NON-INVASIVE POSITIVE PRESSURE VENTILATION (NIPPV)

Indications:

1) Acute hypercapnic respiratory failure during acute exacerbations of COPD
2) Acute respiratory failure due to cardiogenic pulmonary oedema
3) Acute hypoxemic respiratory failure in immunocompromised patients
4) Facilitation of weaning in patients with COPD

Contraindications to NIPPV

1) Cardiac or respiratory arrest
2) Nonrespiratory organ failure eg encephalopathy with GCS < 10, severe upper gastrointestinal bleeding and haemodynamic instability
3) Facial trauma, injury and deformity
4) Upper airway obstruction
5) Uncooperative patient
6) Unable to protect airway
7) Unable to clear sputum
8) High risk of aspiration

Since SARS, another contraindication for NIPPV in this ICU is all community acquired pneumonias and suspected SARS

Protocol for NIPPV

1) Sit patient up
2) Explain to patient about NIPPV and what to expect
3) Hold the mask over the patient's face gently
4) Start with low inspiratory pressure (IPAP): 8 – 10 cm water and expiratory pressure (EPAP):5 cm water
5) Gradual increase in IPAP as tolerated by patient up to 20 cm water
6) Observe for change in respiratory rate, tidal volume, signs of respiratory distress
7) Adjust FiO_2 to maintain SpO_2 > 90%
8) Recheck arterial blood gases within 2 hours after application of NIPPV
9) EPAP may be increased in cases of acute pulmonary oedema
10) Apply strappings to the mask after the patient has get used to NIPPV
11) Dressing eg Duoderm may be applied to nasal bridge or other pressure point to avoid the development of pressure sores
12) For patients with cardiogenic pulmonary oedema without hypercapnia, CPAP 8 – 15 cm water via face mask can be tried. The FiO_2 can be adjusted

according to the arterial blood gases and SpO_2

13) Contraindications to NIPPV might develop while patients is on NIPPV eg change in conscious state, vomiting. Conversion to invasive should be considered
14) Failure of improvement in blood gases or signs of respiratory failure may be due to
    - Severe leakage around the mask
    - Inadequate FiO2, IPAP or EPAP
    - Copious respiratory secretion with difficulty in clearance
    - Intubation and mechanical ventilation may be necessary.

BiPAP Vision ventilators

Ventilatory modes:

- Spontaneous mode (S mode)
- Spontaneous/time mode (S/T mode)
- CPAP mode

In S/T mode, the ventilator delivers pressure support breaths with PEEP. Patient's spontaneous inspiratory effort triggers the ventilator to deliver inspiratory positive airway pressure (IPAP). It cycles to expiratory positive airway pressure (EPAP) during expiration. If the patient breathing rate is lower than a prescribed rate, the ventilator triggers a pressure-controlled breath according to the IPAP prescribed. The breath is ventilator-triggered, pressure limited and time-cylced. The actual level of pressure support is equal to the difference between IPAP and EPAP.

Parameters you need to prescribe in S/T mode:

1. **IPAP** ranges from 4 to 40 cm water with increment of 1 cm water
2. **EPAP** ranges from 4 to 20 cm water with increment of 1 cm water
3. **Rate** ranges from 4 to 40 breath per minute with increment of 1 breath per minute
4. **Timed inspiration** ranges from 0.5 to 3 s with increment of 0.1 s
5. **IPAP rise time :** 0.05, 0.1,0.2, 0.4 s
6. **FiO_2** ranges from 21% to 100%

The monitor of the ventilator can display expired tidal volume, minute ventilation, peak inspiratory pressure, inspiratory time/total cycle time, patient leak flow and % patient triggered breaths.

Alarm parameter adjustment

1. High pressure limit : range from 5 to 50 cm water, should be set above IPAP
2. Low pressure limit : range from “disabled” to 40 cm water, should be set below IPAP and above EPAP. Together with the low pressure alarm delay, the ventilator can detect failure to trigger. If the low pressure alarm is set below the EPAP. It will not detect a failure to trigger.
3. Low pressure alarm delay: “disabled” to 60 s. It should be set at the maximum time acceptable for the pressure to drop below the low pressure limit. It should be longer than the expiratory period (60/set rate - inspired time)
4. Apnea: range from disabled, 20 – 40 s with 10 s increment
5. High rate range from 4 to 120 breaths per minute
6. Low rate range from 4 to 120 breaths per minute
7. Low minute ventilation: range from disabled to 99 L per min

CPAP mode

Parameter you need to prescribe

1. CPAP : range from 4 to 20 cm water with 1 cm water increment
2. FiO_2 : range from 21% o 100%

The monitor will show the exhaled tidal volume, minute ventilation, peak inspiratory pressure, inspiratory time/total cycle time ratio and patient leak flow.

After the advent of SARS, there is great hesitation in the use of NIPPV in PWH because risk of infection.

Discuss with the on-call ICU consultant when there is a potential candidate of NIPPV.

References:

1) Liesching et al. Acute applications of non-invasive positive pressure ventilation. CHEST 2003; 124:699-713
2) International Consensus Conferences in Intensive Care Medicine: Noninvasive positive pressure ventilation in acute respiratory failure. Am J Resp Crit Care Med; 163: 283-291.
3) Mehta S and Hill NS Noninvasive ventilation. State of the Art. Am J Resp Crit

Care Med; 163 : 540-577.

4) Marik PE. Handbook of evidence-based critical care. Noninvasive positive pressure ventilation. Springer 2001.
5) BiPAP Vision Clinical Manual