



# Hemodynamic stability of COVID Patients in Shock and ARDS

**Prof. Dr. Manoranjan Pattnaik**

**Dr. Thitta Mohanty, Assoc. Professor**

**Dr. Jeetendra Kumar Patra, Asst. Professor**

**Department of Pulmonary Medicine,**

**SCB MCH Cuttack**

**COVID-19 CRITICAL CARE**

**TRAINING PROGRAMME**

# CASE DEFINITION :

## When to suspect

- All symptomatic individuals who have undertaken international travel in the last 14 days  
*or*
- All symptomatic contacts of laboratory confirmed cases  
*or*
- All symptomatic healthcare personnel (HCP)  
*or*
- All hospitalized patients with severe acute respiratory illness ( SARI) (fever AND cough and/or shortness of breath)  
*or*
- Asymptomatic direct and high risk contacts of a confirmed case (should be tested once between day 5 and day 14 after contact)

*Symptomatic refers to fever/cough/shortness of breath.*

*Direct and high-risk contacts include those who live in the same household with a confirmed case and HCP who examined a confirmed case.*

## Confirmed case

A person with laboratory confirmation of COVID-19 infection, irrespective of clinical signs and symptoms

# **Clinical syndromes associated with COVID - 19 infection**

**Uncomplicated illness - non-specific symptoms such as**

- **Fever**
- **Cough**
- **Sore throat**
- **Nasal congestion**
- **Malaise**
- **Headache**
- **Myalgia.**

➤ **Mild pneumonia (adults)-**

- **Evidence of pneumonia**
- **No signs of severity**

# **Clinical syndromes associated with COVID - 19 infection**

## **➤ Mild pneumonia (child)-**

- No severe pneumonia**
- Cough / difficulty in breathing**

**(fast breathing-in breaths /min.)**

**< 2 months  $\geq$  60**

**2 – 11 months  $\geq$  50**

**1 – 5 years  $\geq$  40**

# **Clinical syndromes associated with COVID - 19 infection**

## **➤ Severe pneumonia (adult)-**

**Fever / suspected respiratory infection plus one of the following**

- Respiratory rate (>30 breath/min.)**
- Severe respiratory distress**
- SpO<sub>2</sub> <90% in room air.**

# **Clinical syndromes associated with COVID - 19 infection**

**Cough / difficulty in breathing plus atleast one of the following**

- **Central cyanosis / SpO<sub>2</sub> <90%**
- **Severe respiratory distress (exp. Grunting, chest indrawing**

**Signs of pneumonia with any of the following danger signs.**

- **Inability to breast feed or drink**
- **Lethargy / Un-consciousness**
- **Convulsions**

**Cough / difficulty in breathing (fast breathing-in breaths /min.)**

**< 2 months  $\geq$  60**

**2-11months  $\geq$  50**

**1 – 5 years  $\geq$  40**

# Clinical syndromes associated with COVID - 19 infection

## ➤ Acute Respiratory Distress Syndrome-

**Table 3.** The Berlin Definition of Acute Respiratory Distress Syndrome

Acute Respiratory Distress Syndrome	
Timing	Within 1 week of a known clinical insult or new or worsening respiratory symptoms
Chest imaging <sup>a</sup>	Bilateral opacities—not fully explained by effusions, lobar/lung collapse, or nodules
Origin of edema	Respiratory failure not fully explained by cardiac failure or fluid overload Need objective assessment (eg, echocardiography) to exclude hydrostatic edema if no risk factor present
Oxygenation <sup>b</sup>	
Mild	$200 \text{ mm Hg} < \text{PaO}_2/\text{FIO}_2 \leq 300 \text{ mm Hg}$ with PEEP or CPAP $\geq 5 \text{ cm H}_2\text{O}$ <sup>c</sup>
Moderate	$100 \text{ mm Hg} < \text{PaO}_2/\text{FIO}_2 \leq 200 \text{ mm Hg}$ with PEEP $\geq 5 \text{ cm H}_2\text{O}$
Severe	$\text{PaO}_2/\text{FIO}_2 \leq 100 \text{ mm Hg}$ with PEEP $\geq 5 \text{ cm H}_2\text{O}$

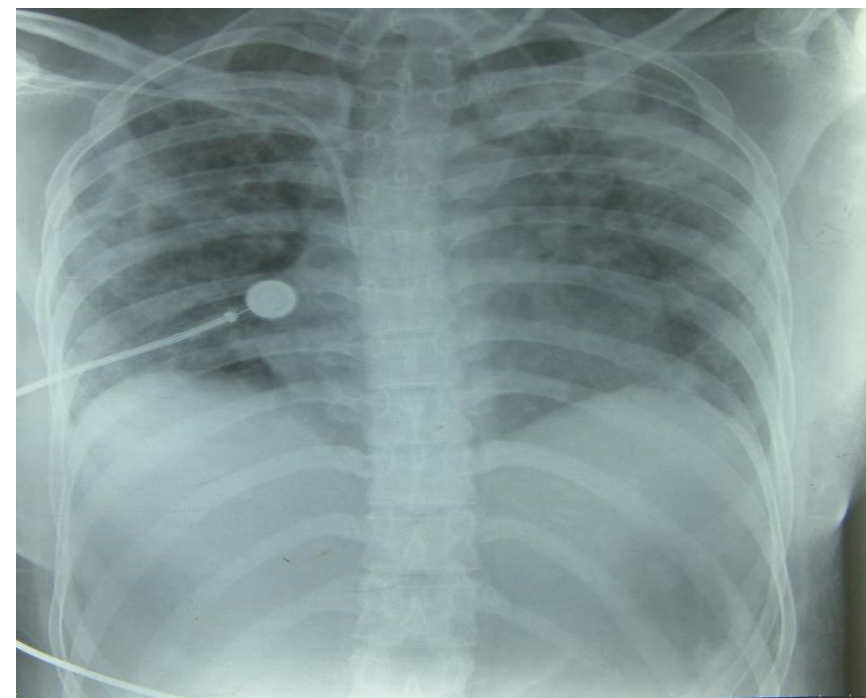
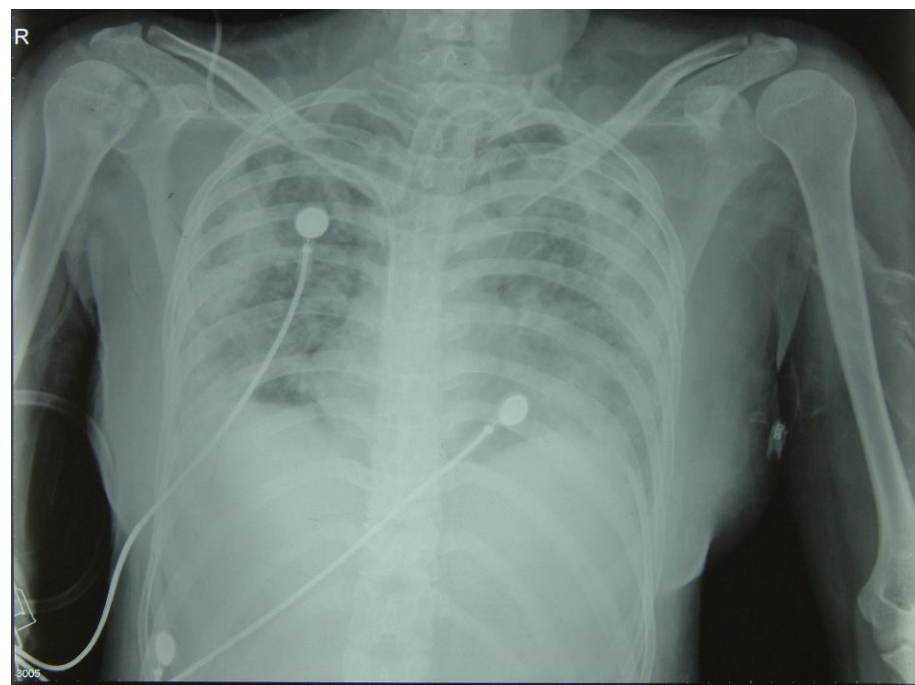
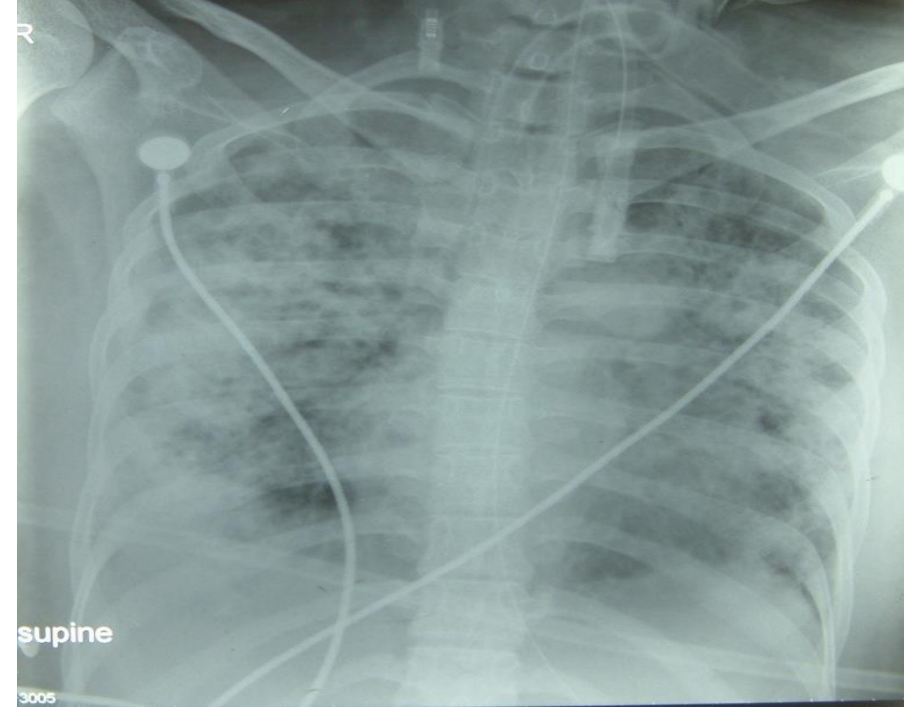
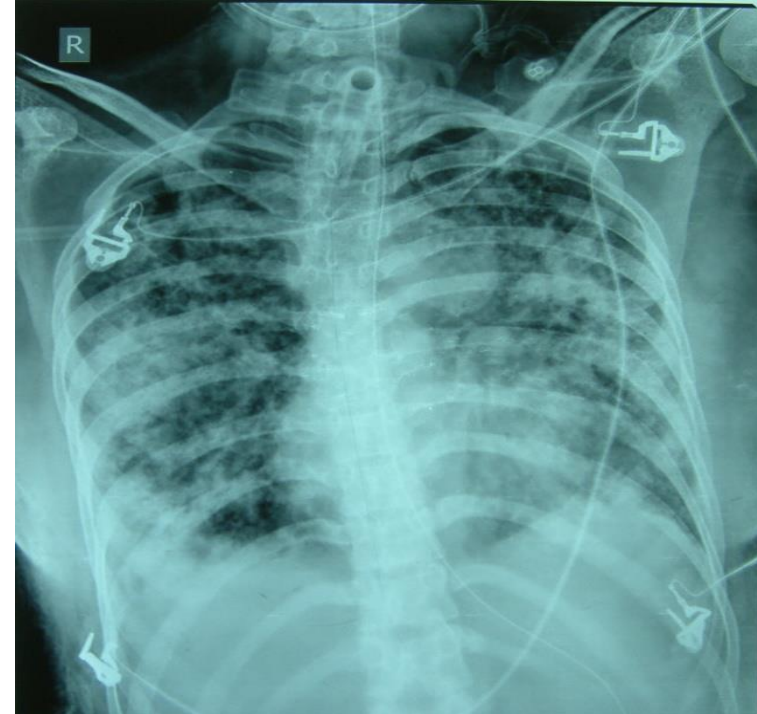
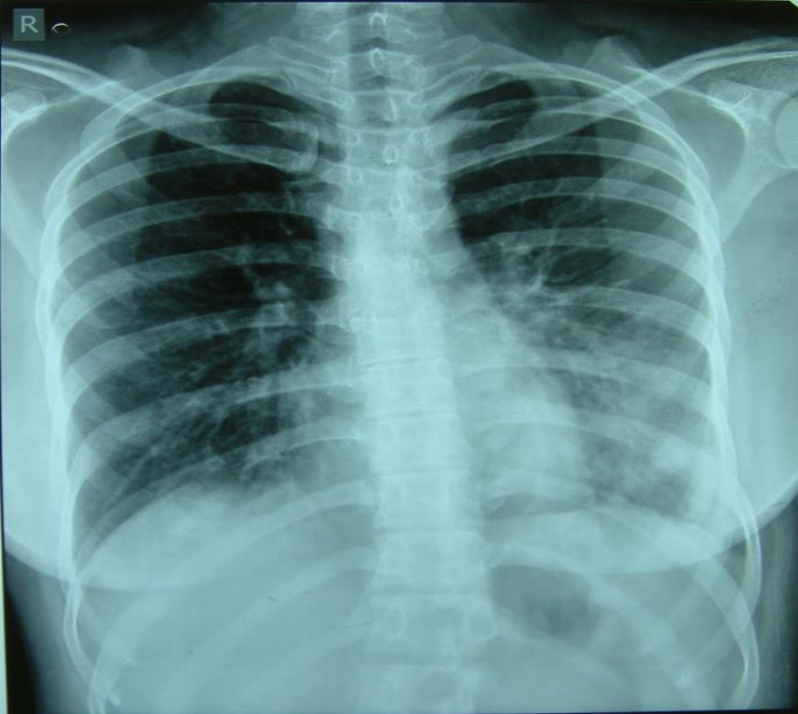
Abbreviations: CPAP, continuous positive airway pressure; FIO<sub>2</sub>, fraction of inspired oxygen; PaO<sub>2</sub>, partial pressure of arterial oxygen; PEEP, positive end-expiratory pressure.

<sup>a</sup>Chest radiograph or computed tomography scan.

<sup>b</sup>If altitude is higher than 1000 m, the correction factor should be calculated as follows:  $[\text{PaO}_2/\text{FIO}_2 \times (\text{barometric pressure}/760)]$ .

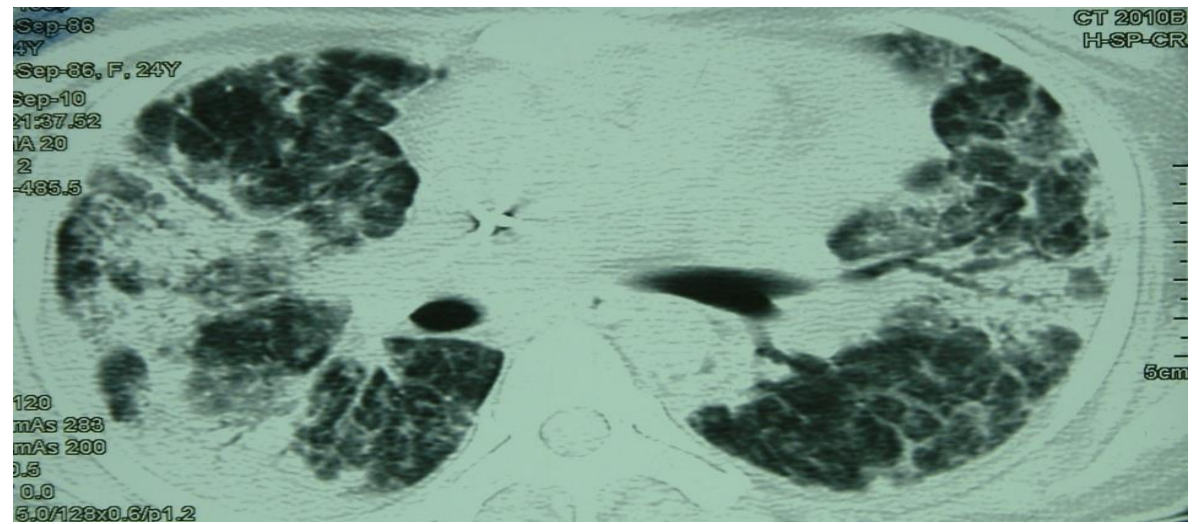
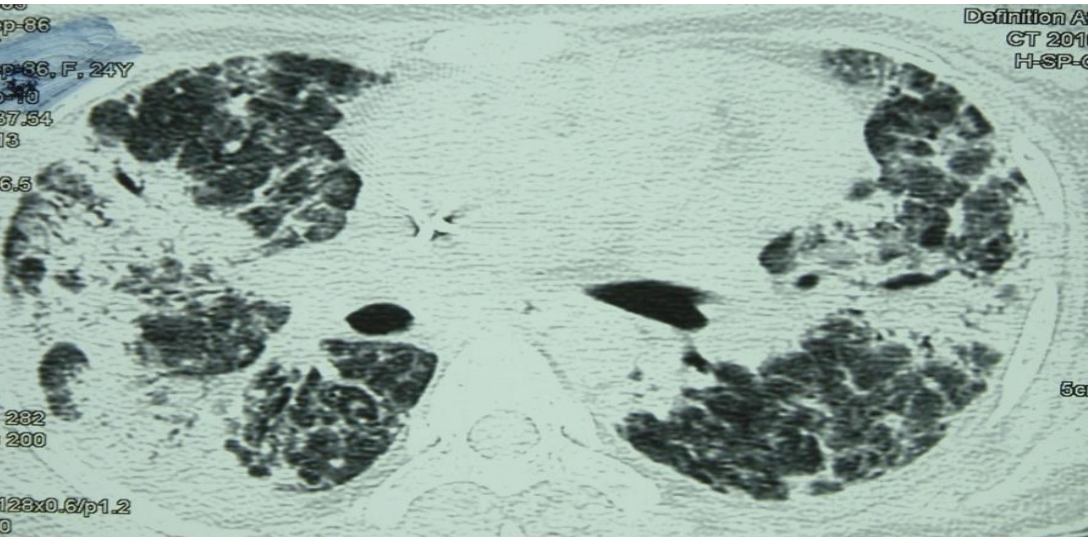
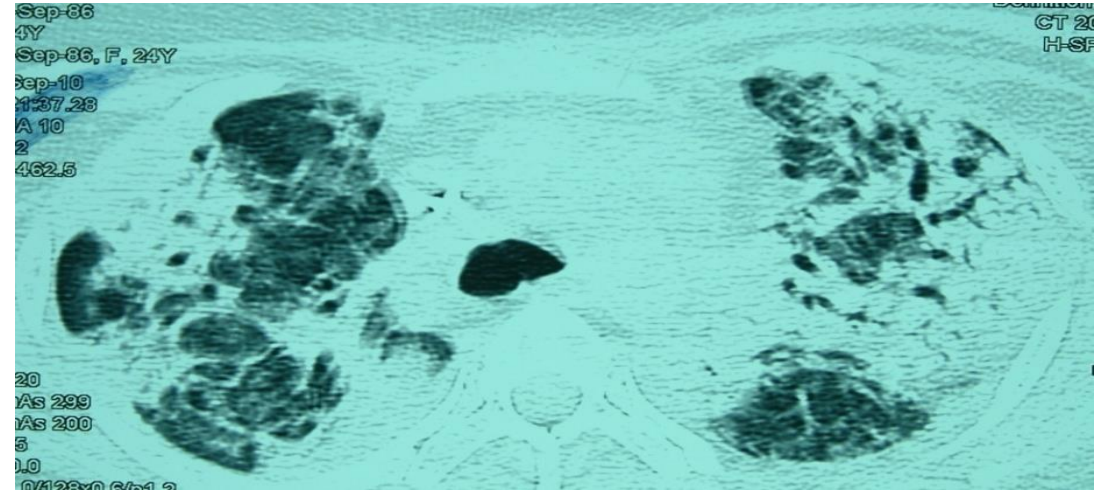
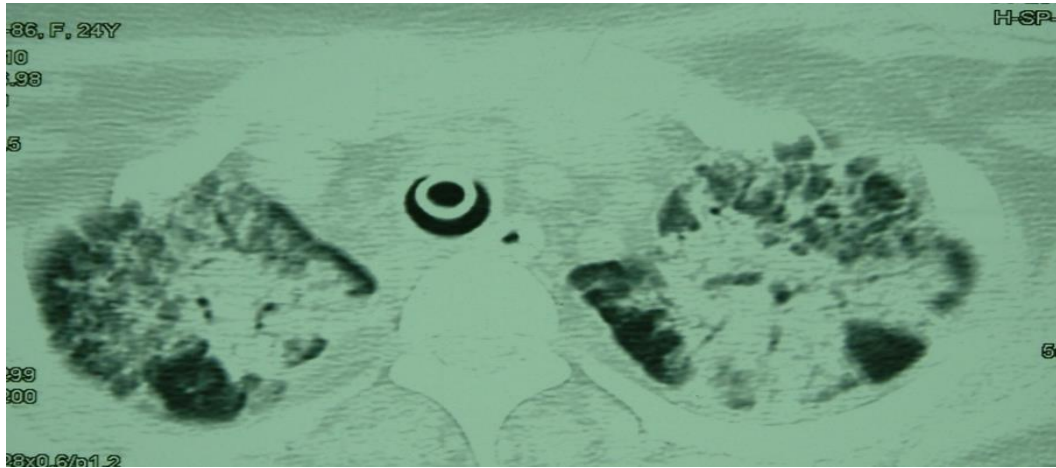
<sup>c</sup>This may be delivered noninvasively in the mild acute respiratory distress syndrome group.







# HRCT Thorax



# **Clinical syndromes associated with COVID - 19 infection**

**SEPSIS (Adult) :- life-threatening organ dysfunction to suspected or proven infection**

## **Organ Dysfunction**

- ❖ **Mental Status**
- ❖ **Fast breathing**
- ❖ **Decrease SpO<sub>2</sub>**
- ❖ **Decrease Urine Output**
- ❖ **Increased Heart Rate**
- ❖ **Weak pulse**
- ❖ **Decreased BP**
- ❖ **Skin mottling**

## **Laboratory findings**

- ❖ **Coagulopathy**
- ❖ **Thrombocytopenia**
- ❖ **Acidosis**
- ❖ **Increase Lactate**
- ❖ **Increase Bilirubin**

# **Clinical syndromes associated with COVID - 19 infection**

**SEPSIS (Child) :-**

**Suspected or proven infection  
≥ 2 SIRS Criteria  
or which one must be abnormal  
temperature or white blood cell count.**

# **SIRS (Systemic Inflammatory Response Syndrome)**

**Two or more of:**

**Temperature  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$**

**Heart rate  $>90/\text{min}$**

**Respiratory rate  $>20/\text{min}$  or  $\text{PaCO}_2 <32 \text{ mm Hg}$   
(4.3 kPa)**

**White blood cell count  $>12\,000/\text{mm}^3$  or  
 $<4000/\text{mm}^3$  or  $>10\%$  immature bands**

# **Clinical syndromes associated with COVID - 19 infection**

**Septic shock (Adult) :-**

- ❑ persisting hypotension despite volume resuscitation,**
- ❑ Requiring vasopressors to maintain MAP  $\geq 65$  mmHg**
- ❑ Serum lactate level  $< 2$  mmol/L**

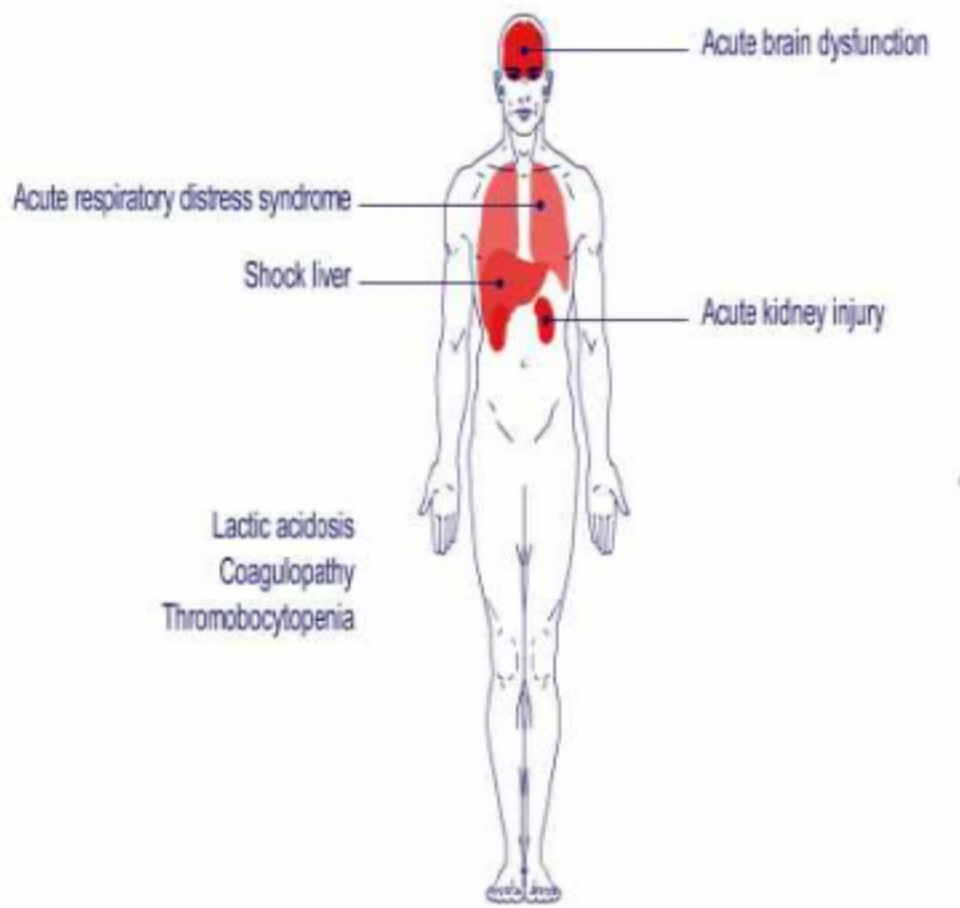


# Clinical syndromes associated with COVID - 19 infection

## ➤Septic shock (Child) :-

Hypotension (SBP <5th centile or >2 SD below normal for age) or 2- 3 of the following:

- Altered mental state
- Bradycardia or tachycardia (HR <90 bpm or >160 bpm in infants and HR <70 bpm or >150 bpm in children); or capillary refill (>2 sec)/ warm vasodilation with bounding pulses;
- Tachypnea;
- Mottled skin or petechial or purpuric rash;
- Increased lactate;
- Oliguria;
- Hyperthermia or hypothermia



- **Brain**
  - confusion, lethargy, coma
- **Lungs**
  - hypoxemia, acute respiratory distress syndrome
- **Cardiovascular**
  - hypotension, hypoperfusion, shock
- **Kidney**
  - oliguria, elevated creatinine, acute kidney injury
- **Liver**
  - transaminitis, elevated bilirubin
- **Gastrointestinal**
  - ileus
- **Hematologic**
  - coagulopathy, thrombocytopenia
- **Lactic acidosis**

# Contact precautions

- **Use PPE (medical mask, eye protection, gloves and gown) when entering room and remove PPE when leaving**
- **Use either disposable or dedicated equipment (e.g. stethoscopes, blood pressure cuffs and thermometers). Instruments should be disinfected using 70% alcohol swabs or hypochlorite solutions before and after each use , if these instruments need to be shared.**
- **Avoid contaminating environmental surfaces that are not directly related to patient care (e.g. door handles and light switches). Ensure adequate room ventilation. Avoid movement of patients or transport. Perform hand hygiene**

# Management

- **Immediate implementation of IPC measures**
- **Early supportive therapy & monitoring**
- **Collection of specimens for Laboratory Diagnosis**
- **Management of septic shock**
- **Management of Respiratory Failure & ARDS**
- **Prevention of complications**

# Shock in COVID-19 – what we know so far..



- Shock in COVID –
  - 1-5% patients
  - 20-35% of ICU patients
- Type of shock !
  - Septic/cardiogenic
  - Cardiac injury 7-23% patients (China, JAMA 2020)
  - Shock (?myocarditis) as cause of death in 40% patients in ICU (China, Int Care Med 2020)



## What we need to know..



- Risk factors for development of shock?
- Prognosis of COVID-19 with shock?
- Early detection of Myocardial injury (↑ troponin) or cardiac dysfunction (Echo) – affect prognosis?
- More evidence on hemodynamic management

Meanwhile

Management extrapolated from Non COVID patients

# Volume status - IVC



AIIMS, New Delhi



शरीरमाद्यं खलु धर्मसाधनम्

# IVC



शरीरमाद्यं खलु धर्मसाधनम्



AIIMS, New Delhi

# **Management of Septic shock**

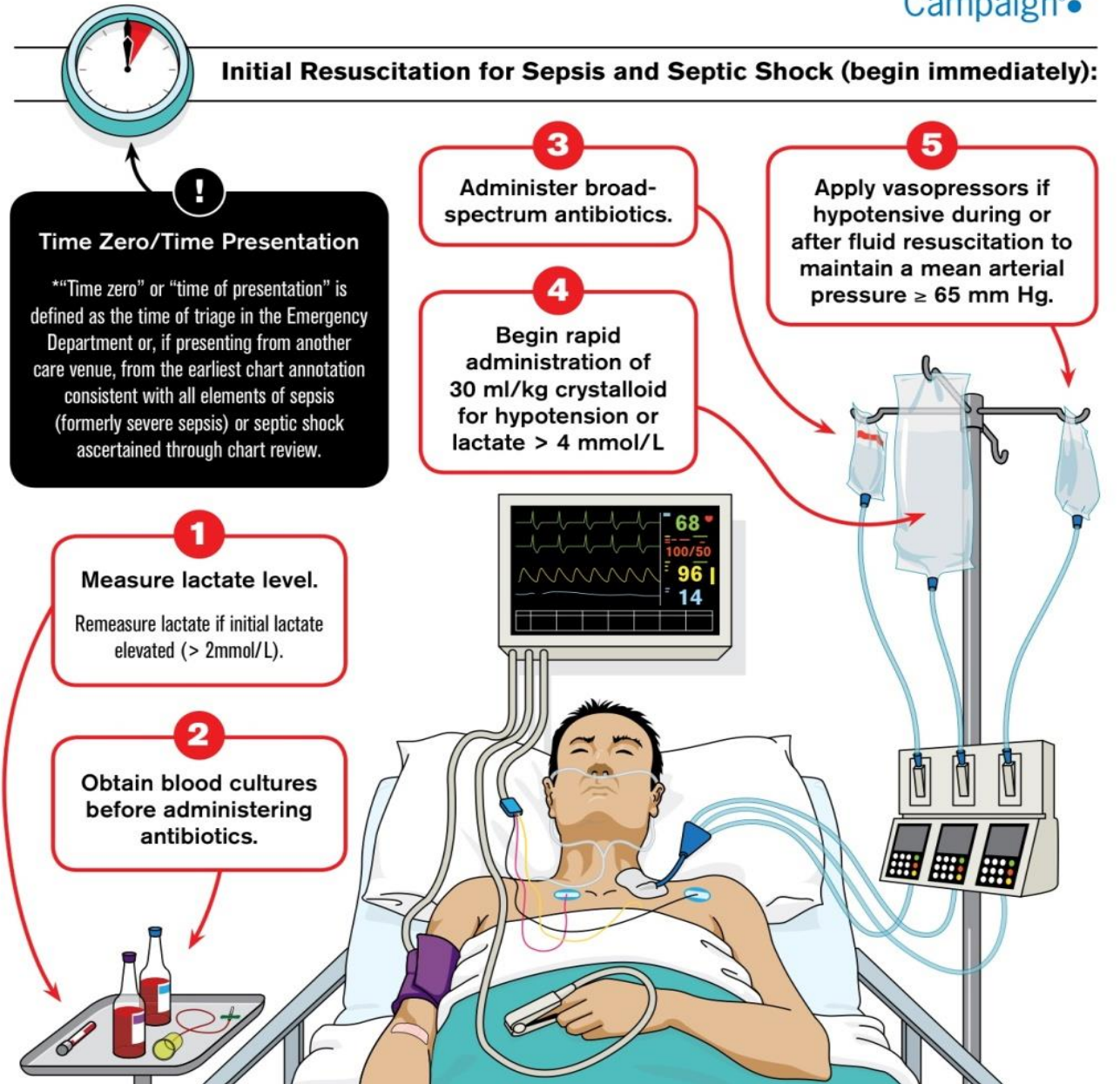
- ❑ Recognize septic shock in adults when infection is suspected or confirmed AND vasopressors are needed to maintain mean arterial pressure (MAP)  $\geq 65$  mmHg AND lactate is  $< 2$  mmol/L, in absence of hypovolemia.**
- ❑ Fluid resuscitation : Adult : 30ml /kg.**
- ❑ Isotonic crystalloids (NS / RL)  $< 3$ hrs.**
- ❑ Don't use hypotonic crystalloids (Hydroxy ethyl starch)**
- ❑ Avoid volume overload**
- ❑ Administer central venous catheter & measure central venous pressure**

# Management of Septic shock

1. Measure lactate level
2. Obtain blood cultures before administering Antibiotics.
3. Administer broad-spectrum antibiotics.
4. Begin rapid administration of 30ml/kg crystalloid for hypotension or lactate >4 mmol/L.
5. Apply vasopressors if hypotensive during or after fluid resuscitation to maintain a mean arterial pressure  $\geq$  65mm Hg.

## Hour-1 Bundle

Surviving Sepsis Campaign





# **Management of Septic shock**

- ❑ Judicious use of norepinephrine, epinephrine, vasopressin, dopamine.**
- ❑ Reserved dopamine for selected patients with low risk of tachyarrhythmia or bradycardia.**
- ❑ Monitor :    MAP, Urine output >0.5ml/ kg. per hour.  
                  Skin mottling , consciousness, lactate.**

# **Management of Septic shock**

- ❑ Other therapeutic measures : to decrease the body's inflammatory response, glucocorticoids can be used for a short period of time (3 to 5 days)**
- ❑ dose should not exceed the equivalent of methylprednisolone 1 – 2mg/kg/day**
- ❑ larger dose of glucocorticoid will delay the removal of coronavirus due to immunosuppressive effects**

## Admit in Hospital when..

- Tachypnea ( $RR > 24/\text{min}$ )
- $SpO_2 < 94\%$  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 disease

# Early Supportive Therapy and Monitoring

**Supplemental oxygen therapy :-**

- **Candidate** : **SARI with respiratory distress**  
**Hypoxemia**  
**Shock**
- **Method** : **5ml / min., oxygen mask**
- **Target SpO<sub>2</sub>** : **≥ 90%**                    **non-pregnant adult**  
**≥ 90-95%**                    **pregnant adult**  
**≥ 94%**                         **children**

**Keep ready pulse oximeter, functioning oxygen system, nasal cannula, simple face mask, mask with reservoir.**

# **Early Supportive Therapy and Monitoring**

## **ANTIMICROBIALS**

- **Empiric administration covering like pathogens**
- **In sepsis introduce in first hour**
- **Consider CAP, HCAP, Sepsis**
- **Local epidemiology, susceptibility data**
- **Can cover Neuraminidase inhibitor for influenza**

**CONSERVATIVE FLUID MANAGEMENT IF NO SHOCK**

# **Early supportive therapy and monitoring**

- **Understand the patient's co-morbid condition(s) to tailor the management of critical illness and appreciate the prognosis**
- **During intensive care management of SARI, determine which chronic therapies should be continued and which therapies should be stopped temporarily**
- **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**



# **Collection of specimens for laboratory diagnosis**

- **Collect blood cultures for bacteria that cause pneumonia and sepsis, ideally before antimicrobial therapy.**
- **DO NOT delay antimicrobial therapy to collect blood cultures**
- **Collect specimens from BOTH the upper respiratory tract (URT; nasopharyngeal and oropharyngeal) AND lower respiratory tract (LRT; expectorated sputum, endotracheal aspirate, or bronchoalveolar lavage) for nCoV testing by RT-PCR**
- **Clinicians may elect to collect only LRT samples when these are readily available (for example, in mechanically ventilated patients)**

# **Management of hypoxemic respiratory failure & ARDS**

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

- **FiO<sub>2</sub> (0.60 to 0.95)**
- **High-flow nasal catheter oxygenation**
- **Non-invasive ventilation (BI-PAP)**
- **Low risk of air borne transmission**
- **Close monitoring**

# Management of hypoxemic respiratory failure & ARDS

## Non-invasive ventilation (BI-PAP) :-

- Beneficial in cardiogenic pulmonary edema
- Pandemic viral illness
- Improves alveolar ventilation
- Recruits alveoli & increases FRC to reverse hypoxia
- Reduces work of breathing

## NIV should not be used in;

- hemodynamic instability,
- multi-organ failure
- abnormal mental status

**Patients with NIV should be monitor closely as they are prone to desaturate early & endotracheal intubation should always be kept in mind and should not be unduely delyed.**



# 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.**

# NIPPV in COVID

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

AIIMS, New Delhi



शरीरमाद्यं खलु धर्मसाधनम्

# NIPPV in COVID



Face Mask

Vs.



Helmet

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



# 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 used with a one-tube system
    - Filter may be attached directly to the mask.
- Helmet masks might theoretically have an advantage here.





# 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> ).*

# **Management of hypoxemic respiratory failure & ARDS**

**Endotracheal intubation :-**

**Indication : Patients with ARDS**  
**Young children**  
**Obese**  
**Pregnancy**  
**Geriatric age group**

- **Pre-oxygenate with 100% FiO<sub>2</sub> for 5 mins. with the help of face mask with reservoir bag , bag-valve mask, HFNO, or NIV**
- **Rapid sequence intubation is appropriate after an airway assessment that identifies no signs of difficult intubation**

# 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



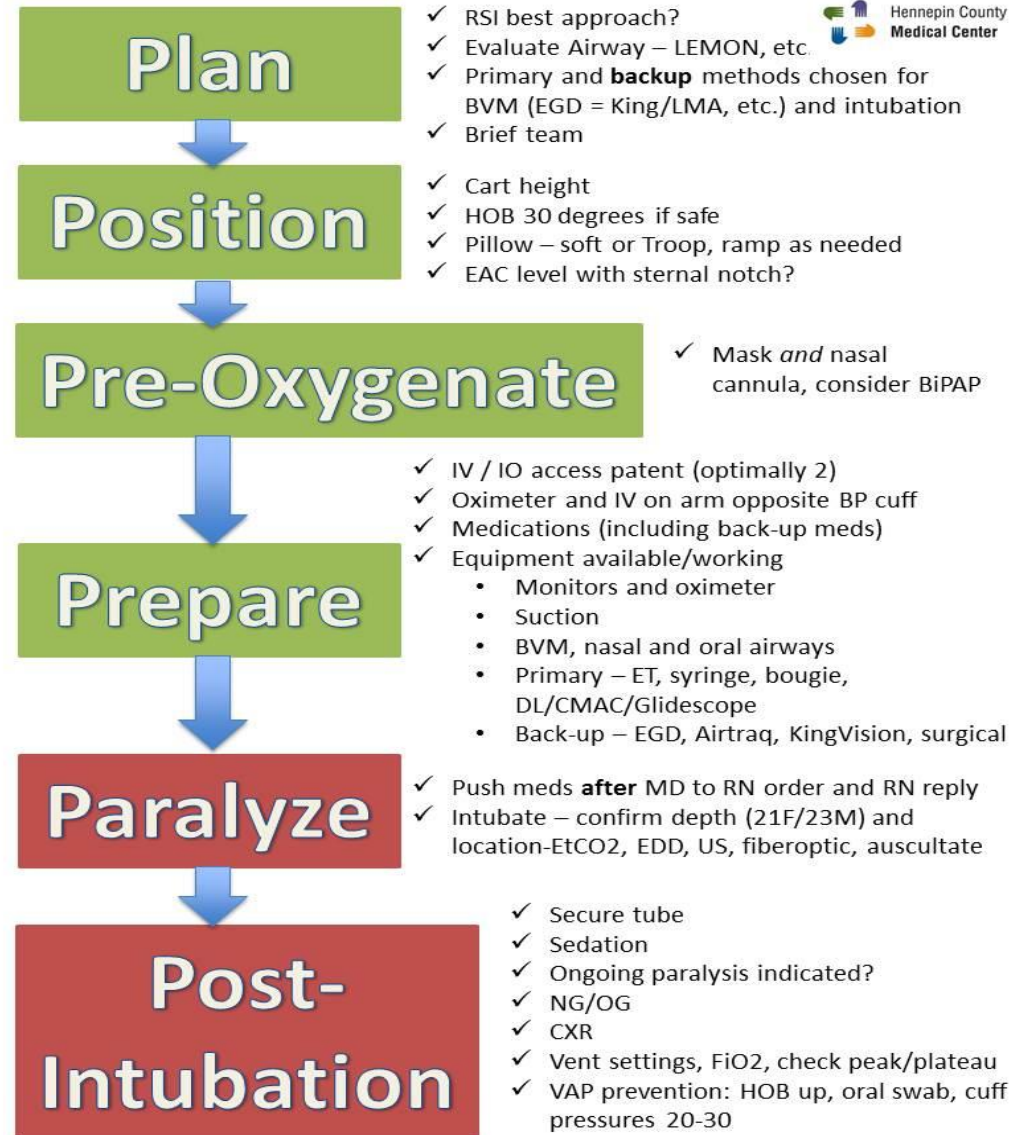


AIIMS, New Delhi

# Management of hypoxemic respiratory failure & ARDS

## Rapid sequence intubation :-

- "Rapid Sequence Intubation (RSI) is the administration of a potent sedative followed immediately by a rapidly acting neuromuscular blocking agent that produces rapid unconsciousness and motor paralysis to facilitate endotracheal intubation."





# Management of hypoxemic respiratory failure & ARDS

## Ventilation strategy in ARDS :-

Table 23.4 Protocol for Lung Protective Ventilation in ARDS	
I. 1st Stage	<ol style="list-style-type: none"><li>1. Calculate patient's <b>predicted</b> body weight (PBW)<sup>†</sup>. Males: <math>PBW = 50 + [2.3 \times (\text{height in inches} - 60)]</math> Females: <math>PBW = 45.5 + [2.3 \times (\text{height in inches} - 60)]</math></li><li>2. Set initial tidal volume (<math>V_T</math>) at 8 mL/kg PBW.</li><li>3. Add positive end-expiratory pressure (PEEP) of 5 cm H<sub>2</sub>O.</li><li>4. Select the lowest FiO<sub>2</sub> that achieves an SpO<sub>2</sub> of 88–95%.</li><li>5. Reduce <math>V_T</math> by 1 mL/kg every 2 hours until <math>V_T = 6</math> mL/kg.</li></ol>
II. 2nd Stage	<ol style="list-style-type: none"><li>1. When <math>V_T = 6</math> mL/kg, measure plateau pressure (Ppl).</li><li>2. If Ppl &gt; 30 cm H<sub>2</sub>O, decrease <math>V_T</math> in 1 mL/kg increments until Ppl &lt; 30 cm H<sub>2</sub>O or <math>V_T = 4</math> mL/kg.</li></ol>
III. 3rd Stage	<ol style="list-style-type: none"><li>1. Monitor arterial blood gases for respiratory acidosis.</li><li>2. If pH = 7.15–7.30, increase respiratory rate (RR) until pH &gt; 7.30 or RR = 35 bpm.</li><li>3. If pH &lt; 7.15, increase RR to 35 bpm. If pH is still &lt; 7.15, increase <math>V_T</math> in 1 mL/kg increments until pH &gt; 7.15.</li></ol>
IV. Optimal Goals	$V_T = 6$ mL/kg, Ppl ≤ 30 cm H <sub>2</sub> O, SpO <sub>2</sub> = 88–95%, pH = 7.30–7.45

Adapted from the protocol developed by the ARDS Network, available at [www.ardsnet.org](http://www.ardsnet.org).

<sup>†</sup>Predicted body weight is the weight associated with normal lung volumes.

## Care of COVID patient on Mechanical Ventilation : Suctioning

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





**AIIMS, New Delhi**

## 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

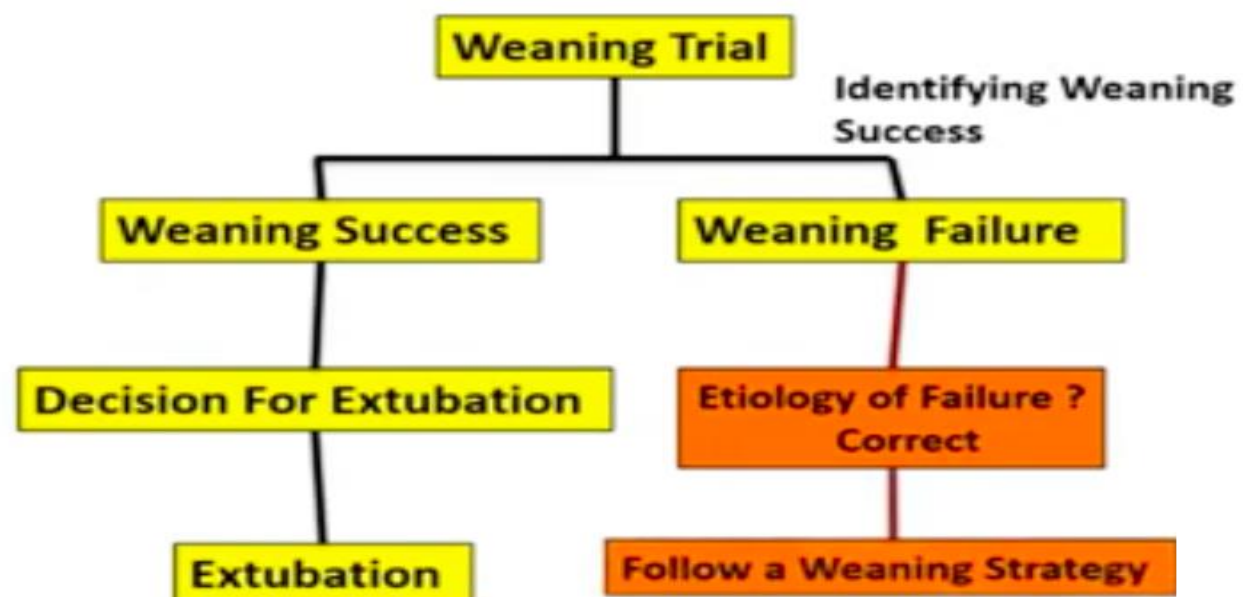
- **Suggest** prone ventilation for 12- 14 hrs.
- Decrease Mortality

# ECMO

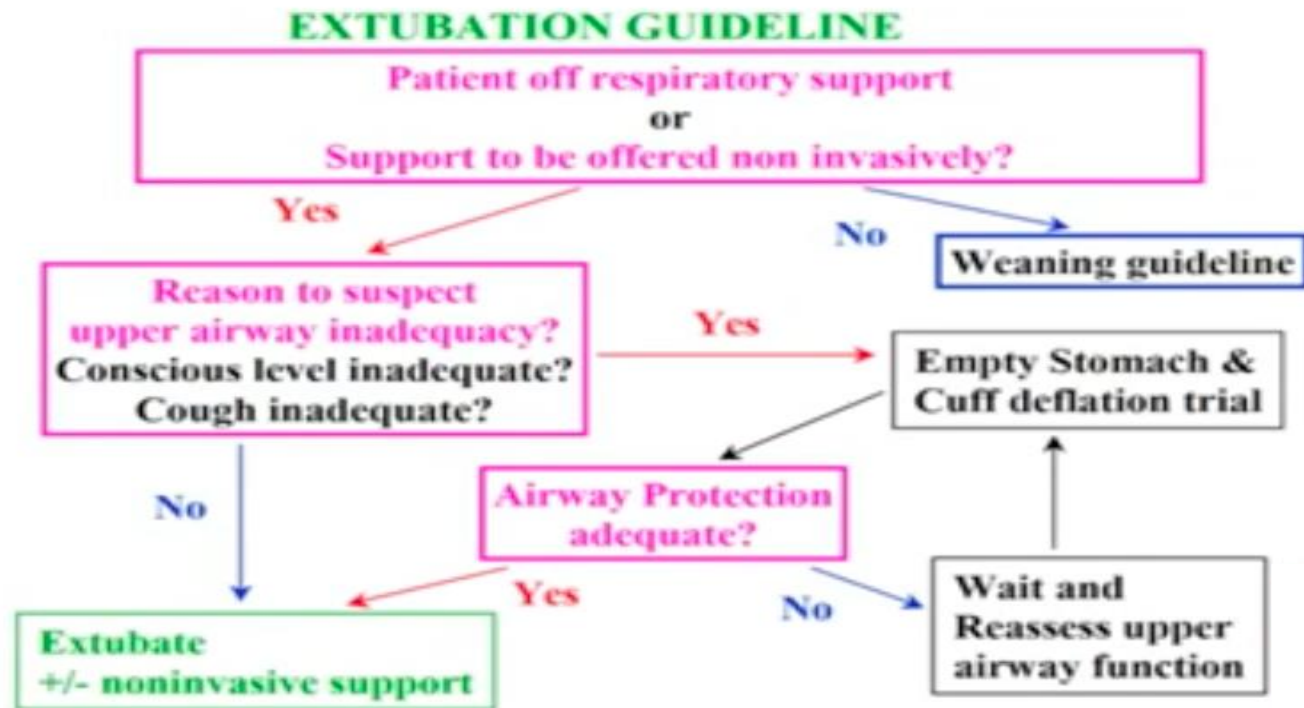
- **Suggest** using venovenous (VV) ECMO if available:
  - Refractory hypoxemia despite optimizing ventilation
  - Use of rescue therapies, and proning
- Referring the patient to an ECMO center
- *Economical & Ethical issues*



# Weaning Trial ?



# Extubation



# 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

❖ Reduce incidence of ventilator associated pneumonia

❖ Weaning protocols

❖ Minimise continuous or intermittent sedation

❖ Oral intubation is preferable to nasal intubation

❖ Semi-recumbent position (head of bed elevation 30-45°)

❖ 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 :**

❖ **Reduce incidence of venous thromboembolism**

❖ **Reduce incidence of catheter related bloodstream infection**

**Interventions**

❖ **Use pharmacological prophylaxis (low molecular-weight heparin**

❖ **mechanical prophylaxis (intermittent pneumatic compression devices)**

❖ **daily reminder to remove catheter if no longer needed**

# Prevention of complications

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

## **Anticipated outcome :**

❖ **Reduce incidence of pressure**

❖ **Reduce incidence of stress ulcers and gastrointestinal bleeding**

❖ **Reduce incidence of ICU related weakness**

## **Interventions**

❖ **Turn patient every two hours**

❖ **early enteral nutrition (within 24–48 hours of admission)**

❖ **Administer histamine-2 receptor blockers or proton-pump inhibitors**

❖ **Actively mobilize the patient early in the course of illness**

# Take Home

- Follow a systematic approach for respiratory support
- HFNC is better than NIPPV
- Consider Awake prone positioning
- Standard ARDS management protocols to be followed
- Avoid aerosol generating interventions
- Prepare for disaster ventilation management
- Follow standard weaning & extubation protocols



# Summary

- Early identification of high risk cases
- Main stay - Supportive and symptomatic therapy
- Aerosol prevention and infection control
- Mechanical ventilation strategy
- Hemodynamic support
- General ICU care - Prevention of complication
- Drug and adjunction therapy in evolution

THANK YOU