NONINVASIVE VENTILATION: PRACTICAL ADVICE

Giuseppe Bello, Gennaro De Pascale, and Massimo Antonelli

Current Opinion in Critical Care: February 2013 - Volume 19 - Issue 1 - p 1–8

R 黃心治
Purpose of review

- discusses the key points that would be of practical help for the clinician who applies noninvasive ventilation (NIV) for treatment of patients with acute respiratory failure (ARF)
Introduction

- Noninvasive ventilation (NIV)
- severe chronic obstructive pulmonary disease (COPD) exacerbation or acute cardiogenic pulmonary edema (CPE)
- improving patient comfort and preserving airway defense mechanisms.
Introduction

- proper NIV interface
- ventilation mode
- plan a close monitoring in an adequate hospital location
Interfaces

(a) nasal mask; (b) oronasal mask; (c) total face mask; (d) helmet; (e) nasal pillows; (f) mouthpiece
60 patients undergoing NIV to treat ARF
- total face mask to be more comfortable compared with traditional oronasal mask
- allowing patients to tolerate NIV for a longer period
- In clinical practice, alternating different interfaces may be the best strategy to improve patients’ tolerance.
VENTILATION MODE AND VENTILATOR SETTING

- CPE: continuous positive airway pressure (CPAP)
- Hypoxemic patients with ARF: noninvasive pressure support ventilation (PSV) combined with PEEP
  - Improved dyspnea and gas exchange,
  - Lowered neuromuscular drive and inspiratory muscle effort
  - CPAP used alone improved oxygenation but failed to unload the respiratory muscles.
- COPD AE: No difference in clinical outcome or arterial blood gases between patients ventilated in assist control ventilation (ACV) and PSV modes (PSV: better accepted/fewer side effects)
VENTILATION MODE AND VENTILATOR SETTING

- Volume control ventilation: severe chest wall deformity or obesity who may need higher inflation pressures
- Triggering systems: flow triggering >> pressure triggering
- Starting at high pressures to facilitate patient tolerance (appropriate initial pressures are a CPAP of 3–5 cm H2O and an inspiratory pressure of 8–12 cm H2O above CPAP)
CARBON DIOXIDE REBREATHING

- The face mask constitutes an additional mechanical dead space, and its effect on CO2 rebreathing is proportional to its internal volume.
- As this volume is small compared with the patient’s tidal volume, the amount of CO2 that is rebreathed is also small.
Optimal synchrony between the patient’s spontaneous breathing activity and the ventilator parameters is one of the key factors determining tolerance to NIV. Ineffective triggering, double-triggering, auto-triggering, premature cycling, and delayed cycling.
ASYNCHRONY


- prospective multicenter observation study
- PSV mode
- the level of pressure support and the magnitude of leaks were significantly associated with asynchrony
ASYNCHRONY

- air leaks should be minimized by optimizing the fitting or size of the interface, or even switching to another type of interface.
- decrease ventilator pressure settings as much as allowed by clinical parameters
- NIV with helmet: highest PEEP and pressure support levels clinically indicated
ASYNCRONY

- wide variability in the estimation of leaks and tidal volume among current bilevel positive-pressure systems used for home mechanical ventilation
PATIENT SELECTION

- best-established indication for NIV is ARF related to COPD exacerbation or CPE
PATIENT SELECTION

 avoided in the following conditions:

(1) coma, seizures or severe central neurological disturbances

(2) inability to protect the airway or clear respiratory secretions

(3) unstable hemodynamic conditions (blood pressure or rhythm instability)

(4) upper airway obstruction
PATIENT SELECTION

- avoided in the following conditions:
  - (5) severe upper gastrointestinal bleeding
  - (6) recent facial surgery, trauma, burns, deformity, or inability to fit the interface (unless a helmet is used)
  - (7) recent gastro-esophageal surgery
  - (8) undrained pneumothorax
  - (9) vomiting
PATIENT SELECTION

- altered levels of consciousness due to hypercapnic ARF associated with COPD Exacerbation are exposed to high risk of NIV failure
- In treatment-responsive patients, recovery of consciousness occurs within 45–60 min after NIV application.
PREDICTORS OF NONINVASIVE VENTILATION SUCCESS OR FAILURE

Predictors of NIV failure observed in COPD patients with ARF

1. lower arterial pH at baseline
2. greater severity of illness, as indicated by Acute Physiology and Chronic Health Evaluation (APACHE) II score
3. inability to coordinate with the ventilator
4. inability to minimize the amount of mouth leak with nasal mask ventilation
PREDICTORS OF NONINVASIVE VENTILATION SUCCESS OR FAILURE

- Predictors of NIV failure observed in COPD patients with ARF
  - (5) less efficient or less rapid correction of hyper-capnia, pH, or tachypnea in the early hours
  - (6) functional limitations caused by COPD before ICU admission, evaluated using a score correlated to home activities of daily living (ADL)
  - (7) higher number of medical complications (particularly hyperglycemia) on ICU admission
Predictors of NIV failure observed in hypoxemic patients with ARF

1. Higher severity score [Simplified Acute Physiology Score (SAPS) II > 35 / SAPS II > 34]
2. Older age (> 40 years)
3. Presence of acute respiratory distress syndrome or community-acquired pneumonia
4. Failure to improve oxygenation after 1 h of treatment (PaO2:FiO2 146 / PaO2:FiO2 175
PREDICTORS OF NONINVASIVE VENTILATION SUCCESS OR FAILURE

- Predictors of NIV failure observed in hypoxemic patients with ARF
  - (5) higher respiratory rate under NIV
  - (6) need for vasopressors
  - (7) need for renal replacement therapy
INITIAL APPROACH TO THE PATIENT

- Staff with adequate skills and experience
- Selection of patients
- Choice of location
- Patient agreement and motivation
- Selection of interface
- Selection of ventilation mode and ventilator setting, monitoring
- Start of NIV

Collaboration among physicians, nurses, respiratory therapists, families
MONITORING

- (1) level of consciousness
- (2) comfort
- (3) chest wall motion
- (4) accessory muscle recruitment
- (5) patient–ventilator synchrony
- (6) respiratory rate
MONITORING

- (7) exhaled tidal volume
- (8) flow and pressure waveforms
- (9) heart rate
- (10) blood pressure
- (11) continuous electrocardiography
- (12) continuous oximetry
- (13) arterial blood gas at baseline, after 1–2 h, and as clinically indicated
MONITORING

Criteria used to perform ETI in ARF patients under-going NIV

(1) patient intolerance;

(2) inability to improve gas exchange;

(3) inability to improve dyspnea or respiratory muscle fatigue;

(4) appearance of severe hemodynamic or electro-cardiographic instability;

(5) severe neurological deterioration.
HUMIDIFICATION

- prevent the detrimental effects of cool, dry gases on the tracheobronchial epithelium.
HUMIDIFICATION

- heated humidifiers
- heat and moisture exchangers (HMEs)
HUMIDIFICATION

- **HMEs**
  - most commonly used due to their simplicity and cost-effectiveness
  - add a substantial amount of dead space
  - may increase flow resistance
  - higher PaCO2 compared with heated humidifier.
CONCLUSION

The success of NIV in patients with ARF depends on several factors, including the
- skills of the clinician
- selection of patient
- choice of interface
- selection of ventilation mode and ventilator setting,
- monitoring
- motivation of the patient.
Thanks