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Ministry of Health

Mechanical Ventilation Protocol for COVID-19

I. Background

Corona Virus Disease 2019 (COVID-19) is a novel strain of the corona virus family, since the first appearance of the disease in Wuhan, China December2019.The virus has proven to be highly infectious affecting more than 4 million cases worldwide. 5-10% of the infected patients require critical care admission and assort of respiratory support ranging from high flow nasal cannula (HFNC) to the invasive mechanical ventilation.

II. Aim & Scope

- To provide clinical practice guideline for the mechanical ventilated patients withCOVID-19.
- Standardize and optimize the use of the mechanical ventilator in patient with COVID19
- Maximize the benefit of the mechanical ventilator in patient with COVID19
- Provide objective parameter for intubation and ventilation of COVID19 patients

III. Targeted population

COVID 19 patents with respiratory failure.

IV. Targeted end users and targeted setup

Critical care physician, Emergency physicians, respiratory care practitioners, Critical care departments, intermediate care departments and emergency departments.

V. Conflict of interest:

None

VI. Funding:

None

VII. Methodology:

These recommendations were based on the latest European Society of Intensive Care Medicine (ESICM), survival sepsis Campaign panel guideline on mechanical ventilation along with expert opinions maintaining the best practices guidelines taking in consideration the local resources, cultural variation and the previous local practices and expertise.

VIII. Respiratory Support for COVID 19 patient

1. Supplemental Oxygen

If endotracheal intubation is not indicated and the patient is tolerating supplemental oxygen, do the following:

- **1.1** Closely monitor the patient for worsening in vital signs and work of breathing.
- **1.2** Target peripheral capillary oxygen saturation (SpO2) at92-96%.
- **1.3** Consider awake proning of the patient. (See figure1)
- **1.4** Ensure appropriate infection control recommended precautions are in place as per Saudi centers for disease control (SCDC).
- **1.5** Do not delay endotracheal intubation if the patient's condition worsens.

2. High-Flow Nasal Cannula (HFNC)

If endotracheal intubation is not indicated and the patient is not tolerating supplemental oxygen, consider using high-flow nasal cannula. If this is tolerated, do the following:

- **2.1** Closely monitor the patient for worsening vital signs and work of breathing. Target SpO2 at 92-96%.
- **2.2** Consider awake proning of the patient. As per the protocol figure1.
- **2.3** Ensure appropriate infection control recommended precautions are in place as per SCDC.
- **2.4** Preferable negative pressure room & if not available room with HEPA filter as per SCDC recommendations.
- **2.5** Do not delay endotracheal intubation if the patient's condition worsens.

3. Noninvasive Positive-Pressure Ventilation (NIV)

If endotracheal intubation is not indicated, the patient is not tolerating supplemental oxygen, and the patient is not tolerating high-flow nasal cannula (or it is not available), do the following:

- **3.1** Consider noninvasive positive-pressure ventilation.
- **3.2** Closely monitor the patient at short intervals.
- **3.3** Ensure appropriate infection control recommended precautions are in place as per SCDC.
- **3.4** Preferable negative pressure room & if not available room with HEPA filter as per SCDC recommendations.
- **3.5** Do not delay endotracheal intubation if the patient's condition worsens.

4. Mechanical Ventilation

4.1 Indications:

4.1 Increase work of breathing & sign of organ failure (e.g altered mental status, low BP, Increase lactate, sign of cardiac ischemia)
4.2 Acute hypoxic respiratory failure not responding to HFNC nor NIV for maximum of 2 hours.
4.3 Hypoxia with acute decrease level of conscious and cannot protect his airway.
4.4 Hypoxia with large copious secretions.
4.5 Hypercapnic respiratory failure not responding to HFNC nor NIV.
4.6 Hemodynamically unstable
4.7 Consider for patient on HFNC or NIV therapy and for transfer by ambulance.

4.2 Mechanical Ventilations Parameters

Despite COVID-19 pneumonia falling in most of the circumstances under the Berlin definition of ARDS, is unique disease.

DifferentCOVID-19patterns were found at presentation depending on the interaction between three factors:

4.2.1 Severity of the infection, the host response, physiological reserve and comorbidities.
4.2.2 Ventilatory responsiveness of the patient to hypoxemia.
4.2.3 Time elapsed between the onset of the disease and seeking medical advice.

These interactions leads to the development of a time-related disease spectrum within two primary “phenotypes”: Type L, characterized by Low elastance (i.e., high compliance), low ventilation-to-perfusion ratio, low lung weight and low recruitability and Type H, characterized by High elastance, High right-to-left shunt, High lung weight and High recruitability impressive non-uniformity.

According to these classifications, we recommend the following:

1. Volume protected strategy is recommended: Tidal Volume 6-8 mL/Kg (predicted bodyweight), limit plateau pressure (Pplat) to less than30cmH2O, Respiratory Rate15-20per minute, with permissive hypercapnia.

2. Start PEEP with 5-10 cmH2O titrating up and down according to patient’s response.

3. Apply lung protective strategy with following target; SpO2:90-92%, PaO2:60 mmHg, Arterial PH>7.30, Pplat <30cmH20 and driving pressure (ΔP) <15cmH2O.

4. Assess lung strain and recruit-ability, if the driving pressure (Driving pressure=Plateau pressure–PEEP) ΔP<15cmH2O, keep TV the same and if the driving pressure>15 cmH20reduce the TV to achieve the target.

5. Assess pneumonia phenotype by assessing the compliance. (Static Compliance= TV/ Plateau pressure-PEEP).

6. If Respiratory System Compliance ≥ 40mL/cmH2O (L phenotype), consider keeping PEEP 5-10cmH2O.

7. If Respiratory System Compliance<40mL/cmH2O (H phenotype), PEEP titration guided by PEEP/FiO2 tables or Recruitment maneuver. (Don't exceed PEEP 15).

8. Neuromuscular blocking agent to be used as intermittent boluses as needed or for 48Hrs if the PaO2/FiO2 ratio<150 as per ARDS protocol to facilitate lung protective strategy.

9. Daily sedation vacation and assessment of sedation requirement and its depth as per Richmond scale.

10. Prone is recommended for patient with refractory hypoxemia. It should be done for 16hours.

11. In case of refractory hypoxemia consider ECMO for the patient and discuss the case with ECMO team.

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This guide represents the best practice at the time of launching it and it will be updated regularly with any new evidence

Step 1
Assess the need for intubation

Low flow oxygen therapy ± awake proning (*Figure 1*)
Target SpO2 90 - 92% with acceptable work of breathing

Intubate if 1 or more recommended indication

1. **SpO2 < 90-92% on FiO2 0.6 plus High Work of Breathing**
   a. RR 30 breaths per minute
   b. Obvious accessory respiratory muscles use
   c. Paradoxical breathing
2. **Rapid progression of suspected/ confirmed COVID-19disease**
   a. *Clinical*: escalating FiO2 requirements
   b. *Imaging*: >50% worsening over 24 – 48H (CXR, lung U/S or Chest CT)
3. **Evolving hypercapnia**
   a. Arterial pH < 7.3 and PaCO2 >50 mmHg (If COPD – depend only on pH)
4. **Persistent Hemodynamic instability despite resuscitative measures**
5. **Multi-organ failure**
6. **A clinical indication at discretion of the treating physician**

Address code status if appropriate
(consider age, frailty, and comorbidities in your decision)

Targets
SpO2: 90 - 92%
PaO2: *60 mmHg*
Arterial PH > *7.30*
Pplat *< 30 cmH20*
Delt P *< 15 cmH2O*

Initial MV settings:
Volume Control mode
Tidal Volume 8 mL/Kg (PBW)
PEEP 8 cmH2O
RR 15-20

Sedation-analgesia Target RASS -4

Step 2
Asses lung strain and recruitability

Driving pressure P <15 cmH2O

If not shocked at presentation or low dose vasopressors- minimize fluids

POCUS: Obtain lung US and focused ECHO as soon as feasible

Yes → Keep Vt at 8 mL/Kg IBW

No → Vt to 6mL/Kg IBW

PaO2/FiO2 ratio <150

Neuro-Muscular Blockade

Step 3
Assess COVID19 Pneumonia Phenotype

Respiratory System Compliance 40 mL/cmH2O

Yes → ***COVID19 Pneumonitis (L-Phenotype)*** → Prone Position (16h) PEEP 8-10

No → ***COVID19 ARDS (H-Phenotype)*** → PEEP titration guided by PEEP/FiO2 tables or P Recruitment maneuver Prone position (6-16h)

May progress to

Step 4
Rescue Measures

Hypoxemia rerfarctory to prone position 6 hours (or sooner if life-threatening)

Discuss with ECMO Team
ECMO candidate?

Yes → VV-ECMO

No → Review Targets and Strategy

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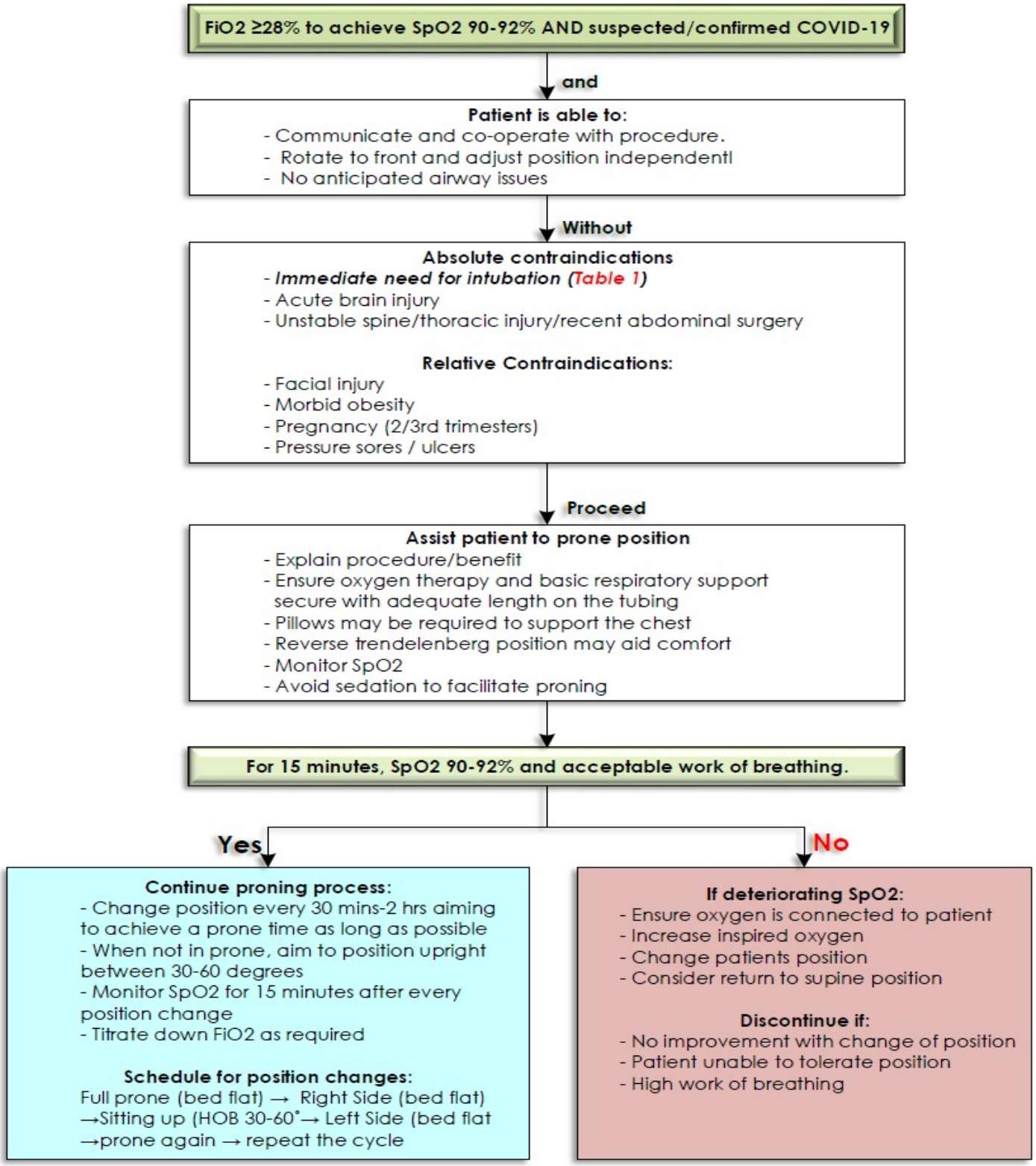
Figure 1. Guide for PRONE POSITION of Awake Patient with COVID 19



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IX. Reference

1. COVID-19Ventilation Clinical Practice Guidelines (ESICM,2020)-Medscape-Apr 07, 2020.

2. Alhazzani W, Muller MH, Arabi YM et al (2020) Surviving Sepsis Campaign: guidelines on the management of critically ill adults with Corona Virus Intensive Care Med. https://doi.org/10.1007/s00134-020-06022-5.

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