



## Noninvasive Positive Pressure Ventilation

HKTS and ACCP (HK & Macau Chapter)

### Introduction

Noninvasive positive pressure ventilation (NIPPV) is being increasingly used in treating respiratory failure because of its proven effectiveness in acute and chronic respiratory failure from many causes, and because of the associated reduction of potential complications associated with endotracheal intubation. Considerations regarding the potential generation of aerosols during NIPPV usage in infectious lung disease have, however, resulted in concerns for the safety of health care workers during its application. Special precautions which may be useful to reduce infection risks for health care workers should thus be taken in case NIPPV is applied to such patients.

### Indications

#### *Acute respiratory failure*

The use of NIPPV in the treatment of acute respiratory failure secondary to COPD has good evidence to decrease the mortality, reduce the need of endotracheal intubation and decrease the length of hospital stay. In non-COPD patients, NIPPV can also decrease the need for endotracheal intubation.

Strong evidence (multiple controlled trials)

- COPD
- Acute cardiogenic pulmonary oedema
- Immunocompromised patients

Less strong evidence (single controlled trial or multiple case series)

- Pneumonia
- Asthma
- Postoperative respiratory failure
- Avoidance of extubation failure
- Do not intubate patients

Weak evidence (few case series or case reports)

- Upper airway obstruction
- Acute respiratory distress syndrome
- Trauma
- Obstructive sleep apnoea, obesity hypoventilation

#### Controversial

The use of NIPPV in SARS is controversial as its potential risk of aerosol generation which may endanger the health care workers. However, from the Chinese literature, there was no reported increase in staff infection following the application of NIPPV in SARS patients. From the experience of NIPPV usage in more than 20 SARS patients in a Hong Kong hospital, 102 out of over 105 health care workers who had taken care of these SARS patients and who consented to have their blood checked were negative for coronavirus serology.

### ***Chronic respiratory failure***

NIPPV is also indicated as a long-term ventilatory support for patients suffering from chronic respiratory failure secondary to restrictive lung disease due to neuromuscular or chest wall disease, sleep-related breathing disorders and COPD.

### **Contraindications**

NIPPV is contraindicated in the following conditions:

- Cardiorespiratory arrest/patients unable to sustain spontaneous breathing
- Cardiorespiratory instability (e.g. hypotension with impaired perfusion, serious dysrhythmia)
- Uncooperative patients
- Recent facial, oesophageal, or gastric surgery
- Craniofacial trauma or burns
- High aspiration risk (inability to manage secretion)
- Inability to protect airway
- Fixed anatomic abnormalities of the nasopharynx (e.g. choanal atresia, severe laryngomalacia)

### **Environmental requirement**

- ***Non-SARS patients/No potentially infectious disease***

Adequate air change of at least 6 shifts per hour (6 ACH).

- ***SARS patients/Potentially infectious disease***

1. Air change of at least 12 shifts per hour (12 ACH) achieved by negative pressure ventilation, with HEPA filters for incoming and outgoing air (to protect the environment and to allow recirculation), and
2. Uni-directional airflow from the corridor through the nursing station, then to the patient and finally out to the atmosphere through the exhaust is preferred.

### **Personal protective equipment**

- ***Non-SARS patients***

- N-95/surgical mask
- protective eyewear, full-face shield, surgical gloves, cap and gown for potentially aerosol generating procedures.

- ***SARS patients***

- N-95/surgical mask, protective eyewear, full-face shield, cap, gown and surgical gloves.

### **NIPPV application with due regard to reducing environmental spread of infective droplets**

#### ***A. Ventilator Settings***

##### ***1. BiPAP machine***

- ST mode is preferred with back-up rate 12 breaths/min
- iPAP is set to achieve respiratory rate less than 25 breaths/min and tidal volume at least 6-7ml/kg
- O<sub>2</sub> and ePAP are set to achieve minimal CO<sub>2</sub> re-breathing and target oxygenation
- Facial mask is preferred to decrease aerosol generation
- Whisper-Swivel II exhalation port is preferred because of its round the tube outflow

- Viral-bacterial filter is connected between the mask and the exhalation port to decrease viral and bacterial load excretion to the environment

## **2. Mechanical ventilator**

- The pressure support mode is used and capability for leak compensation is preferred.
- The pressure support level is set to achieve respiratory rate less than 25 breaths/min and tidal volume of at least 6-7ml/kg.
- The CPAP level and FiO<sub>2</sub> are set to achieve target oxygenation.
- Facial mask is preferred to decrease aerosol generation.
- Viral-bacterial filter is added at the entry of the expiratory tubing to the ventilator to decrease discharge of viral and bacterial loads to the environment.
- To reduce inadvertent aerosol generation during addition of water, heat and moisture exchanger (HME) may be used instead of heated humidifier.

## **Special notes for SARS patients**

- *In general, settings for SARS patients are the same as for the usual non-SARS induced Type I acute respiratory failure (ARF). However, pneumomediastinum and pneumothorax are common, and ARF due to SARS frequently responds to low positive pressures. The following ranges are thus appropriate as initial settings:*
  - CPAP 4-6cm
  - IPAP 6-10cm
  - EPAP 4-6cm
- *All volume & rate requirements and use of viral/bacterial filters apply.*

## **B. Indications for initiation of NIPPV in SARS**

NIPPV should be started early in patients presented with respiratory failure, defined as SaO<sub>2</sub> < 95% on nasal O<sub>2</sub> 5L/min and respiratory rate more than 30/min

## **C. Monitoring**

- All patients should be maintained continuously on NIPPV for at least 6 hours after commencement.
- NIPPV can be stopped for **not more than 30 minutes at a time** thereafter for meals and sputum clearance.
- Close monitoring of respiratory rate (RR), signs of respiratory distress, supplemental oxygen requirement, oxygen saturation and actual blood gas (ABG) is mandatory.
- Patients should be intubated if there is increase in respiratory distress and/or SaO<sub>2</sub> < 95% with increasing oxygen requirement e.g. more than 10-12L/min
- If patients show improvement in terms of respiratory rate and supplemental oxygen requirement, gradual weaning from NIPPV can be tried.

## **Cleaning and disinfection**

### **SARS patients**

- Disposable tubings should be utilized for single patient application.
- Used masks should be soaked in 1000 ppm pre-sept for at least 30 minutes

### **Non-SARS patients**

- Tubings and mask should be cleaned at least weekly or prn for the same patient
- Used tubings and mask should be soaked in 1000 ppm pre-sept for at least 30 minutes

## **Reference**

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8. Centers for Disease Control and Prevention. ‘Interim domestic infection control precautions for aerosol-generating procedures on patients with severe acute respiratory syndrome (SARS).’ Access at <http://www.cdc.gov/ncidod/sars/index.htm>.

*The information and opinions expressed in these guidelines are provided to the best of our knowledge and understanding at the time of drafting (January 2004), and must be cross-referred to the most updated literature upon application.*