis. Focused on history and examination and particular examinations counting blood vessel blood gas investigation, blood tests, microbiological evaluation, and imaging (CXR/CT) to recognize the cause.
  - c. Treat.

Treat the basic cause where suitable, for illustration:

- I. Antibiotics for pneumonia.
  - II. Analgesia/fixation of a flail chest.
  - III. Intercostal deplete inclusion for pneumothorax or pleural emission.
- **Good supportive care:**
    - a. Early sustenance: enteral at whatever point conceivable.
    - b. Consideration to liquid and electrolyte adjust.
    - c. Glycaemia control.
    - d. Minimize utilize of sedation.
    - e. Normal appraisal and administration of torment, disturbance, and ridiculousness (Pad guidelines).
    - f. Skin and weight range care.
  - **Minimize harm**
    - a. Lung defensive ventilation.
    - b. Sedation break and unconstrained breathing trial.
    - c. Early mobilization.
    - d. Profound vein thrombosis and stretch ulcer prophylaxis.

- e. Anticipate ventilator-associated pneumonia and catheter-related circulation system diseases.

### Mechanical Ventilation

The capacity to successfully wean the quiet from mechanical ventilation is subordinate on a few components [6]; these include:

- Determination of the fundamental cause of respiratory failure.
- Satisfactory cognizant level, without risky ridiculousness after cessation of profound sedation and NMBDs (Neuromuscular Blocking Sedate), to empower assurance of the airway after extubation.
- Satisfactory blood vessel oxygenation breathing a moo FiO<sub>2</sub> (division of motivated oxygen) (<0.5) and PEEP less than or break even with to 5 cm H<sub>2</sub>O.
- Satisfactory respiratory muscle work and cough/clearance of emissions.
- Hemodynamic solidness with negligible inotropic and/or vasopressor agent.

Once recognized, patients ought to experience an unconstrained breathing trial to recreate those respiratory conditions that would happen taking after extubation, and to watch their capacity to manage. Effective completion of unconstrained breathing trial (s) increments the probability of the understanding effectively isolating from mechanical ventilation, and ponders have appeared that roughly 75% of patients who total an unconstrained breathing trial can be extubated without the required for reintubation. The rate of successful weaning is higher with spontaneous breathing trials than with more advanced ventilator weaning strategies. In a comparison of four strategies of weaning patients, every day trials of unconstrained breathing brought about in extubation three times more rapidly than with synchronized intermittent required ventilation and twice as rapidly than with pressure-support ventilation. Both a once-daily trial or the execution of numerous every day trials show up to be similarly fruitful, and the trial can be completed with the quiet breathing suddenly on the ventilator (continuous

positive airways pressure) with or without a low level of weight support or evacuated from the ventilator and breathing on a T-piece. The unconstrained breathing trial can change from 30 min to 120 min, and should be ceased in case there's any prove of respiratory trouble, such as:

- Respiratory rate more prominent than 40 breaths/min or less than 6 breaths/min for 5 min or longer.
- Blood vessel blood oxygen immersion less than 92%.
- Heart rate more prominent than 140 bpm or less than 60 bpm or more prominent than 25% over standard.
- Systolic blood weight more noteworthy than 40 mmHg over pattern.
- Disturbance, uneasiness, or distress.

Mechanical ventilation in intense respiratory failure has been seen as generally steady, but it is presently recognized that appropriate administration of the patient-ventilator framework can have a positive impact on result [11]. The required for and the sort of mechanical ventilatory bolster depend on the component of respiratory failure. Potential complications of mechanical ventilation are moreover decided to a few degrees by the seriousness and component of disease. The choice of ventilator, mode, and settings ought to be made by the critical care physician in consultation with respiratory care professionals. Since changes in ventilator settings influence not as it were respiratory parameters but moreover hemodynamic and other organ framework capacities, observing of the mechanically ventilated patient can be a complex errand. Choices to start and end mechanical ventilation require both physiologic understanding and clinical judgment.

Within the past, the objective of mechanical ventilation was to rectify blood vessel blood gasses to ordinary. It is recognized presently that tidal volume and respiratory rate settings required to realize typical PaCO<sub>2</sub> in patients with irregular lungs may encourage harm the lungs. Presently, when a low-tidal-volume technique is utilized in ARDS or asthma, for case, hypercapnia may be "permitted." As a

result, the lungs experience less harm, and mortality is decreased.

### Conclusion

Acute respiratory failure occurs when the normal physiological function of the lungs - delivery of oxygen and removal of carbon dioxide from the body - is reduced. Then the organs cannot get enough oxygen-rich blood to function. Acute respiratory failure is a common condition among adults treated in intensive care units worldwide.

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