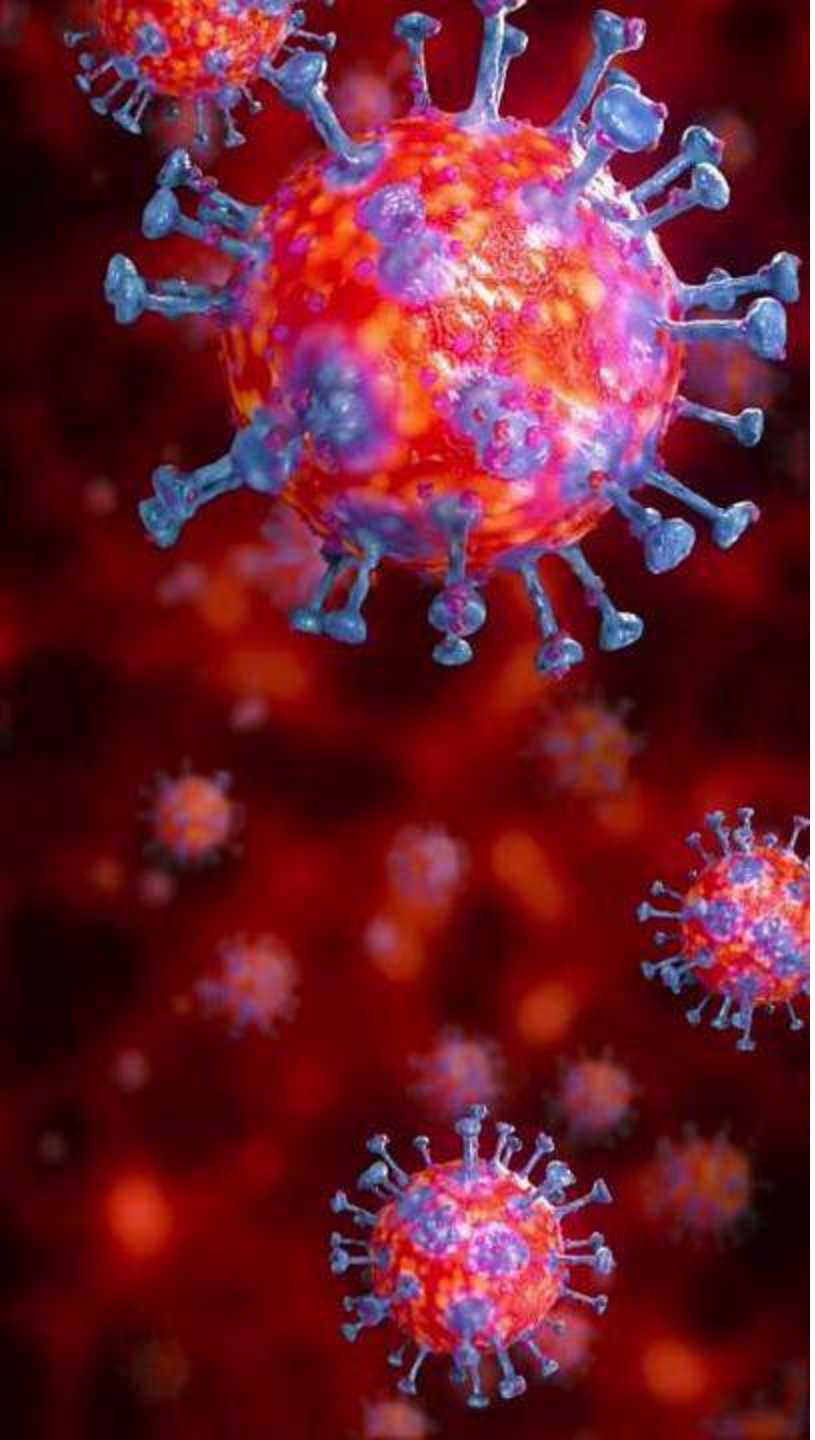

critical care management of COVID 19(RESPIRATORY SUPPORT)

Prof. Dr. Nibedita Pani

Department of Anaesthesiology & Critical Care

SCB MCH CTC.

Admit in Hospital when..

- Tachypnea (RR>24/min)
- SpO_2 < 94% on room air (PaO_2/FiO_2 <300)
- Signs of hypoperfusion
  - Low BP, altered mentation
- Risk of severe disease
  - Age >60
  - DM, HTN, immunocompromised
  - Chronic lung/cardiac/renal/hepatic diseas

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Criteria for ICU admission

- Ventilation support
- Vasopressor need
- Worsening of mental status
- MODS (Multi Organ Dysfunction Syndrome)

Poor prognosis

- Age
- Lympho penia
- High NLR
- Raised LDH
- Raised D-Dimer
- Raised Ferritin

Respiratory

Principles of management of ARDS in COVID-19

1.1. Early recognition

2. Initiation of ventilatory support

3. Treating the underlying cause

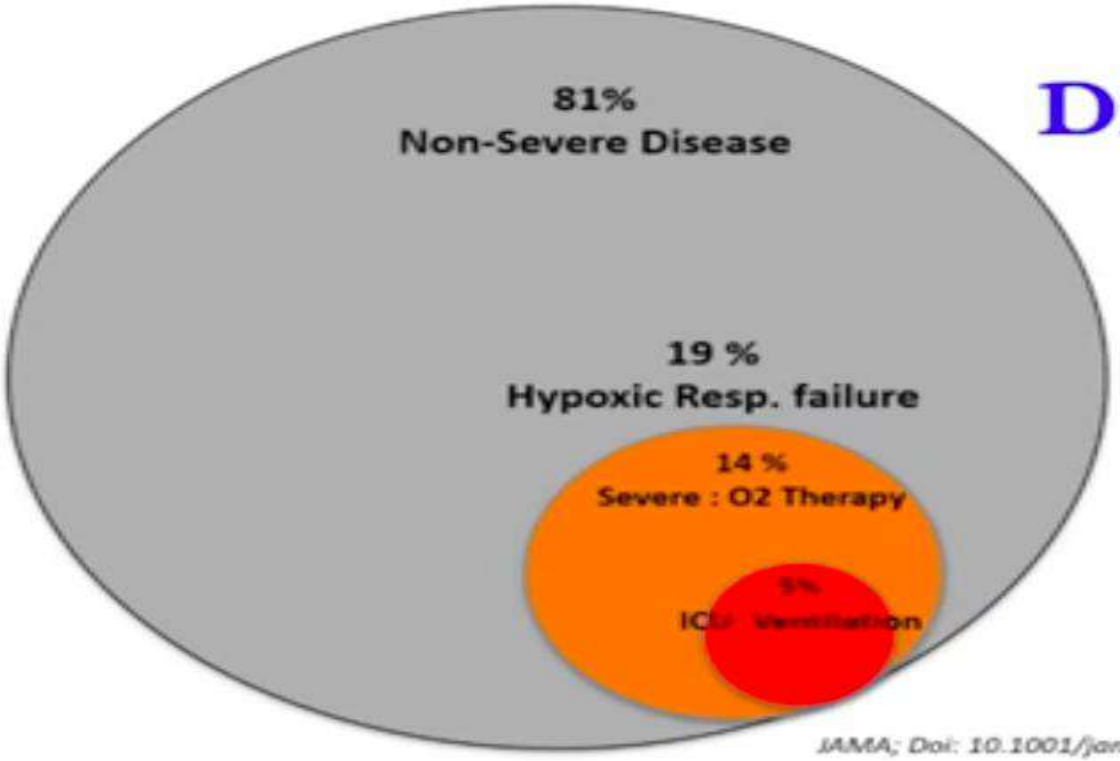
4. Monitor-record- interpret- respond

5. Delivering quality care.

Early recognition - ARDS

Onset	• New or worsening respiratory symptoms within one week of known clinical insult.
Chest imaging	• Bilateral opacities, not fully explained by effusions, lobar or lung collapse, or nodules.
Origin of oedema	• Respiratory failure not fully explained by cardiac failure or fluid overload.

COVID 19: Disease Severity



Critically ill COVID Patients

- 67% ARDS
- 56% Mechanical Ventilation

Lancet Respir Med,Doi: 10.1016/S2213-2600(20)30079-5

JAMA; Doi: 10.1001/jama.2020.2648

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L and H Types Pneumonia

L TYPE

- **Low Elastance**
- **High Compliance**
- **Low VQ Ratio**
- **Low lung weight**
- **Low lung recruitability**

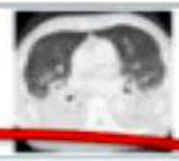
H TYPE

- **High Elastance**
- **Low compliance**
- **High right to left shunt**
- **High lung weight**
- **High lung recruitability**

Severe SARS-CoV-2 infections: practical considerations and management strategy for intensivists

Intensive Care Med (2020) 46:579–582

COVID Presentation



PERIOD and ONSET OF SYMPTOMS 3 DAYS AGO		FIRST WEEK				SECOND WEEK				NO TERM INFO PENDING
	SETTING	WARD Illness day 4	WARD Illness day 5	WARD Illness day 6	WARD Illness day 7	WARD/ICU Illness day 8	ICU Illness day 9	ICU Illness day 10	ICU Illness day 11	
	REPEATED SAMPLING OF THE NASOPHARYNX AND TRACHEAL ASPIRATES (IF INTUBATED) BY rRT-PCR FOR THE COVID-19	Initial important viral shedding		Decrease of the viral shedding sometimes associated with transient respiratory deterioration		...atory failure, increase of the viral shedding and viremia			...of viral secretion unknown	
	OXYGEN THERAPY AND MECHANICAL VENTILATION	NO		Consider oxygen support	FNC	FNC followed by MV	MV		MV	
	ORGAN FAILURE	**Typical signs according to current publications:** Fever, cough, and shortness of breath (18%) Bilateral pneumonia (75%), lymphopenia (35%), thrombocytopenia (12%), prothrombin time decreased (30%), elevated liver enzyme levels (about 30%)		Deterioration of respiratory status with most often spontaneous recovery		ARDS ... Possible renal failure Neurological failure unlikely Hemostasis disorders			YES	

Typical features according to current publications

Age Mean (SD) 55.5 (13-1), Male (68%)

Exposure to Huanan seafood market in Wuhan, China (49%)

Chronic medical underlying illness (51%)

Admission to Intensive Care Unit (23%)

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RESPIRATORY SUPPORT

Oxygen Therapy

- Majority of patient required O_2 therapy *{Day 5-6}*

When to start O_2?

- **Suggest** starting O2 therapy when $SpO_2 < 92\%$
- **Recommend** starting O2 therapy when $SpO_2 < 90\%$

SPO2 Targets ?

- **Recommend** SPO2 no higher than 96%
- Target SpO_2 = 92-96%

WHO

- Initial resuscitation target: *SpO_2 > 94%*
- Once Patient is stable :
  - *Target = SpO_2 > 90%*
  - *Pregnant Patient = SpO_2 ≥ 92 - 95%*

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Requirements for O_2 therapy for COVID ICU

- Pulse oximeters
- Functioning oxygen systems
- Oxygen cylinders for back up
- Disposable, single-use, oxygen-delivering interfaces

  (nasal cannula,
  simple face mask
  venturi mask
  mask with reservoir bag).

Non invasive ventilator/HFNC

- Helmet interface
- Scavenging systems
- Etco2 monitorig

- ABG machine

Oxygen Therapy

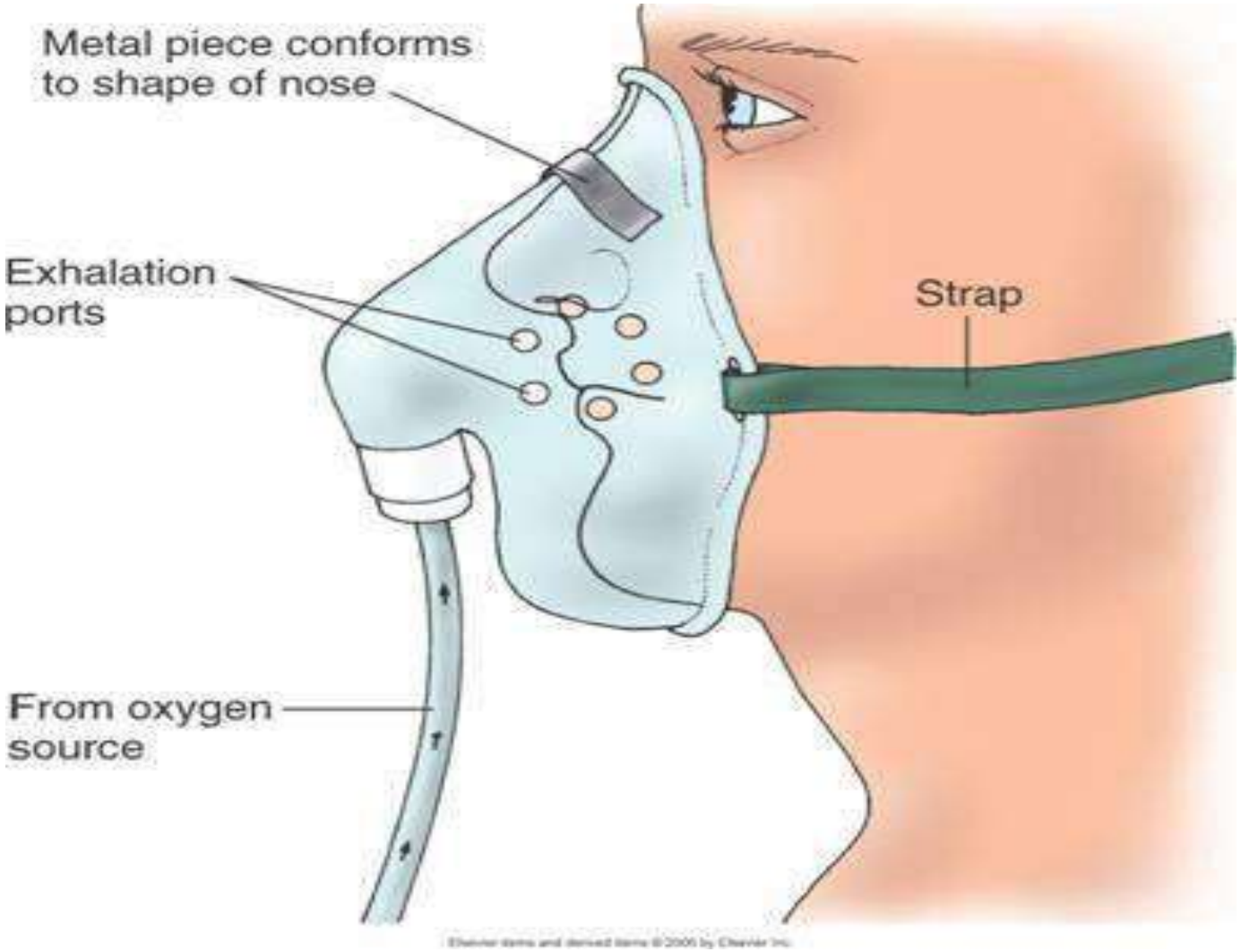
- Conventional, Single use, oxygen-delivering interfaces
  - Nasal cannula
  - Nasal prongs
  - Simple face mask &
  - Mask with reservoir bag

Nasal cannula (prongs):

Amount of oxygen delivered

- Fio2 (Fraction Inspired Oxygen)
- Low flow 24-44%
- 1L/Min= 24%
- 2L/Min= 28%
- 3L/Min= 32%
- 4L/Min= 36%
- 5L/Min= 40%
- 6L/Min= 44%

The simple Oxygen mask



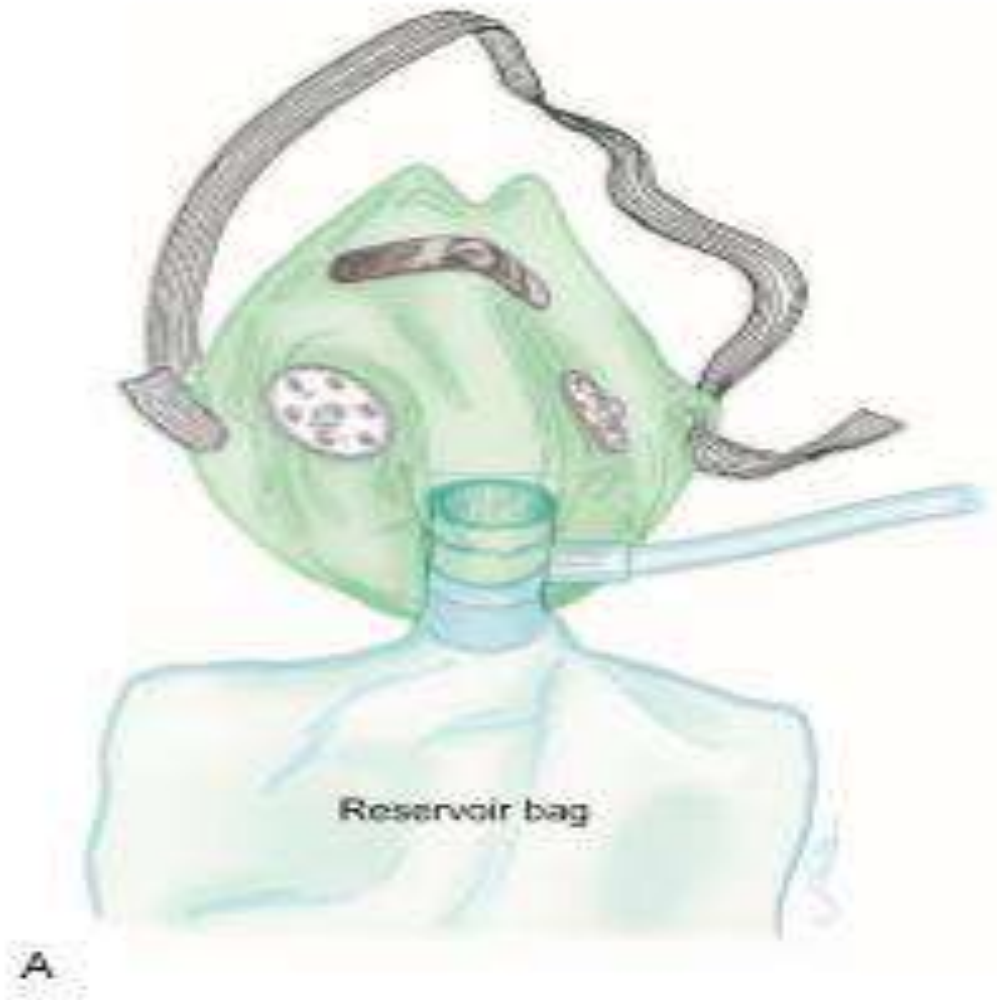
The simple Oxygen mask

I

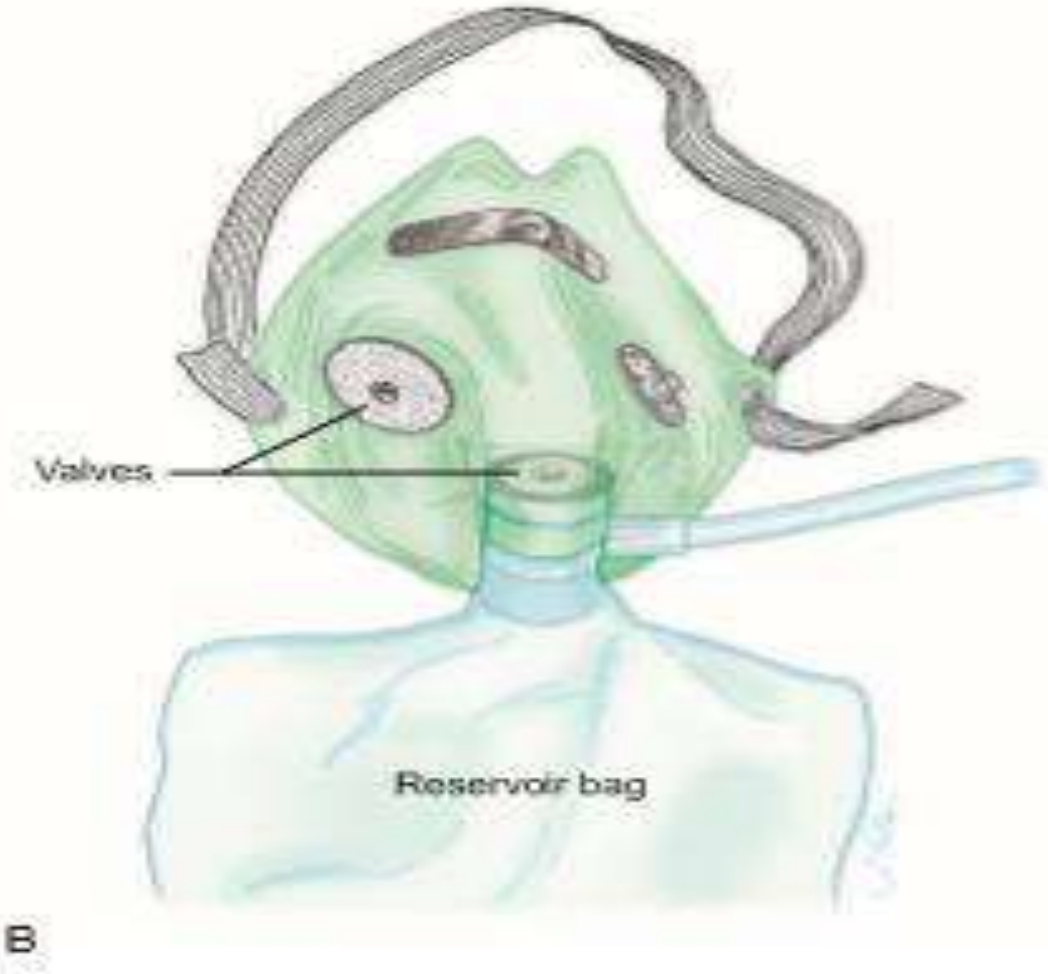
Delivers 35% to 60% oxygen .
A flow rate of 6 to 10 liters per minute.

It has vents on its sides which allow room air to leak in at many places, thereby diluting the source oxygen.

Partial Rebreathing Mask



Non Rebreathing Mask



Oxygen mask with reservoir bag

……The Non Re- Breather Mask

The Non Re- Breather Mask

- This mask provides the highest concentration of oxygen (95-100%) at a flow rate6-15 L/min.
- It is similar to the partial re-breather mask except two one-way valves prevent conservation of exhaled air.
- The bag has an oxygen reservoir

The Non Re- Breather Mask

- *Advantages*

- Delivers the highest possible oxygen concentration
- Suitable for pt breathing spontaneous with sever hypoxemia

The Non Re- Breather Mask

- ***Disadvantages***

- Impractical for long term Therapy
- Malfunction can cause CO2 buildup
- suffocation
- Expensive
- Uncomfortable

“Venturi” Device with mask

Venturi System Varieties

Management of hypoxemic respiratory failure & ARDS

Standard oxygen therapy (flow rates of 10-15ltr / min.)

- **FiO2 (0.60 to 0.95)**
- **High-flow nasal catheter oxygenation**
- **Non-invasive ventilation**
- **Low risk of air borne transmission**
- **Close monitoring**

Management

- ***Immediate initiation of oxygen/ventilatory support***

- Options
- High flow nasal cannula (HFNC) oxygen systems (limited availability)
- Non invasive ventilation (NIV) (ideally through a critical care ventilator)
- Invasive mechanical ventilation (IMV) (after endotracheal intubation) – *maybe required in a large majority*

- ***Supportive treatment***
- ***Strategies*** for severe/refractory hypoxemia

Acute hypoxemic respiratory failure despite conventional oxygen therapy

HFNC

NIPPV

Intubation

- WHO !

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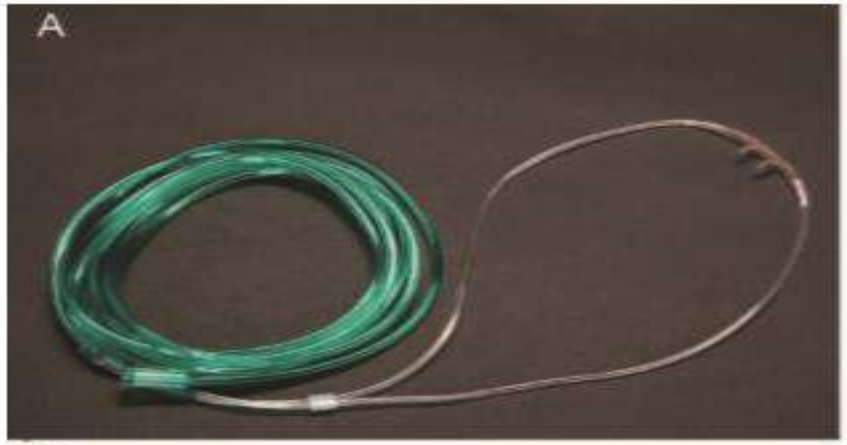
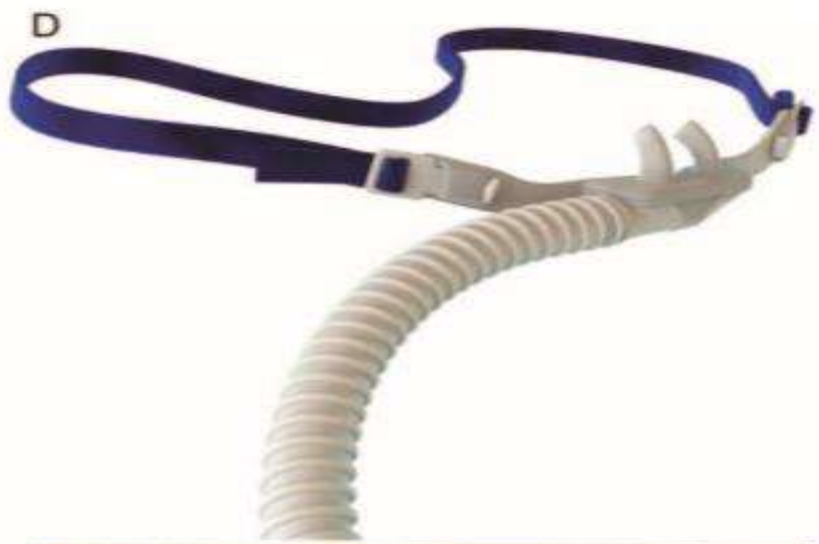
HFNC





High flow nasal cannula (HFNC)

May consider in selected patients if -

- awake, cooperative with normal haemodynamics
- without urgent need for intubation
- ($PaCO_2$ < 45 mmHg).

- 40% or greater patients may still require intubation and mechanical ventilation

If no clinical improvement in 1-2 hours,

DO NOT delay intubation.

High potential for virus aerosolization therefore PPE accordingly

Management of hypoxemic respiratory failure and ARDS

- **Recent publications suggest that newer HFNO and NIV systems with good interface fitting do not create widespread dispersion of exhaled air and therefore should be associated with low risk of airborne transmission.**

Failure of Conventional Oxygen Therapy

- **Suggest** HFNC if ↓SpO_2 on conventional O_2 therapy
- **Suggest** HFNC over NIPPV

HFNC : Decrease risk of intubation
NIPPV: Increase risk to HCP
HFNC : Patient Comfort

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Risk to HCP

- HFNC does not seems to increase disease transmission

HFNC = Conventional O_2

(Contamination risk)

*SARS: HCP exposed to HFNC not at increase risk

NIPPV in COVID

- **Suggest** a trial of NIPPV if HFNC is not available
- **WHO !**

NIPPV in COVID

Face Mask

Vs.

Helmet

- Insufficient data for any recommendation
- Safety and efficacy of helmet with COVID is not known ?

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Non-invasive ventilation (NIV)

- Continuous positive airway pressure (CPAP) or bi-level positive airway pressure (BIPAP) delivered via a tight-fitting full face mask.
- As high concentration for oxygen may be required, to be used in ARDS only with a critical care ventilator

- **Like HFNC, can be tried in selected patients. In case of failure of improvement within 1-2 hours, immediate endotracheal intubation and initiation for mechanical ventilation.**

High potential for virus aerosolization therefore PPE accordingly

Non Invasive Ventilation

Continuous Positive Airway Pressure (CPAP) Or Bi-level Positive Airway Pressure (BiPAP) delivered via a tight fitting mask.

- Not generally recommended for treatment of patients with ARDS as it may preclude achieving low tidal volumes and adequate PEEP level

If used, apply airborne precautions.

Ensure Safe NIV

- Increased **risk** to Health Care Worker
- Increased **failure rate** in non-cardiogenic etiology patients
- **Large** tidal volume
- Facial skin breakdown
- **Delayed intubation**
  - Do not wait for more than **1 hour**

Close monitoring is a must!!

Non-invasive ventilation (NIV)

- NIV can also be delivered through a helmet interface with a possibility of lesser aerosolization (no consensus although on its superiority in patients with COVID-19)
- NIV and HFNC should be used in ARDS, only under close monitoring with physicians experienced with management of patients with hypoxemic respiratory failure
- NIV and HFNC may be used as a temporizing measure until IMV is initiated.

In sick COVID-19 patients with severe respiratory distress and impending signs of respiratory arrest/fatigue, it is advisable to directly proceed to endotracheal intubation and initiation of mechanical ventilation

Maximum exhaled air dispersion

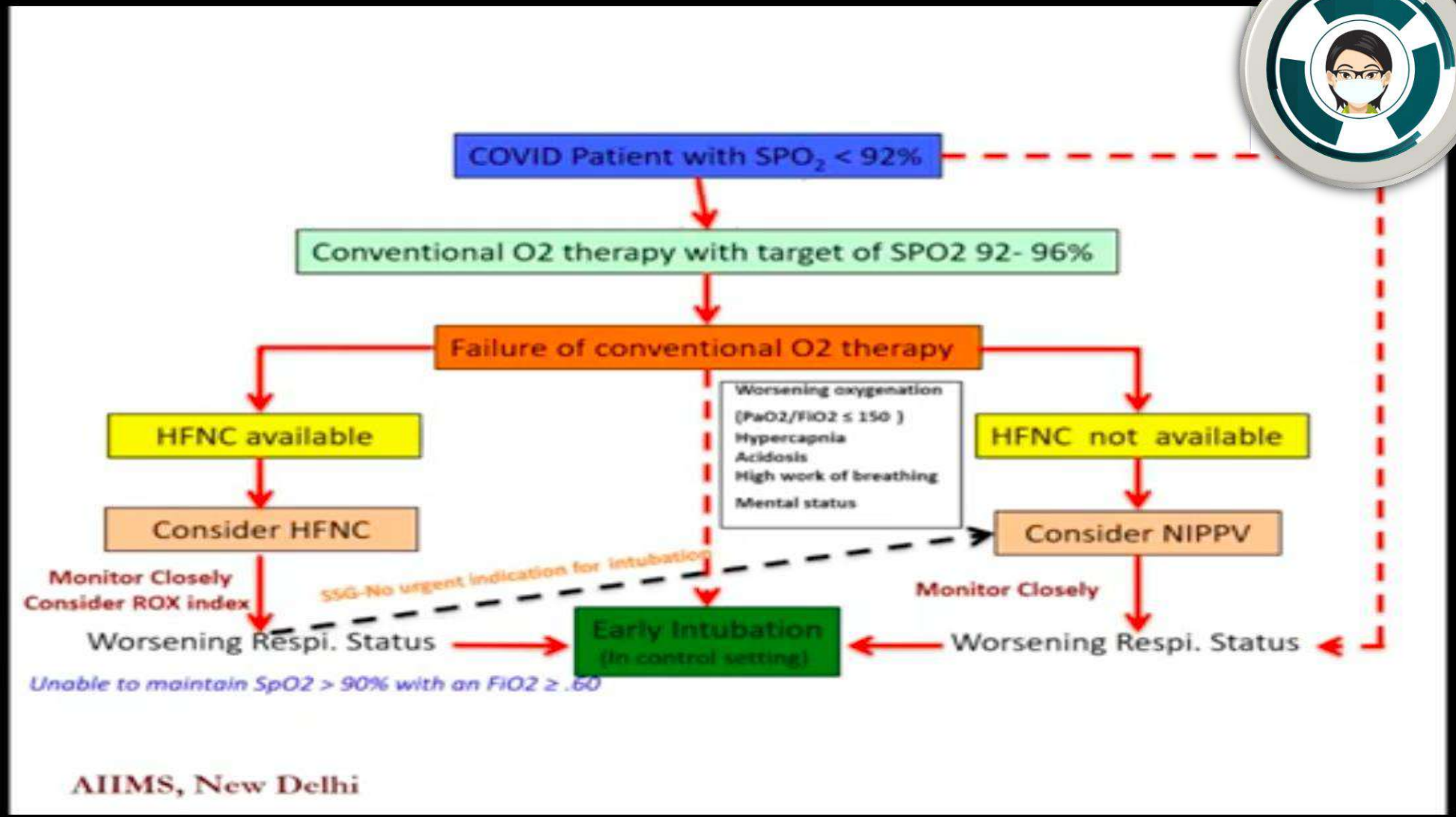
- **Maximum exhaled air dispersion via different oxygen administration and ventilatory support strategies: (in a negative pressure room, with human simulator at an inclination of 45’)**
- **Method Maximum exhaled air dispersion distance (in cm)**
- **Oxygen via NC (5L/min) 100**
- **Oxygen via simple face-mask (4L/min) 40**
- **Oxygen via Venturi mask (FiO2 40%) 33**
- **Oxygen via non rebreathing mask 12 L/min <10**

Maximum exhaled air dispersion

- **CPAP via oro-nasal mask (20cm of H2O) - Negligible**
- **HFNC (60L/min) -17 (62cm sideways leakage if not tightly fixed)**
- **NIV via full face mask (IPAP 18cm/EPAP 5cm H2O) - 92**
- **NIV via helmet without tight air cushion - 27**
- **NIV via helmet with tight air cushion (IPAP 20cm/EPAP 10cm H2O) - Negligible air dispersion**

Safety when using HFNC /NIV

- Mask over HFNC ?
- Viral filters are essential to limit transmission.
  - If a ventilator is being used with a two-tube system:
    - Filters may be placed in-line with the exhalation port.
  - If a BiPAP machine is being with a one-tube system
    - Filter may be attached directly to the mask.
- Helmet masks might theoretically have an advantage here.


COVID Patient with SPO2 < 92%
Conventional O2 therapy with target of SPO2 92- 96%
Failure of conventional O2 therapy
Worsening oxygenation
(PaO2/FiO2 ≤ 150)
Hypercapnia
Acidosis
High work of breathing
Mental status
HFNC available
HFNC not available
Consider HFNC
Consider NIPPV
Monitor Closely
Consider ROX index
SSG-No urgent indication for intubation
Monitor Closely
Worsening Respi. Status
Early Intubation
(In control setting)
Worsening Respi. Status
Unable to maintain SpO2 > 90% with an FiO2 ≥ .60
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Schema for Noninvasive Support

Low flow nasal cannula
- Typically set at 1-6 liters/minute.

High flow nasal cannula
- Titrate FiO2 based on patient's saturation. If FiO2 requirement escalating (e.g. over ~80%) consider awake pronation or CPAP trial.
- Consider limiting flow rate below ~40 L/min to reduce aerosolization.
- N95 mask & aerosol precautions.

CPAP
- Titrate CPAP up as tolerated (in more severe hypoxemia might target ~15-18 cm)
- Viral filter.
- N95 mask & aerosol precautions.
- (Helmet interface likely ideal if available).

Awake pronation plus {High Flow Nasal Cannula or CPAP}
- If tolerated, awake patient may lie in a prone position (ideally for 12-18 hr/day).
- Limited to cooperative patients. *May be useful if access to ventilator is limited.*

Invasive mechanical ventilation
- Target tidal volumes of ~6 cc/kg.
- Permissive hypercapnia may be useful to allow for lung-protective settings.
- May use conventional lung-protective ventilation strategies or APRV.

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Awake Prone Positioning with Non-invasive Support

- Self Prone positioning :
  - with convectional oxygen therapy
  - Can be combined with other noninvasive support (HFNC & NIV).
- Requires cooperative patient with intact mentation.
- Same Physiological principle.
- Can avoid intubation
- Could be useful in situations where access to invasive ventilation is limited.

Sun et al. (https://annalsofintensivecare./10.1186/s13613-020-00650-2)).

Patient information sheet For "Conscious Proning"

intensive care society | 50 YEARS

proud to be the voice of critical care since 1970

These instructions are for patients who have been advised to undertake "Conscious Proning"

Please try to not spend a lot of time lying flat on your back. Lying on your stomach and in different positions will help your body to get air into all areas of your lungs.

It is recommended to change your position every 30 minutes to 2 hours rotating as below. Please note sitting up is better than lying on your back;

1. 30 minutes – 2 hours: lying fully prone on your stomach (bed flat)
2. 30 minutes – 2 hours: lying on your right side (bed flat)
3. 30 minutes – 2 hours: sitting up (30-60 degrees) by adjusting head of the bed
4. 30 minutes – 2 hours: lying on your left side (bed flat)
5. Then back to position 1 and continue to repeat the cycle.

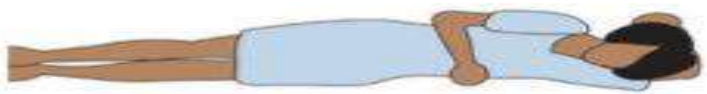
In pictures:

1. 30 minutes – 2 hours: lying fully prone (bed flat)

2. 30 minutes – 2 hours: lying on your right side (bed flat)

3. 30 minutes – 2 hours: sitting up (30-60 degrees) by adjusting head of the bed

4. 30 minutes – 2 hours: lying on your left side (bed flat)



5. Then back to Position 1. Lying fully prone (bed flat)

Adapted from Self Positioning Guide. Elmhurst Hospital. SB, https://www.embeds.co.uk/wp-content/uploads/2020/04/Self-Proning-Positioning-leaflet.pdf

INDICATION OF INTUBATION IN COVID PNEUMONIA

Respiratory distress (not tachypnea only)

Severe hypoxia (pa02< 60 or Spo2 <88%with >10-12LO2/min).

Increased CO2 retention

Drowsy patient – low breathing rate and poor cough

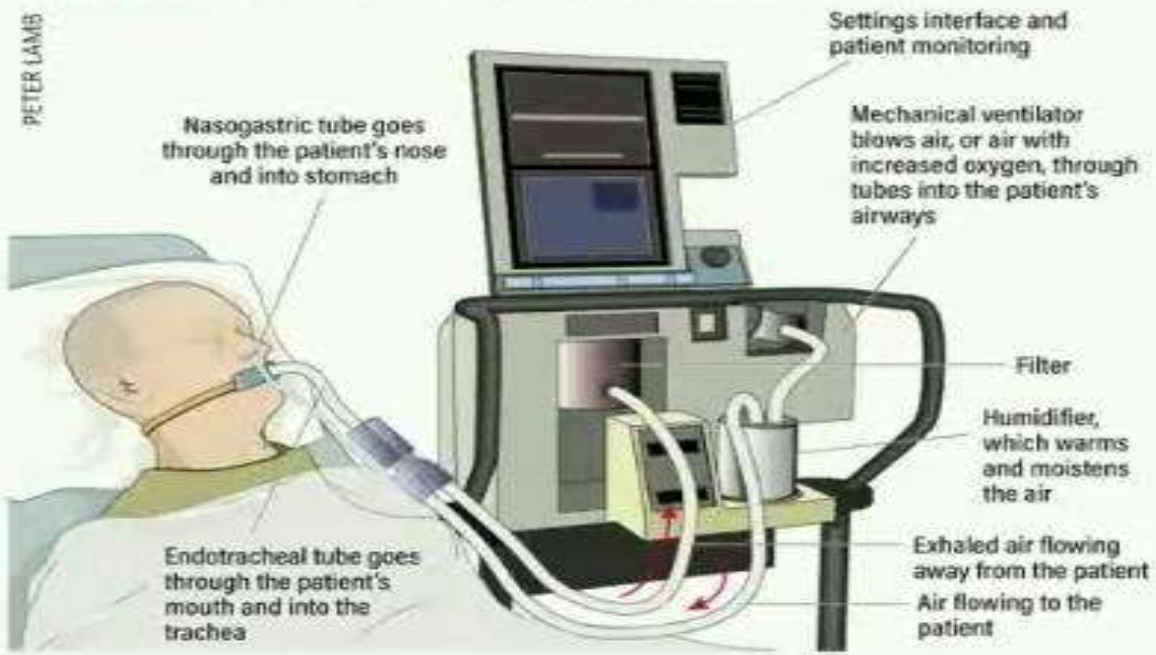
Hemodynamic instability with moderate hypoxia (noradrenaline)

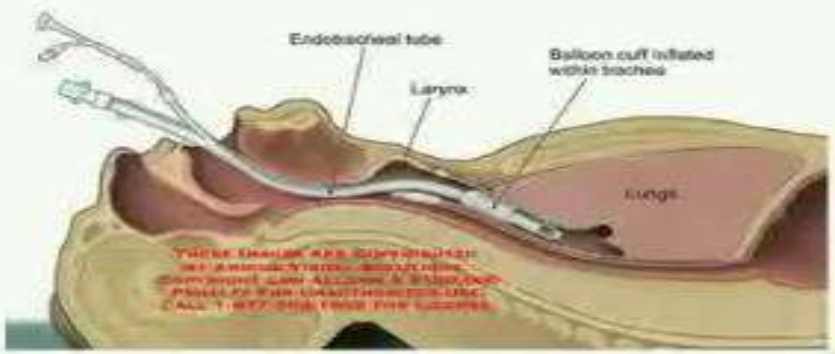
How to intubate these patients ?

- Decide more electively than not…
- Full PPE – most important
- Check suction, airway equipments, IV fluids, monitors, drugs, IV line and ventilator
- A hydrophobic filter between mask and AMBU/Circuit.
- Experienced person for intubation
- Minimise number of persons inside room
- Pre oxygenation with 100% OXYGEN
- Rapid Sequence Intubation with opioid and suxamethonium/ Rocuronium
- Avoid bag mask ventilation

Invasive mechanical ventilation (IMV) with Lung Protective ventilation (LPV)

Figure 1. Mechanical ventilator for positive pressure ventilation





Nursing Standard. doi: 10.7748/ns.2

Modes of delivery of IMV

- ***Endotracheal tube (preferred)***
- Nasotracheal tube
- Laryngeal mask (short-term, emergency)
- Tracheostomy (emergency airway, or long-term ventilation)

- Requires sedation, appropriate equipment and trained staff

Airway management in ICU

- Pre-oxygenate with closed circuit
- Avoid AMBU bag-mask ventilation
- **Rapid sequence induction**
  - Etomidate/propofol and scholine/rocuronium
- Most experienced operator
  - **Anesthesiologist** in each shift
- Use **video-laryngoscopy**
  - ↑First attempt and ↑over-all intubation success rate

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STORZ

COVID : Mechanical Ventilation

- Critically ill ARDS = 67% presents with ARDS
- ARDS Classification : {Berlin definition}
  - **Mild ARDS =** $200 < PaO_2/FiO_2 \leq 300\ mmHg$
  - **Moderate ARDS =** $100 < PaO_2/FiO_2 \leq 200\ mmHg$
  - **Severe ARDS =** $PaO_2/FiO_2 \leq 100\ mmHg$

When PaO2 is not available, $SpO_2/FiO_2 \leq 315$ suggests ARDS

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Initiate ventilatory support

Follow checklist for rapid sequence induction.

Anticipation and preparation are keys:

- do not delay procedure as patients with ARDS can desaturate quickly when oxygen is removed
- Monitor & respond to haemodynamic instability
- Properly titrate induction anaesthetics

Pre-oxygenate with 100% FiO2 for 5 minutes

Lung Protective Ventilation (LPV) reduces

- Ventilator-induced lung injury
- Barotrauma (e.g pmeumothorax)
- Volutrauma - Excessive strain
- Atelectrauma
- Biotrauma
- Oxygen toxicity

Management of hypoxemic respiratory failure & ARDS

Ventilation strategy in ARDS :-

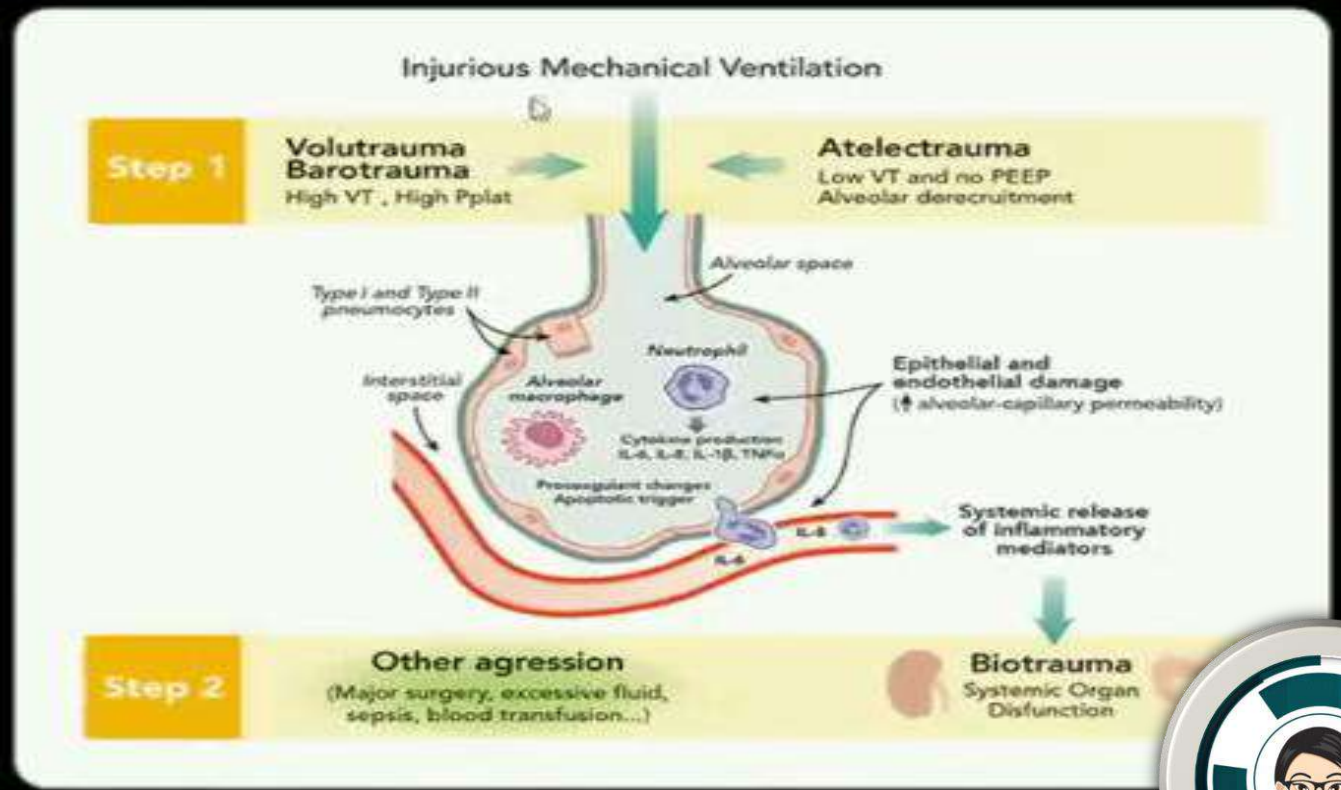
Table 23.4 Protocol for Lung Protective Ventilation in ARDS

I. 1st Stage	1. Calculate patient's **predicted** body weight (PBW)†. Males: PBW = 50 + [2.3 × (height in inches − 60)] Females: PBW = 45.5 + [2.3 × (height in inches − 60)] 2. Set initial tidal volume (V_T) at 8 mL/kg PBW. 3. Add positive end-expiratory pressure (PEEP) of 5 cm H_2O. 4. Select the lowest FiO_2 that achieves an SpO_2 of 88–95%. 5. Reduce V_T by 1 mL/kg every 2 hours until V_T = 6 mL/kg.
II. 2nd Stage	1. When V_T = 6 mL/kg, measure plateau pressure (Ppl). 2. If Ppl > 30 cm H_2O, decrease V_T in 1 mL/kg increments until Ppl < 30 cm H_2O or V_T = 4 mL/kg.
III. 3rd Stage	1. Monitor arterial blood gases for respiratory acidosis. 2. If pH = 7.15–7.30, increase respiratory rate (RR) until pH > 7.30 or RR = 35 bpm. 3. If pH < 7.15, increase RR to 35 bpm. If pH is still < 7.15, increase V_T in 1 mL/kg increments until pH > 7.15.
IV. Optimal Goals	V_T = 6 mL/kg, Ppl ≤ 30 cm H_2O, SpO_2 = 88–95%, pH = 7.30–7.45

Adapted from the protocol developed by the ARDS Network, available at www.ardsnet.org.
†Predicted body weight is the weight associated with normal lung volumes.

Lung Protective Ventilation

- Minimization of alveolar overdistension
- Minimization of rapid alveolar opening and collapse
- Ventilatory strategies aimed at preventing the aggravation of lung injury



Initiation of Mechanical Ventilation

- Endotracheal Intubation
- Aerosol precautions
- Intubation teams

- Pre-oxygenate with 100% FiO2 for 5 minutes
  - Bag valve mask
  - NIV
  - Highflow system.

  - Usual mode Volume controlled ventilation - ACMV (Assist Control Mode)

Lung Protective Ventilation – How?

Target	Target tidal volume 6 mL/kg in adult and children - ideal body weight
Target	Target plateau airway pressure (Pplat) ≤ 30 cmH2O
Target	Target SpO2 88–93%

Initial settings and monitoring

- Set TV 6–8/kg predicted body weight.
- Set RR to approximate minute ventilation (MV).
- Set inspiratory flow rate above patient demand – commonly > 50-60 L/min.
- Set FiO2 at 1.00, titrate down.
- Set PEEP 5–10 cm H20 or higher and then adjust.

- Monitoring
  - SpO2 and ventilator parameters and ventilator waveforms continuously
  - pH, PaO2, PaCO2 as needed using ABG

Achieving the targets

- If TV is at 6 mL/kg and Pplat remains > 30 cm H2O then reduce TV by 1 mL/kg gradually, to a minimum 4 mL/kg:
  - at the same time, increase RR to maintain MV
  - allow for permissive hypercapnia
  - monitor and treat asynchrony

- Minute ventilation = Tidal Volume X Respiratory rate
  - Therefore, reduction in VT to be compensated by increase in RR
  - Low tidal volumes will lead to increase PaCO2 but that is acceptable

Permissive hypercapnia

- Mortality benefits of LPV outweigh risk of moderate respiratory acidosis
- No benefit to normalizing pH and $PaCO_2$

- If pH 7.15–7.30:
  - increase RR until pH > 7.30 or $PaCO_2$ < 25 (maximum 35)
  - decrease dead space by: decreasing I:E ratio, shortening the tube/flex connector

- If pH < 7.15 after above:
  - give buffer therapy intravenously (e.g. sodium bicarbonate)
  - TV may be increased in 1 mL/kg steps until pH > 7.15
  - if necessary, Pplat target of 30 may be temporarily exceeded

Oxygenation goals using PEEP-FiO2

- Titrate the FiO2 to the lowest value that maintains target SpO2 88–93%
- Set corresponding PEEP
- Higher PEEP for moderate-severe ARDS

Lower PEEP/higher FiO2

FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
PEEP	5	5	8	8	10	10	10	12

FiO_2	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

Higher PEEP/lower FiO2

FiO_2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5
PEEP	5	8	10	12	14	14	16	16

FiO_2	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	18	20	22	22	22	24

HIGH PEEP

Hypotension due to decreased venous return to right heart.

Over-distension of normal alveoli and possible **ventilator-induced lung injury** and increase in **dead space** ventilation.

Titrate the FiO_2 to the lowest value that maintains target SpO_2 88–93%.

Maximal PEEP levels to be determined on individual basis, range between 10–15 cm H_20

Use caution with higher PEEP levels in children.

Monitoring in LPV

Monitor SpO_2 continuously.

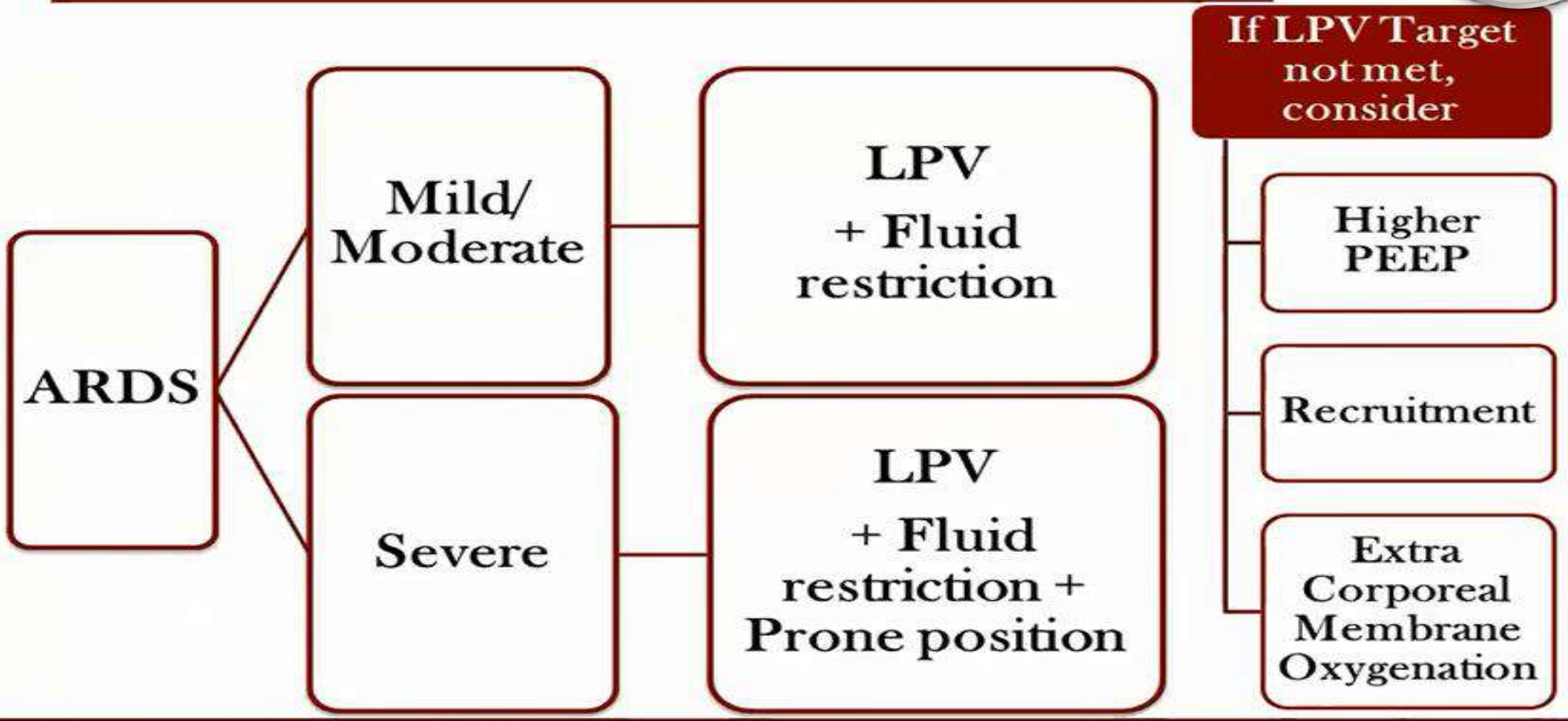
Monitor pH, PaO_2, $PaCO_2$ using blood gas analyser

- should be available in all ICUs.

Monitor ventilator parameters regularly:

- Pplat and compliance at least every 4 hours, and after changes in PEEP or TV
- intrinsic PEEP and I:E ratio after changes in respiratory rate
- ventilator waveforms for asynchrony..

Severe ARDS

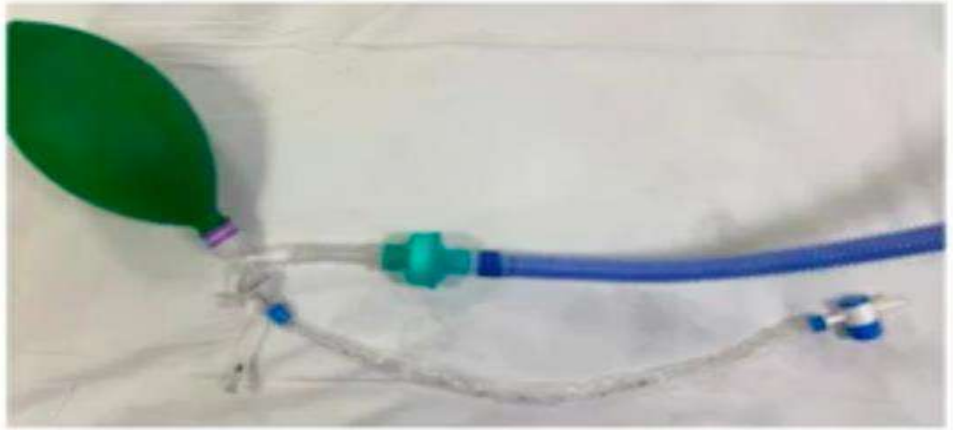

ARDS
Mild/ Moderate
Severe
LPV + Fluid restriction
LPV + Fluid restriction + Prone position
If LPV Target not met, consider
Higher PEEP
Recruitment
Extra Corporeal Membrane Oxygenation

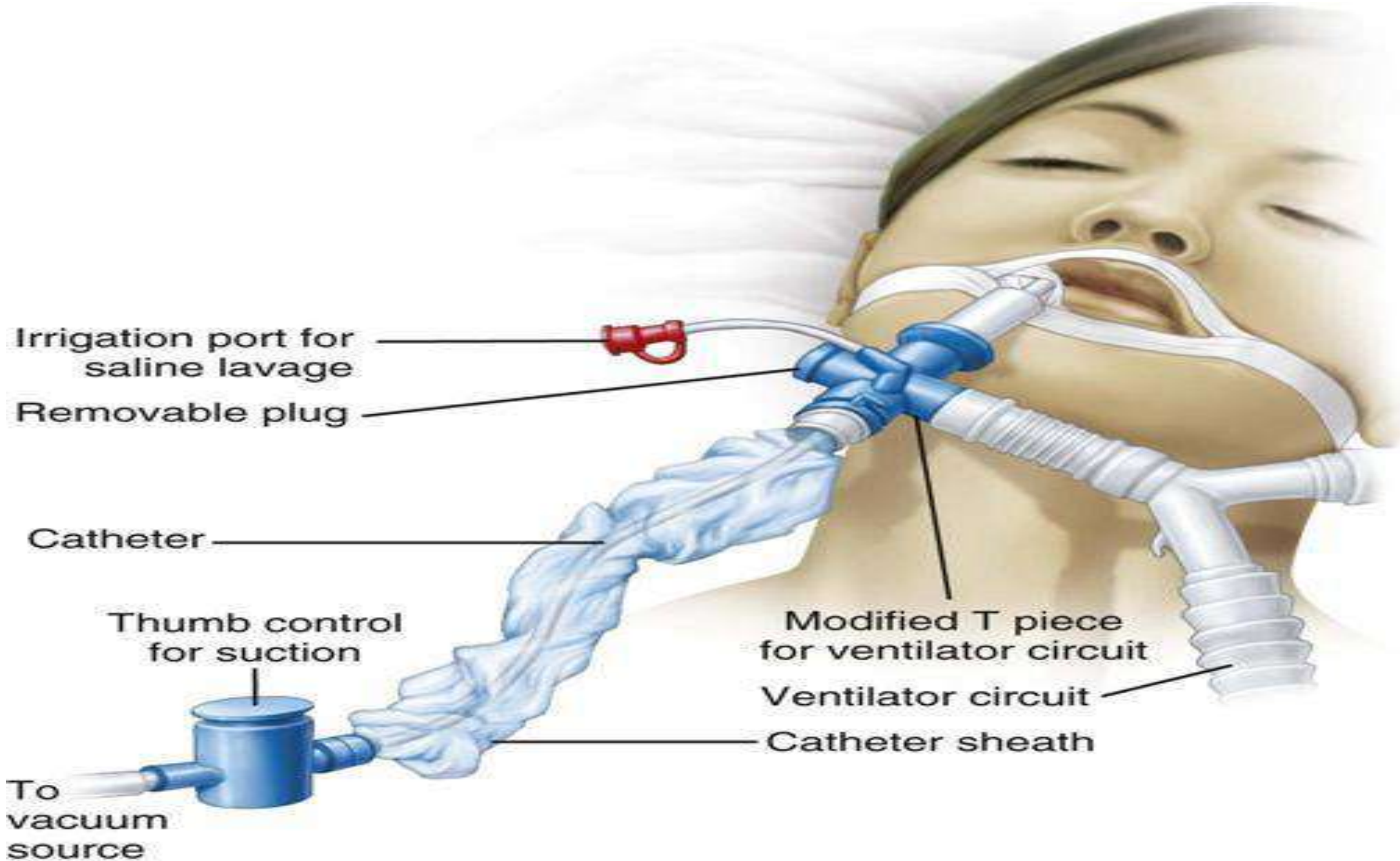
NMBA

- **Suggest** using intermittent boluses NMBA over continuous NMBA infusion, (to facilitate protective lung ventilation)
- **Suggest** continuous NMBA infusion for < 48 hrs:
  - Persistent ventilator dyssynchrony
  - Need for ongoing deep sedation
  - Prone ventilation
  - Persistently high plateau pressures,

Care of COVID patient on Mechanical Ventilation : Suctioning

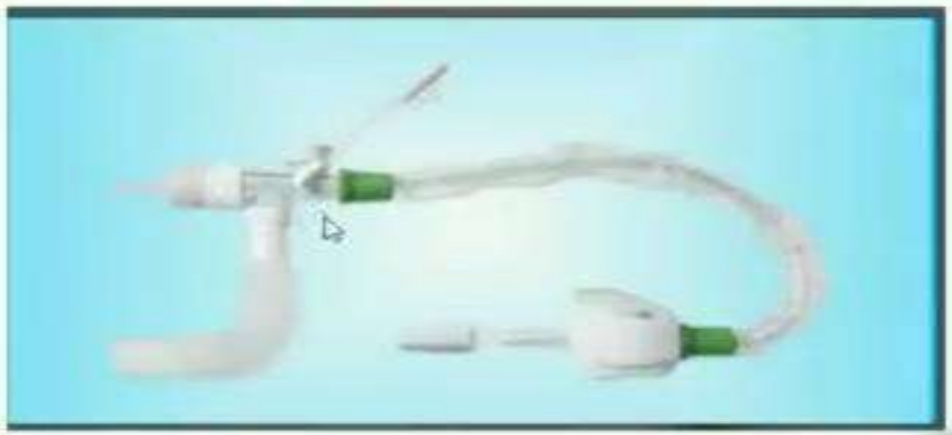
- Close suction only
- As and when required
- **Not hourly** basis
- PPE precautions if using open suction




Irrigation port for saline lavage
Removable plug
Catheter
Thumb control for suction
To vacuum source
Modified T piece for ventilator circuit
Ventilator circuit
Catheter sheath

Other precautions

- Avoid disconnecting the patient from the ventilator to prevent lung collapse and worsen hypoxemia
- **Use closed suctioning**
- Clamp tube when disconnection required
- Minimize unnecessary transport



Avoid aerosol

- MDI preferred over **nebulization**
- Use **HMEF** – change when soiled or 5-7 days
- Change circuit only when soiled (not routinely)
- Avoid circuit disconnections
- Before unavoidable circuit disconnections
  - **Clamp ETT and put ventilator on stand by**
- **Closed suction catheter system**

Care of patient on Mechanical Ventilation

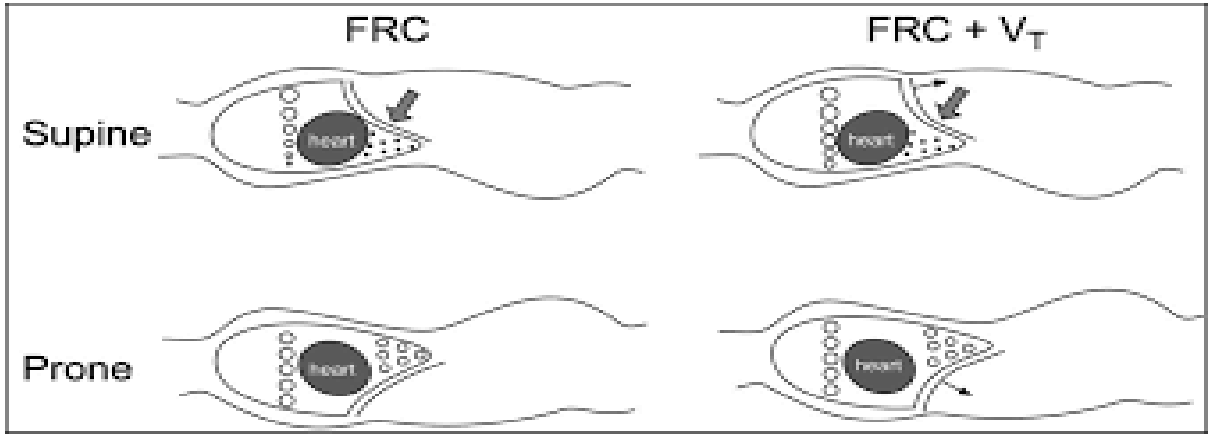
- **Nebulization**
  - **Avoid routine nebulization** (only when its absolutely necessary)

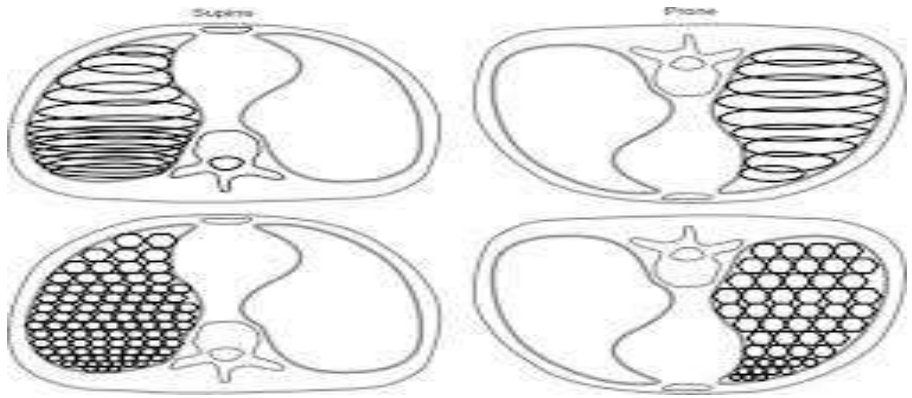
  Clamp ETT with artery forceps or umbilical cord clamp → disconnect circuit → attach nebulization kit → connect

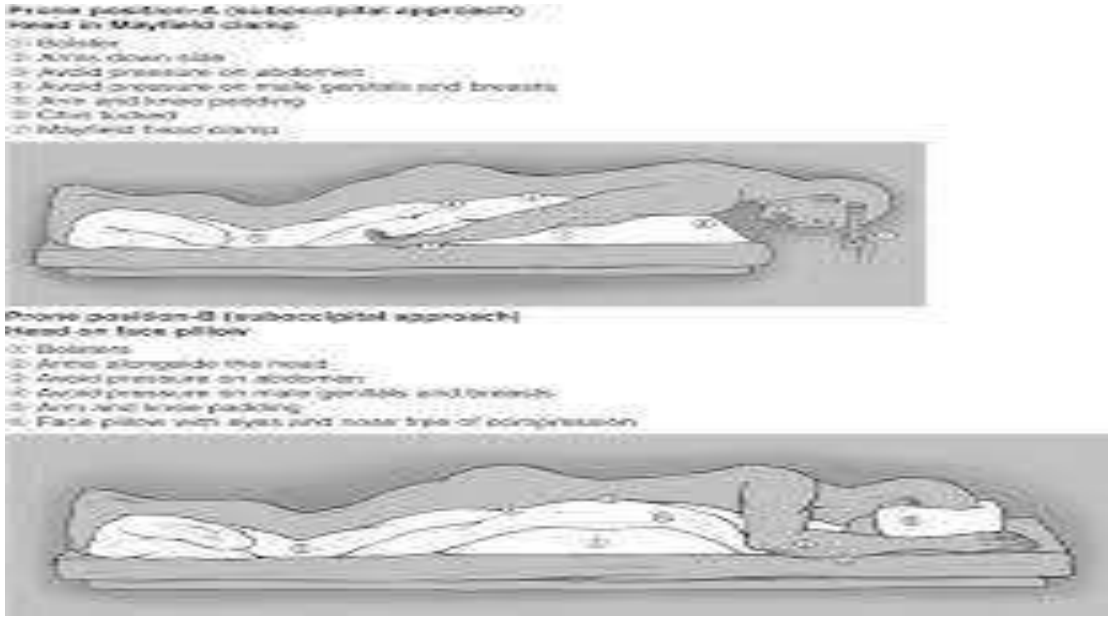
  (repeat in reverse way after nebulization)
- **Bronchoscopy**
  - only when its absolutely indicated

Prone Ventilation

- Suggest prone ventilation for 12- 14 hrs.
- Decrease Mortality







. Increases ventilation in dorsal part of lungs
. Improves VQ mismatch
. 6- 12 hours usually ,
. can extend upto 24 hours if necessary

Contraindications-

Shock
Hypoxia not responding
Dialysis
Adbominal distension

Respiratory Nursing Care

Prone for 16 / 24 hours - Turning teams are a success

- Awake prone / Self prone
- Care scheduling during semi recumbent position
- Skin care – One hour bony prominence massage
  - Medical devices check for skin injury
- Swollen lips care
- Ice for inflammation

Cautious feeding through nasogastric or nasoduodenal tube

Respiratory Nursing Care

Complications of proning

- Transient hemodynamic instability
- Brachial plexus injury
- Skin injury due to pressure & medical devices
- Facial oedema
- Swollen lips & tongue
- Lines & tubes displacement
- Aspiration

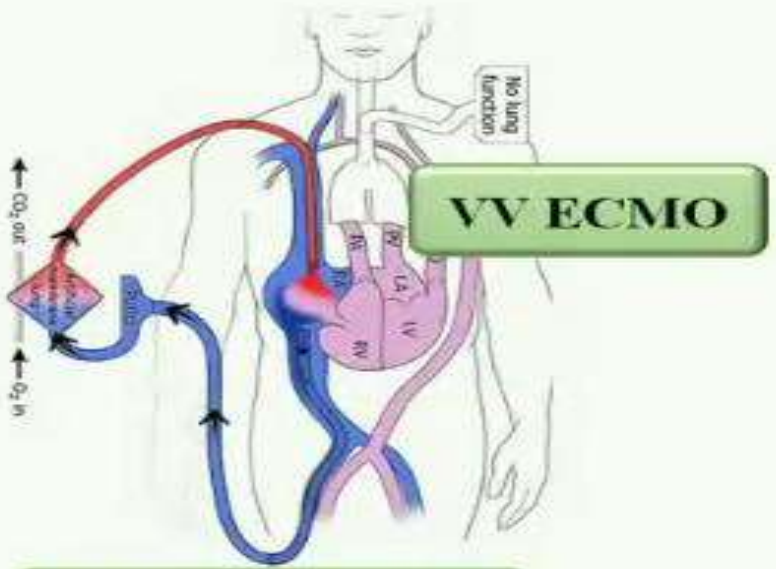
Recruitment Maneuvers

- If patients are hypoxemic despite optimized vent settings : **Suggest** RMs.
- **Recommend against** Staircase RMs.

- **WHO !**

ECMO

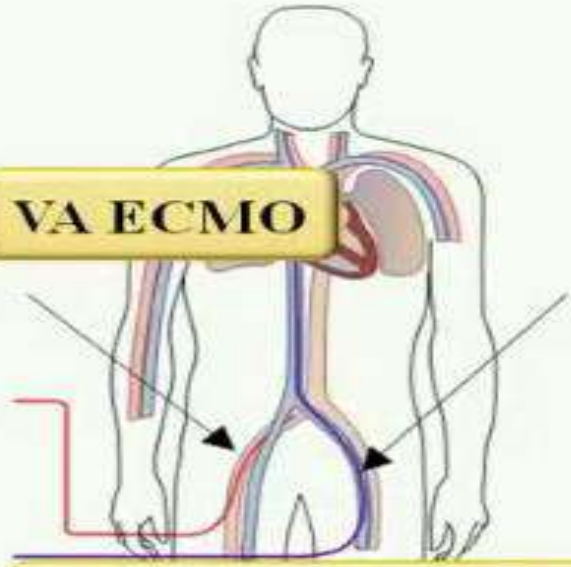
- **Suggest** using venovenous (VV) ECMO if available:
  - Refractory hypoxemia despite optimizing ventilation
  - Use of rescue therapies, and proning
- Referring the patient to an ECMO center
- *Economical & Ethical issues*



VV ECMO

Respiratory Support

VA ECMO

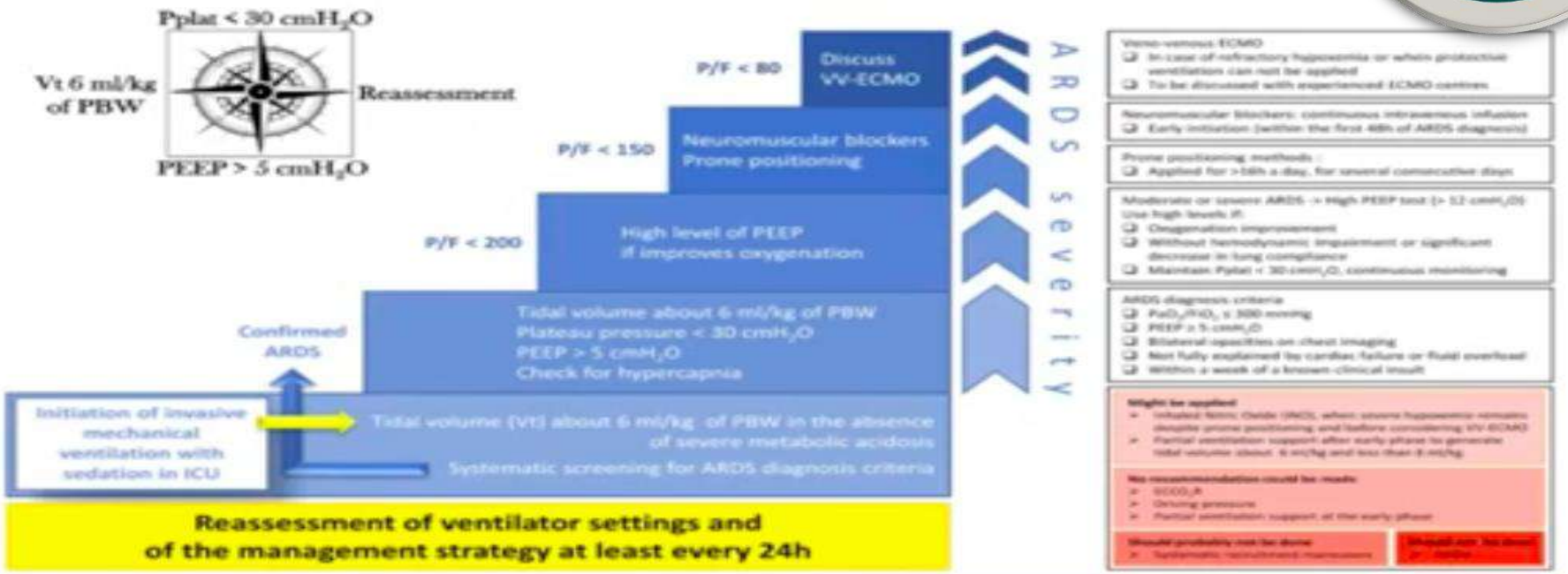


Respiratory +Cardiac Support

ECMO (Extracorporeal membrane oxygenation

Formal guidelines: management of acute respiratory distress syndrome

Papazian *et al. Ann. Intensive Care* (2019
https://doi.org/10.1186/s13613-019-0540-9



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Pain management and sedation for IMV

- Implement a protocolized management approach to pain, agitation and delirium (PAD) to improve patient outcomes.
- Regularly assess patients using standardized, reproducible scales (i.e. VAS, RASS, CAM-ICU).

- **First, treat pain (with opioids and non-opioids) to minimize the harmful effects of sedatives.**

- Then treat anxiety using non-benzodiazepines sedatives (when possible) and target light sedation in most patients.
- Use non-pharmacologic interventions to prevent delirium.

Management of hypoxemic respiratory failure & ARDS

In patients with moderate to severe ARDS (PaO2/FiO2<150), neuromuscular blockade by continuous infusion should not be routinely used.

Avoid disconnecting the patient from the ventilator, which results in loss of PEEP and atelectasis .

Disaster Ventilation Strategy

- Splinting Ventilators
- Outpatient-design BiPAP machines for intubated patients
- Oxylator resuscitator / Votran automatic resuscitator

Disaster Ventilation Strategy

There is no one-size fits all solution.

- Splitting ventilators: Could be used for extremely ill patients (intubated, on deep sedation).
- BiPAP machines attached to ET tubes:

  Could be used for patients who are close to weaning off ventilation.
- Automatic resuscitator:

  Might be used for patients intubated for non-pulmonary reasons (patients with normal lungs).

Liberation from Mechanical Ventilator

Mechanically Ventilated Patient

Readiness testing for Weaning

Clinical Criteria
Weaning Predictors
Integrated Indices

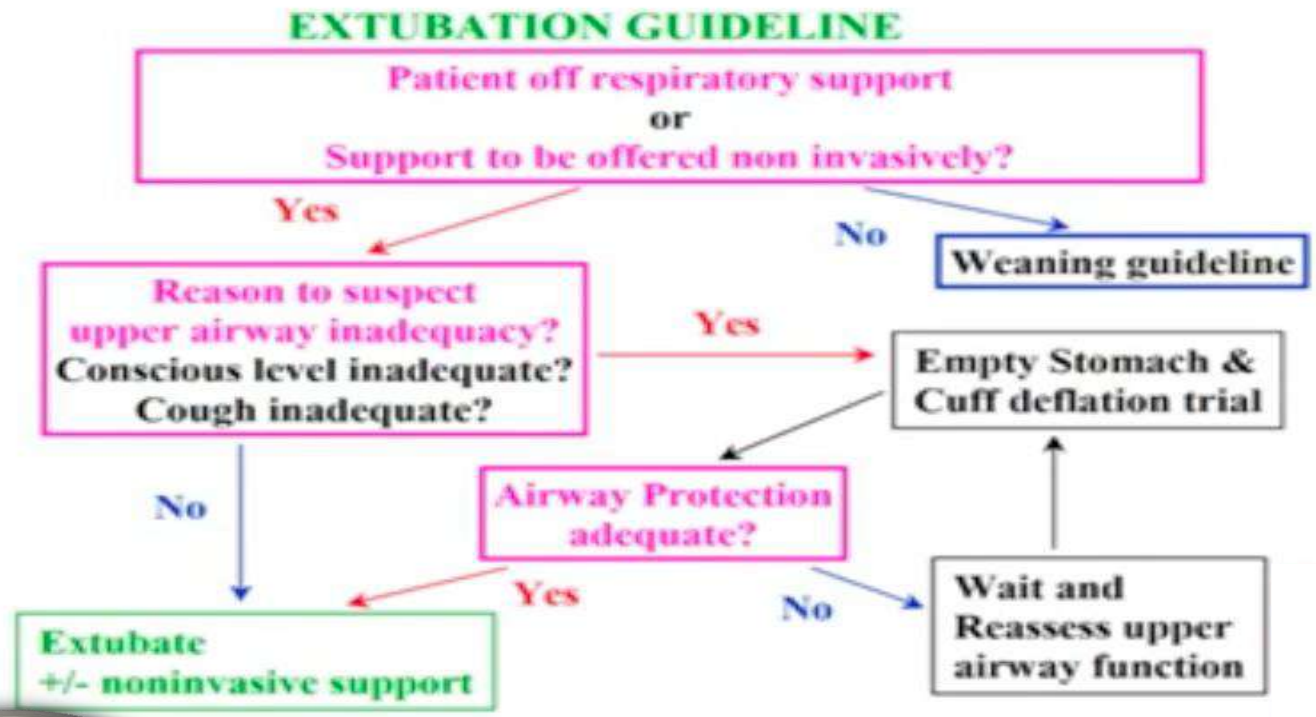
Qualifies For Weaning

Weaning Trial

*SBT: low PS vs. T-piece

Weaning Trial ?

Extubation


EXTUBATION GUIDELINE
Patient off respiratory support
or
Support to be offered non invasively?
Yes
No
Weaning guideline
Reason to suspect
upper airway inadequacy?
Conscious level inadequate?
Cough inadequate?
Yes
Empty Stomach &
Cuff deflation trial
No
Airway Protection
adequate?
Yes
No
Wait and
Reassess upper
airway function
Extubate
+/- noninvasive support

Precautions during Extubation

- Plan for gentle extubation
- Avoid open tracheal suction during extubation
- *History < 2 weeks: take all precautions*
- *History > 2 weeks may be treated as non COVID*

(Consider Viral load)

Prevention of complications

- These interventions are based on Surviving Sepsis or other guidelines

Anticipated outcome :	Interventions
❖Reduce days of invasive mechanical ventilation	❖Weaning protocols ❖ Minimise continuous or intermittent sedation
❖Reduce incidence of ventilator associated pneumonia	❖Oral intubation is preferable to nasal intubation ❖Semi-recumbent position (head of bed elevation 30-45º) ❖ New ventilator circuit for each patient ❖Change heat moisture exchanger every 5-7days.

Prevention of complications

- These interventions are based on Surviving Sepsis or other guidelines

Anticipated outcome :	Interventions
❖Reduce incidence of venous thromboembolism	• Use pharmacological prophylaxis (low molecular-weight heparin 5000 IU BD ❖ mechanical prophylaxis (intermittent pneumatic compression devices)
❖Reduce incidence of catheter related bloodstream infection	❖daily reminder to remove catheter if no longer needed

Prevention of complications

- **These interventions are based on Surviving Sepsis or other guidelines**

Anticipated outcome :	Interventions
❖Reduce incidence of pressure	❖Turn patient every two hours
❖Reduce incidence of stress ulcers and gastrointestinal bleeding	❖early enteral nutrition (within 24–48 hours of admission) ❖ Administer histamine-2 receptor blockers or proton-pump inhibitors
❖Reduce incidence of ICU related weakness	❖Actively mobilize the patient early in the course of illnes

Psychosocial spiritual nursing care

- Smile!
- Communicate, communicate, communicate!!
- Connect with loved ones through a device – tab, mobile etc : works wonders.
- Address pain, agitation & delirium
- Ensure sleep and rest with scheduling

ICU preparation

COVID designated area

Designated donning area

Safe cleaning & disinfection

N95 respirators

Safe doffing space

High Efficiency Particulate Air Filter (HEPA) filter

Negative pressure rooms with minimum 12 air changes / hr OR 160 L / sec / patient

Rational Use of PPE in ICU

S.No	Setting	Activity	Risk	Recommended PPE	Remarks
1	ICU	Critical Care Management	High Risk	Full complement of PPE	Aerosol generating activities performed
2	ICU	Dead body packing	High Risk	Full complement of PPE	
3	ICU	Dead body transport to mortuary	Low Risk	Triple layer medical mask Gloves	

CONCLUSION

- **Communicate early with patient and family.**
- **If possible families to be communicated using web based plat forms like zoom or watsapp video calls inorder to restrict their movement to hospital.**
- **Communicate proactively with patients and families and provide emotional support and prognostic information**
- **Understand the patient’s values and preferences regarding life-sustaining interventions**