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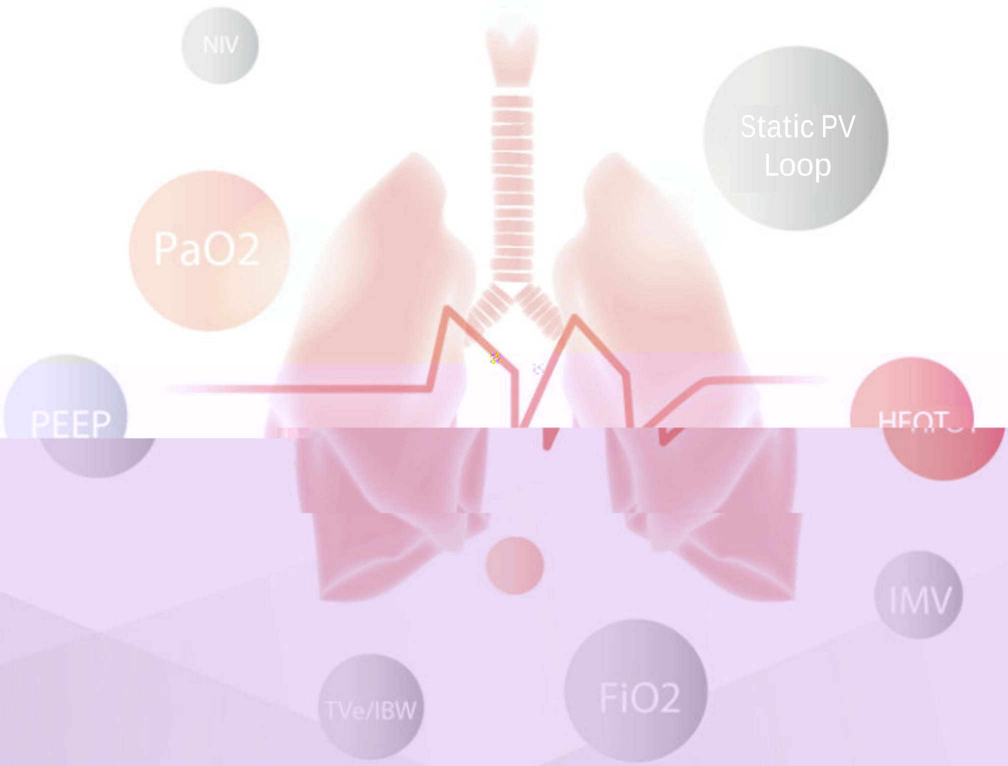
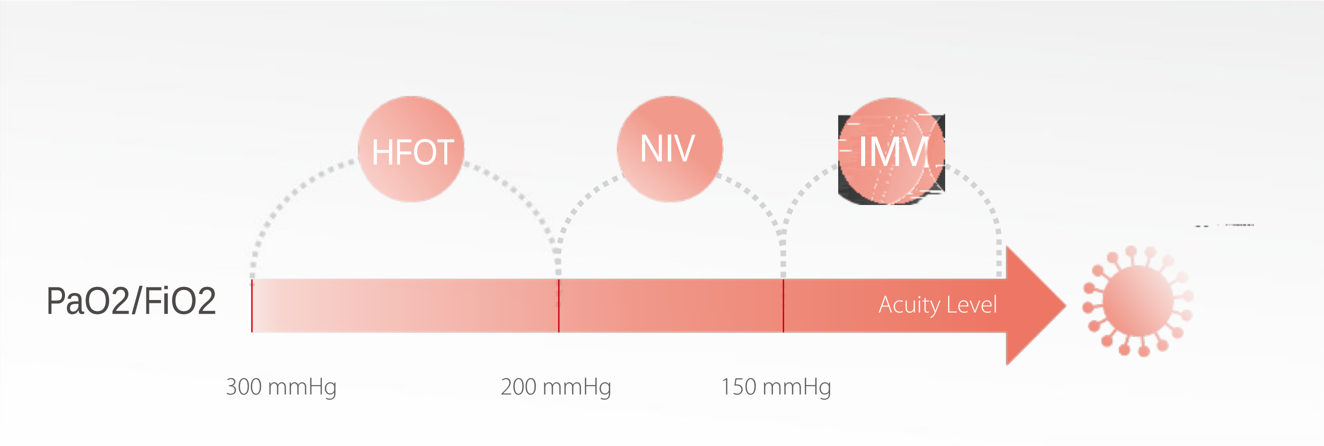
Respiratory Support Strategies For Severe COVID-19





Invasive Mechanical Ventilation (IMV)

▸ Clinical Consensus

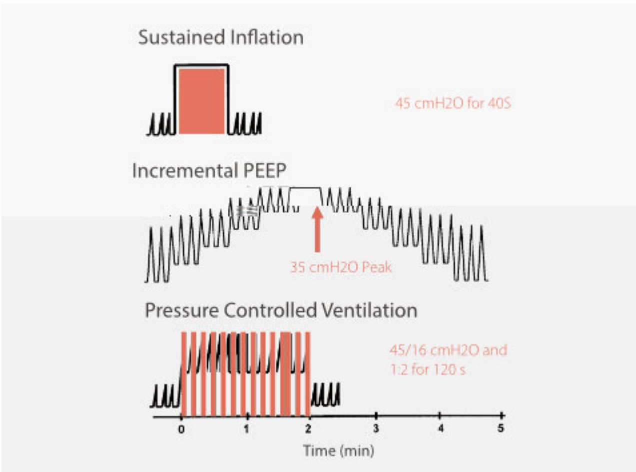
For patients with PaO2/FiO2≤ 150mmHg, IMV should be implemented as soon as possible. According to lung protection strategy, lower tidal volume ventilation is the first choice (6ml/kg PBW to 8 ml/kg PBW). It is also recommended to perform optimal positive end-expiratory pressure (PEEP) titration, appropriate lung recruitment maneuvers [4,5], and other lung protective measures.

For patients with severe ARDS (PaO2/FiO2 < 100 mmHg) who shown little effect to regular ventilation practices, particularly those with unevenly distributed lesions, it is recommended that clinicians give mechanical ventilation with prone positioning to the patient, with a minimum time of 12 hours.

Recruitment maneuvers: First, evaluate the patient's lung recruitability. Increase PEEP from 5cmH2O to 15cmH2O [6], and check whether the following is observed:

1. PaO2/FiO2 rises;
2. PaCO2 decreases;
3. Respiratory compliance improves.

If two of above is observed, the patient's lung is identified as recruitable, thus a suitable recruitment maneuvers could be implemented.



PEEP Titration: Setting the appropriate PEEP is important to maintain oxygenation of ARDS patients and to avoid lung injuries. PEEP titration is necessary to keep the lung open after recruitment. There are several PEEP titration methods commonly used by clinicians including : ARDSnet FIO2-PEEP table, Low flow P-V curve, Best Oxygenation, Stress index, PEEP Decremental, and Transpulmonary pressure.

ARDS net FiO2 - PEEP

Lower PEEP/higher FiO2

FiO2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	8	10	10	7 12	14	14	14	16	18	18-24

Higher PEEP/lower FiO2

FiO2	0.3	0.3	0.3	0.3	0.3	0.	0.	0.	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	5	8	10	12	14	4 14	4 16	5 16	18	20	22	22	22	24

OXYGENATION GOAL： PaO2 55-80mmHg or SpO2 88-95%

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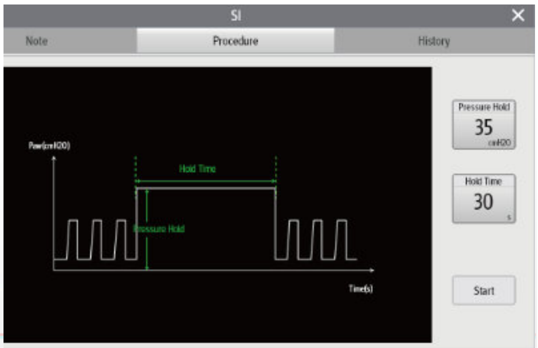
AMV
20
2.9
TVe/IBW
5.8
5.63
14
37
FiO2
14 25
0 0.00
99
80
40
100
3


SI
Note
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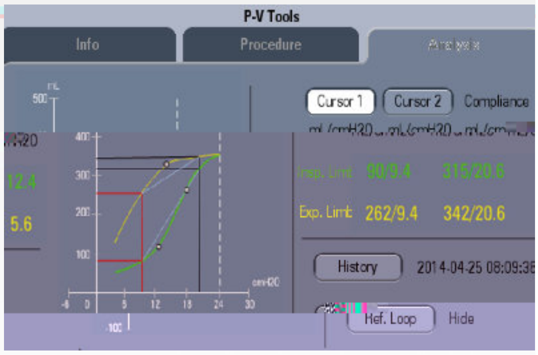
History
Paw(cmH2O)
Hold Time
Pressure Hold
Time(s)
Pressure Hold
35
Hold Time
30
Start


P-V Tools
Info
Procedure
Cursor 1
Cursor 2
Compliance
Exp. Limit
262/9.4
342/20.6
History
Hide

Respiratory Mechanics Measurement

- **PulmoSight**: It is essential to closely monitor the changes of respiratory mechanics during PEEP titration in ARDS patients. The SV Series ventilators monitor patient's respiratory mechanics and display the data in a graphic way - PulmoSight to help display intuitive real-time feedback.

PulmoSight

Non-Invasive Mechanical Ventilation (NIV)

▸ Clinical Consensus

For severe cases of COVID-19, when the patient' s PaO2/FiO2 is between 150 mmHg and 200 mmHg, start with non-invasive ventilation. The initial NIV parameters are to be set as the following:

1. Inspiratory positive airway pressure (IPAP): 8 cmH2O to 10 cmH2O (1 cmH2O = 0.098 kPa);
2. Expiratory positive airway pressure (EPAP) : 5 cmH2O to 8 cmH2O; and
3. FiO2: 100%.

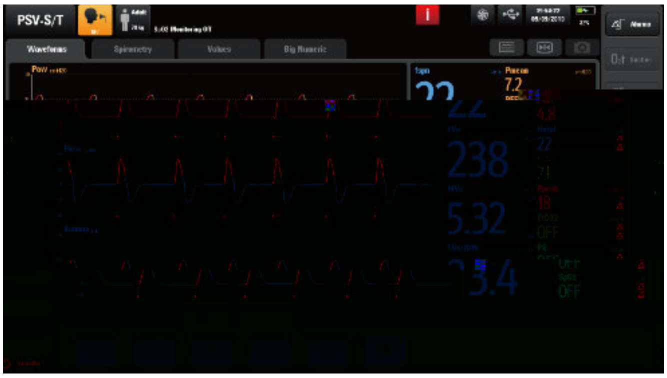
Observe for 2 hours. During this period, NIV parameters need to be adjusted according to the patient's breathing status, tidal volume (Vt) and SpO2.

1. if Vt is < 9ml/kg, RR is <30 times/min and PaO2/FiO2 is stable or improved, then continue NIV treatment;
2. if Vt is between 9 ml/kg - 12 ml/kg, PaO2/FiO2 is stable, then use NIV and observe the patient for 6 hours;
3. during which if Vt is > 12 ml/kg or PaO2/FiO2 worsens, then immediately stop NIV and change to invasive ventilation (endotracheal intubation).

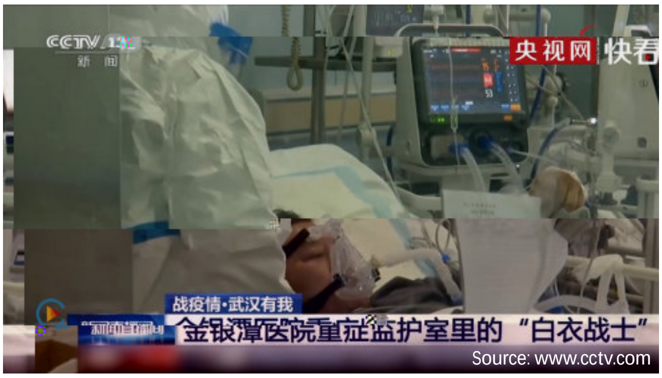
▸ Solutions for NIV

Mindray SV series ventilators support non-invasive ventilation, equipped with common non-invasive ventilation modes such as PSV-S/T, CPAP/PSV, P-A/C, etc., with the leak compensation up to 65 L/min. The ventilator is used with a dual-limb circuit with a closed non-invasive mask to support NIV. During the ventilation, VTi (insp. tidal volume), VTe(exp. tidal volume), MVleak (leaked volume in a minute) and leak% (percent of leaked tidal volume) can all be closely monitored.

When providing respiratory support for COVID-19 patients, the use of non-invasive ventilation with dual-limb circuits can greatly reduce the amount of gas exhale into the atmosphere (compared with traditional single-limb circuit expiratory valve). At the same time, with additional filter at the expiratory valve can efficiently process the exhaled air, and reduce the risk of aerosol infection to a minimal level.



NIV



Application of Mindray SV300 ventilator with dual-limb circuits for non-invasive ventilation in Wuhan Jinyintan Hospital.

High-Flow Oxygen Therapy (HFOT)

▸ Clinical Consensus

When PaO2/FiO2 is between 200 mmHg and 300 mmHg, it is advised that the patient is supported with high-flow oxygen therapy (HFOT) through nasal cannula (commonly called HFNC or HFNOT). The initial setting of HFNC can be at 40 - 50L/min with 100% FiO2. During the therapy, clinicians should closely observe the patient's vital signs and oxygenation.

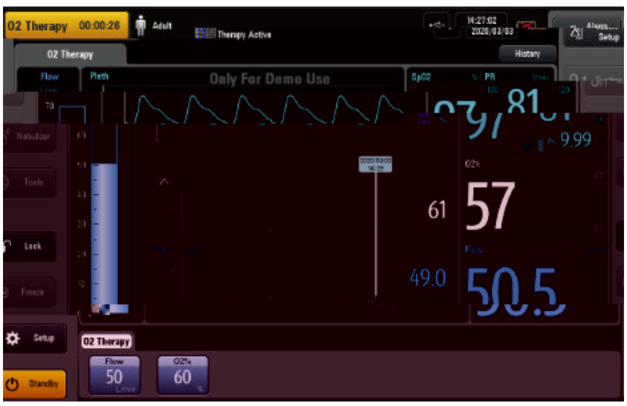
If the oxygenation deteriorates to PaO2/FiO2 < 200 mmHg, or SpO2 falls below 93%, and/or the RR is above 30 times/min, then HFNC is not likely to be effective and NIV may be a better choice in this case.

If the patient has any of the following symptom, invasive ventilation should be used instead of HFOT:

1. unconsciousness; severe arrhythmia;
2. shock (intravenous norepinephrine dosage> 0.1 µg/kgmin);
3.
4. acute respiratory acidosis (pH < 7.25); or
5. airway obstruction.

▸ Solutions for HFOT

Compared with the standard oxygen therapy, Mindray's SV Series ventilator's HFOT can provide 2 - 60 L/min flow of oxygen and up to 100% FiO2. In addition, with humidifier to actively warm and humidify the HFOT's gas flow delivered to patients, preventing mucociliary damage, sputum buildup, and other complications. Autopsy reports shown that COVID-19 lesions are concentrated in the lungs with a large amount of viscous sputum. Therefore, humidified HFOT has a great significance for patients requiring sputum clearance.



HFOT

HFOT is applied to COVID-19 patients.

Challenges of treating COVID-19 patients

- Demanding clinical environments
- Shortage of medical supplies
- Heavy workload for caregivers

What Minday can oer:

1. The comprehensive respiratory support therapy solution, including HFOT, NIV and IMV in one device, can be switched over seamlessly to meet the changing needs of the patients;
2. The lung protection strategy package is available for effective treatment of COVID-19 patients;
3. An extensive range of parameter measurement can help facilitate weaning of patient in a safe and effective way.

[1] Critical Care Committee of Chinese Association of Chest Physician, Respiratory and Critical Care Group of Chinese Thoracic Society, Respiratory Care Group of Chinese Thoracic Society. Conventional respiratory support therapy for Severe Acute Respiratory Infections (SARI): Clinical indications and nosocomial infection prevention and control.

[2] Experts' Suggestions on Clinical Management of Severe Cases of COVID-19. Chinese Journal of Critical Care & Intensive Care Medicine [e-Journal]. 2020, 06.

[3] World Health Organization. Clinical management of severe acute respiratory infection when Novel coronavirus (2019-nCoV) infection is suspected: Interim Guidance. 2020 Jan 28.

[4] Marini JJ. Recruitment maneuvers to achieve an 'open lung': whether and how? Crit Care Med 2001; 29:1647–1648.

[5] Halter JM et al. Positive End-Expiratory Pressure after a Recruitment Maneuver Prevents Both Alveolar Collapse and Recruitment/Derecruitment. Am J Respir Crit Care Med 2003; 167: 1620-1626

[6] Chen et al. Implementing a bedside assessment of respiratory mechanics in patients with acute respiratory distress syndrome. Critical Care (2017) 21:84