Noninvasive Ventilation in Acute Respiratory Failure: General Indications

or

WHEN TO USE NIV and when NOT TO

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So why use noninvasive positive pressure to ventilate anyways?

No invasive airway....

- no trauma, no risky intubation
- Less infection risk
- Can take off mask and allow patient to talk, interact with family, ? Eat
- Doesn’t have to be in the ICU
But its not always that simple……

- Careful patient selection (primum non nocere)
- When is the right time to start NIV
- How do you make sure the patient is doing ‘OK’?
- Knowing when to stop and intubate
When to Start NIV

Is indicated when there are functional and clinical signs of acute respiratory distress;

- Poor alveolar gas exchange (PaO2/ FiO2 ratio < 200)

- Ventilatory pump failure (Paco2 > 45, pH < 7.35)

- Tachypnea (respiratory rate > 35)
Which of the following findings is NOT an exclusion criterion for using noninvasive positive-pressure ventilation (NPPV) in the patient with acute respiratory failure?

A Apnea
B Hemodynamics or cardiac instability
C Low risk of aspiration
D Lack of cooperation by the patient
When NOT to start NIV

- Respiratory arrest
- Shock or CV instability
- Impaired mental status
- Excessive airway secretions
- Facial lesions that prevent fitting of nasal or face masks
Patient Selection

Able to protect the airway
Patient Selection
Which of the following therapies should be considered as first line of therapy in patients with exacerbation of chronic obstructive pulmonary disease (COPD)?

A Noninvasive positive-pressure ventilation (NPPV)

B Mechanical ventilation

C High-flow nasal cannula

D Systemic steroids
COPD exacerbations with initial pH< 7.35

NIV v/s conventional therapy

- Avoids intubation 28% risk reduction (RR 0.39, CI 0.28, 0.54)

- Reduces mortality 10% risk reduction (RR 0.52, CI 0.36, 0.76)
  - Higher success with mild acidosis (pH > 7.30)
  - Acute exacerbation with severe CAP; reduced intubations (p 0.005)
Hypercapneic respiratory failure

- Bronchiectasis exacerbations  
  (failure predicted by severe hypoxemia)


- Chronic hereditary neuromuscular disease (not acquired weakness)

Your patient has acute pulmonary edema from left heart failure. Which therapy should be tried first?

A noninvasive positive-pressure ventilation (NPPV)

B continuous positive airway pressure (CPAP)

C mechanical end-expiratory pressure
Cardiogenic Pulmonary Edema

CPAP by mask v/s $O_2$

- reduced intubation rate (RR 0.5, CI 0.28, 0.63)

- Trend towards improved survival (RR 0.84, CI 0.63, 1.13)

- No difference b/w CPAP and BiPAP
- No risk of increasing myocardial ischemia
- NOT indicated for cardiogenic shock
Obesity Hypoventilation Syndrome

- BMI > 30 kg/m²
- Awake hypercapnia
- Obstructive apnea/ hypopnea during sleep
ARDS in hematologic malignancies, BMT

• 1302 patients

• 21% were treated with NIV as initial management and 54% avoided intubation


• Pooled results from 2 RCTs; Intubation: RR 0.46, CI 0.22,0.95), Mortality: RR 0.62, CI 0.43,0.90)
All cause ARDS

• No benefit, possibly increased risk of adverse events

• No data to either support or dismiss NIV in chest trauma, severe CAP
All cause ARDS

- 479 patients with ARDS (pulmonary & extrapulmonary)
- 147 treated with NIV
- 54% avoided ET intubation
  - 2% v/s 20% VAP (p 0.001)
  - 6% v/s 53% ICU mortality (p 0.001)
  - Failure of NIV: older age (>60 years), SAPS II (>34), PaO$_2$/FiO$_2$ ratio <175 at 60 min of NIV
- Timing extremely important; success associated with early application with P/F ratios <285 > 210

Weaning from mechanical ventilation

• Adjunct to early liberation in patients failing spontaneous breathing trials......

• Evidence so far supports only those patients who have COPD (RR 0.49, CI 0.29,0.83 for hospital mortality)
After planned Extubation

- In patients considered at high risk of deterioration after extubation:
  - Failed SBT
  - Hypercapnia during SBT or at extubation
  - Cardiac disease
  - Chronic respiratory disease with > 48 hrs ventilation
  - APACHE II score > 12 at extubation

NIV applied immediately after extubation reduced

- Re-intubation rate
  - (RR 0.42, CI 0.25, 0.70)

- ICU mortality
  - (RR 0.35, CI 0.16, 0.78)
Post-extubation respiratory failure

- Occurs in 15 - 20%
- Becomes apparent at 24- 72 hrs and results in higher mortality & VAP rates
- NIV leads to NO reduction in reintubation rates or mortality with possibility of harm by delaying invasive ventilation

Postoperative Setting


- Ricksten SE. Effects of periodic positive airway pressure by mask on postoperative pulmonary function. *Chest* 1986;89:774–781


Pandemics

- Can overwhelm ICUs
- NIV use has been shown to be effective in milder cases and to reduce the intubation rate
Dispersion map of particles released from an oronasal mask during BiPAP 18/4.

The particles disperse up to 0.5 m with 18 and 4 cm H$_2$O pressure.
Procedures in high-risk patients
Procedures in high-risk patients

[Graph showing oxygen saturation (SpO₂) over different steps of the study, including CPAP, Oxygen, and various FiO₂ mask options.]
Monitoring for Success

PREDICTORS OF SUCCESS DURING ACUTE APPLICATIONS OF NPPV

Younger age
Lower acuity of illness (APACHE score)
Able to cooperate; better neurologic score
Able to coordinate breathing with ventilator
Less air leaking, intact dentition
Hypercarbia, but not too severe ($P_{aCO_2} > 45$ mm Hg, $< 92$ mm Hg)
Acidemia, but not too severe (pH $< 7.35$, $> 7.10$)

Improvements in gas exchange and heart and respiratory rates within first 2 h
Monitoring for Success

What is the best option for the patient in respiratory failure who continues to deteriorate 30 minutes after initiation positive-pressure ventilation (NPPV)?

A Wait another 30 minutes and monitor the patient

B Begin continuous positive airway pressure

C Intubation and begin mechanical ventilation

D Ventilation the patient using a bag-valve-mask
Key points

• Timing of NIV is CRUCIAL to achieve a success rate; the earlier the better

• Close monitoring of functional (tachypnea) and blood gas parameters (PCO$_2$, PaO$_2$/ FiO$_2$) can identify patients FAILING NIV and requiring invasive ventilation
Key Points (cont.)

• NIV should be the first ventilatory option for COPD exacerbations or Cardiogenic Pulmonary edema

• Patients who are immunosuppressed due to hematologic malignancies or chemotherapy and develop ARDS should be considered for a trial of NIV
Key points (cont.)

• Patients with COPD can be considered for a trial of early extubation to NIV

• Other possible indications are:
  » Prevention of hypoxema during procedures
  » Prevention & treatment of postoperative hypoxema