Departmental Policy	**Dept.: Intensive Care Services**		**Policy No: 1-2-9451-03-021** **Version No: 02**	
Title: MECHANICAL VENTILATION FOR ARDS PATIENT			**JCI Code:** COP	
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1. INTRODUCTION

Acute Respiratory Distress syndrome (ARDS) is a common cause of respiratory failure. It can occur as a consequence of critical illness of diverse causes. This policy presents an overview of the current approach to mechanical ventilation management of ARDS patients.

2. PURPOSE

This policy aims to guide the Respiratory Care Practitioners (RCPs) in the safe management of patients who suffer from Acute Respiratory Distress Syndrome (ARDS), and who need to be mechanically ventilated.

3. POLICY

3.1 Patients who meet the following criteria are recognized as having ARDS:

3.1.1. Acute onset (diagnosis) within 7 days of some defined event, which may be sepsis, pneumonia, or simply a patient's recognition of worsening respiratory symptoms.

3.1.2. Bilateral opacities must be present but may be detected on CT or chest X-ray.

3.1.3. PaO2/FiO2 in the range of ≤100 to 300 while on PEEP of 5 cmH_2O or more.

3.2 Patients receiving PEEP more than 5 and diagnosed with ARDs are categorized based on the following:

3.2.1 PaO2/FiO2 200-300 are labelled as having "mild ARDS".

3.2.2 PaO2/FiO2 100-200 are labelled as having "moderate ARDS"

3.2.3 PaO2/FiO2 ≤100 are labelled as having "severe ARDS"

3.3 The following strategies will be followed when managing ARDS patients on mechanical ventilation.

3.3.1 Low tidal volume (4-6 ml/kg) and higher respiratory rate.

3.3.2 Lung protective strategy (allow permissive hypercapnia)

3.3.3 High positive end-expiratory pressure (PEEP) (usually required with low Vt to prevent atelectasis)

4. RESPONSIBILITIES

All Respiratory Care Practitioners (RCP) who care for ARDS patients on mechanical ventilation are expected to implement this policy.

5. DEFINITION OF TERMS

5.1 **Acute Respiratory Distress Syndrome (ARDS)** is a respiratory disorder characterized by respiratory insufficiency and hypoxemia; triggers include sepsis, oxygen toxicity, trauma, pneumonia, and systemic inflammatory responses. It also includes "acute diffuse, inflammatory lung injury, leading to increased pulmonary vascular permeability, increased lung weight, and loss of aerated lung tissue with hypoxemia and bilateral radiographic opacities, associated with increased venous admixture, increased physiological dead space, and decreased lung compliance."

5.2 **(Pa02**) is the abbreviation for the partial pressure of oxygen in arterial blood.

5.3 **Refractory hypoxemia**: Is defined as having PaO_2 value of less than 60 mmHg, and FiO_2 of 8.0-1.0, and PEEP of greater than 14 cm H2O.

5.4 **Lung Recruitment Manoeuvre**: Is a strategy aimed at re-expanding collapsed lung tissue.

6. PROCEDURES

6.1 INCLUSION CRITERIA: Acute onset of

6.1.1 PaO2/FiO2 ≤ 100 to 300

6.1.2 Bilateral (patchy, diffuse, or homogeneous) infiltrates consistent with pulmonary edema

6.1.3 No clinical evidence of left atrial hypertension.

6.2 PART I: VENTILATOR SETUP AND ADJUSTMENT

6.2.1 Calculate predicted body weight (PBW)
Males = 50 + 2.3 [height (inches) - 60]
Females = 45.5 + 2.3 [height (inches) -60]

6.2.2 Select ventilator mode

6.2.3 Set ventilator settings to achieve VT = 6 ml/kg PBW

6.2.4 Set initial rate to approximate baseline minute ventilation (not > 34 bpm).

6.2.5 Adjust VT and RR to achieve pH and plateau pressure goals below.

6.3 **OXYGENATION GOAL: PaO_2 55-80 mmHg or SpO_2 88-95%**

Use appropriate PEEP to keep FIO_2 in the low side. Consider use of incremental FIO_2/PEEP combinations such as shown below (not required) to achieve goal.

Table 1. CONSERVATIVE PEEP –FIO2 APPROACH (Lower PEEP/higher FiO2)

FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	18-20

Table 2.AGGRESSIVE PEEP-FIO2 APPROACH (Higher PEEP/lower FiO2)

FiO_2	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.55	0.55	0.6-1.0
PEEP	5	8	10	12	14	14	16	16	18	20

6.4 **PLATEAU PRESSURE GOAL: ≤ 30 cm H_2O**

6.4.1 Check Pplat (0.5 -3 seconds inspiratory pause), at least q 4 h and after each change in PEEP or VT.

6.4.2 If Pplat > 30 cm H_2O: decrease VT by 1ml/kg steps (minimum = 4 ml/kg).

6.4.3 If Pplat < 25 cm H_2O and VT< 6 ml/kg, increase VT by 1 ml/kg until Pplat >25 cm H_2O or VT = 6 ml/kg.

6.4.4 If Pplat < 30 and dys-synchrony occurs: may increase VT in 1ml/kg increments to 7 or 8 ml/kg if Pplat remains < 30 cm H_2O.

6.5 **Target pH between 7.20 and 7.35 (Allowing Permissive Hypercapnia)**

6.5.1 Acidosis Management: (pH < 7.20).

6.5.2 If pH 7.15 - 7.20: Increase RR until pH > 7.20 or $PaCO_2$ < 25 (Maximum set RR = 35).

6.5.3 If pH < 7.15: Increase RR to 35.

6.5.4 If pH remains < 7.15, VT may be increased in 1 ml/kg steps until pH > 7.15 (Pplat target of 30 may be exceeded).

6.5.5 Alkalosis Management: (pH > 7.45) Decrease ventilator rate if possible.

6.6 I: E RATIO GOAL: Recommend that duration of inspiration be < duration of expiration.

6.7 WEANING

6.7.1 **Conduct a SPONTANEOUS BREATHING TRIAL daily when:**

6.7.1.1 $FiO_2 \leq 0.40$ and PEEP ≤ 8.

6.7.1.2 PEEP and $FiO_2 \leq$ values of previous day.

6.7.1.3 Patient has acceptable spontaneous breathing efforts. (May decrease vent rate by 50% for 5 minutes to detect effort.)

6.7.1.4 Systolic BP $\geq$ 90 mmHg without vasopressor support.

6.7.1.5 No neuromuscular blocking agents or blockade

6.7.2 **SPONTANEOUS BREATHING TRIAL (SBT):**

6.7.2.1 If all above criteria are met and subject has been in the study for at least 12 hours, initiate a trial of UP TO 120 minutes of spontaneous breathing with $FiO_2 < 0.45$ and PEEP < 8:

6.7.2.1.1 CPAP $\leq$ 5 cm H_2O with PS < 5

6.7.2.1.2 Assess for tolerance as below, for up to two hours.

6.7.2.1.2.1 $SpO_2 \geq 90$: and/or $PaO_2 \geq 60$ mmHg
6.7.2.1.2.2 **Spontaneous VT ≥ 4 ml/kg IBW**
6.7.2.1.2.3 **RR** ≤ 35/min
6.7.2.1.2.4 **pH ≥ 7.3**
6.7.2.1.2.5 No respiratory distress (distress = 2 or more)

6.7.2.1.2.5.1 HR >20% of baseline

6.7.2.1.2.5.2 Marked accessory muscle use
6.7.2.1.2.5.3 Abdominal paradox
6.7.2.1.2.5.4 Diaphoresis
6.7.2.1.2.5.5 Marked dyspnea

6.7.2.1.3 If tolerated for at least 30 minutes, consider extubation.

6.7.2.1.4 If not tolerated resume pre-weaning settings.

6.8 **When the patient oxygenation fails to improve with conventional therapy, consider the following therapies**:

6.8.1 Inverse Ratio ventilation
6.8.2 Prone positioning
6.8.3 High Frequency Oscillation Ventilation
6.8.4 Extra Corporal Membrane Oxygenation (ECMO)
6.8.5 Nitric Oxide Therapy

6.9 Lung Recruitment Manoeuvre (LRM):

6.9.1 LRM's are used to improve oxygenation after de-recruiting events (i.e. suctioning, bronchoscopy, circuit disconnect) or for patients who continue to have marginal oxygenation during mechanical ventilation.

6.9.2 LRM's must be physician ordered and preferably performed with the physician present.

6.9.3 Adverse effects of LRM's include:

6.9.3.1 Barotrauma
6.9.3.2 Cardiovascular compromise
6.9.3.3 Assuming no adverse effects, and if the PaO_2 does not increase at least by 20%, LRM is repeated up to 2 more times to total of 3 times in 24 hour period.

6.9.4 How to perform LRM:

6.9.4.1 Increase FIO_2 to 1.0
6.9.4.2 Set pressure alarm limit
6.9.4.3 Set apnea alarm to 60 seconds
6.9.4.4 Change to Continuous Positive Airway Pressure (CPAP) mode.

6.9.4.5 Assure pressure support set at "0", and tube compensation should always be "off"
6.9.4.6 Increase PEEP to 40 cmH20 and maintain inflation for 40 seconds
6.9.4.7 Lower PEEP to higher 2 cmH_2O prior to LRM.
6.9.4.8 Resume the previous mode and reset alarm limits.
6.9.4.9 Lower FIO_2 to Set Level prior LRM

6.9.5 The Plateau Pressure (Pplat) must be measured prior and following the LRM.
6.9.6 Return the patient to previous settings and consult the attending physician for any increases in (Pplat)

6.9.7 Follow the departmental policy regarding documentation of procedures and any critical events in the patient's chart.

6.9.8 Do **not** perform LRM's in patients with

6.9.8.1 Hypotension
6.9.8.2 Pneumothrorax
6.9.8.3 Active air leak.
6.9.8.4 "Pre-existing focal lung disease that may predispose to barotrauma.(for example extensive apical bullous lung disease)"

6.9.9 Patient must be fully monitored during LRM. Monitoring should include (at least) invasive arterial pressure, pulse oximetry and Electro-Cardio-Gram (ECG).

6.9.10 Terminate the LRM immediately if associated with:

6.9.10.1 Hypotension (mean arterial blood pressure < 60 mmHg or decrease by > 20 mmHg)
6.9.10.2 Changes in heart rate (> 140 bpm or <60 bpm)
6.9.10.3 Development of cardiac arrhythmias
6.9.10.4 Desaturation (decrease in oxygen saturation to less than 85% or decrease of more than 5%).

6.9.11 Do not repeat an LRM for at least 24 hours in patients in whom previous LRM had to be terminated.

6.9.12 Consider doing an Arterial Blood Gas Analysis (ABG) prior and post the LRM.

6.9.13 When RLM is successful expect the following:

6.9.13.1 Improved ABG values i.e. PaO_2…
6.9.13.2 Increased Tidal Volume Exhaled.
6.9.13.3 Improved Lung Compliance
6.9.13.4 Decreased Resistance
6.9.13.5 Decreased Peak Inspiratory Pressure
6.9.13.6 Decreased Pplat

7. REFERENCES

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