Noninvasive Ventilation in the Home

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This program has been approved for 1 hour of continuing education credit.

Course Objectives

- Identify at least four goals of home NIV
- Identify candidates for home NIV therapy
- Explain the use of NIV in chronic respiratory insufficiency
- Describe the protocol for initiation and management of NIV.

NIV Definition

Noninvasive ventilation refers to the delivery of mechanical ventilation to the lungs using techniques that do not require an artificial airway.

Advantages of Home Noninvasive Ventilation

- Ease of use
- Reduced need for skilled caregivers
- Elimination of tracheostomy-related complications
- Improved patient comfort
- Allows speech, improved communication
- Lower overall cost of care

Clinical Application of NIV

- Patient selection
- Equipment Selection
- Titration
- Mask fitting
- Monitoring

The Use of NIV in Chronic Respiratory Insufficiency

What is Chronic Respiratory Insufficiency?

Chronic respiratory insufficiency is the inability to adequately provide oxygen to the cells and eliminate carbon dioxide from them. This may result from different diseases.

- Decreased PaO_2 (hypoxemia)
- Increased $PaCO_2$ (hypercapnia)

Consequences of Respiratory Insufficiency

- Excessive work of breathing
- Respiratory muscle dysfunction
- Inadequate alveolar ventilation
- Severe hypoxemia

Treatment of Respiratory Insufficiency

Noninvasive Ventilation

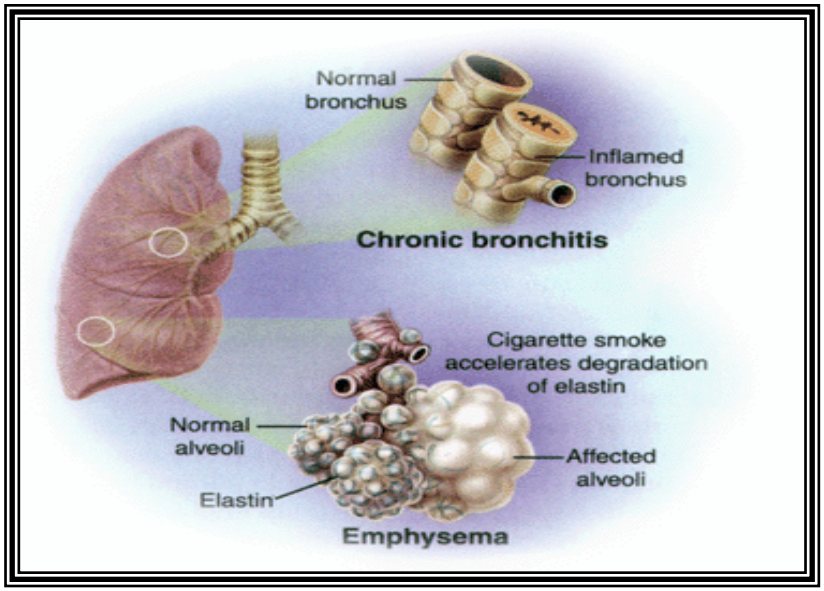
- Acute Respiratory Insufficiency
- Chronic Respiratory Insufficiency

Goals of Noninvasive Ventilation

- Relieve symptoms
- Reduce work of breathing
- Improve or stabilize gas exchange
- Improve duration and quality of sleep
- Maximize quality of life
- Prolong survival

Nicholas Hill, *Noninvasive Positive Pressure Ventilation: Principles and Applications*

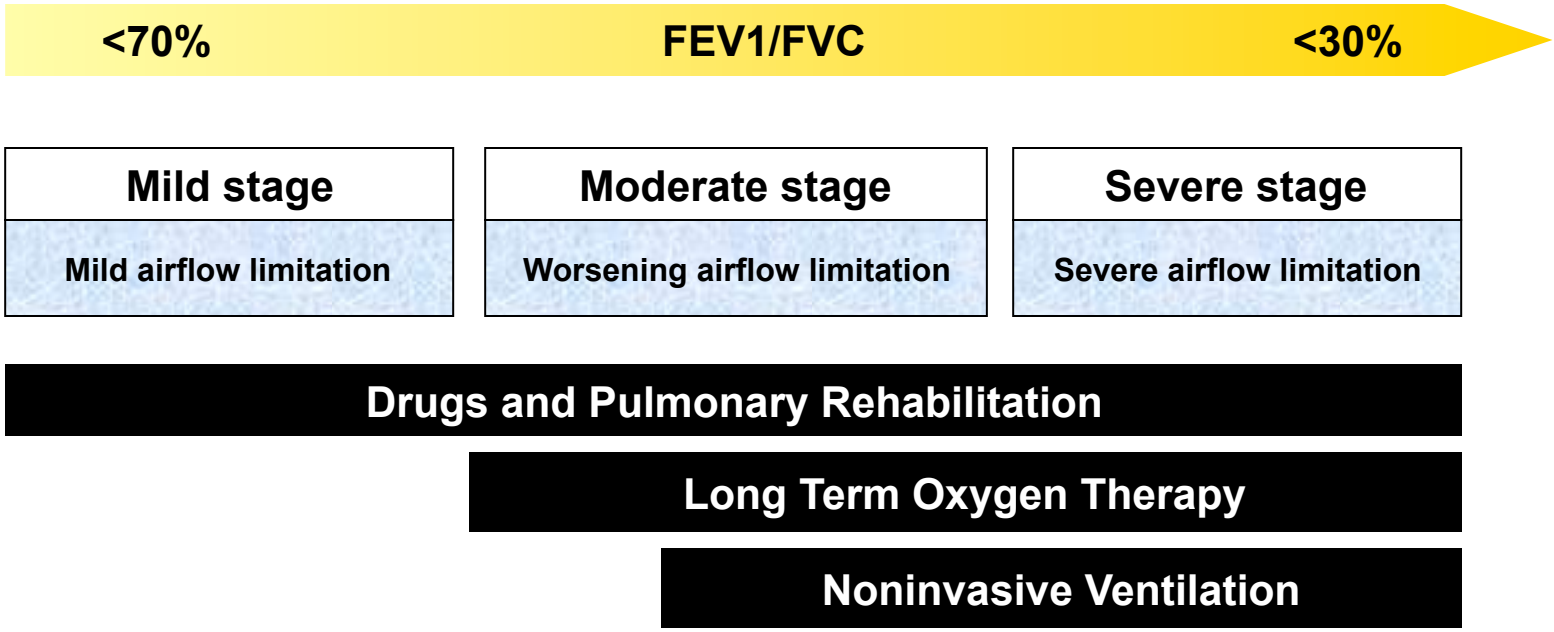
COPD and NIV



"*Chronic obstructive pulmonary disease* (COPD) is a preventable and treatable disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and is associated with an abnormal inflammatory response of the lungs to noxious particles or gases, primarily caused by cigarette smoking. Although COPD affects the lungs, it also produces significant systemic consequences"

ATS/ERS Task Force 2004

COPD Patient



As the disease progresses, hypoxemia occurs and hypercapnia is seen in advanced disease.

Global Strategy for the Diagnosis, Management, and Preventation of Chronic Obstructive Pulmonary Disease
Gold Scientific Committee, NHLBI/WHO workshop summary, AJRCCM 2001

COPD patients who may benefit from NIV

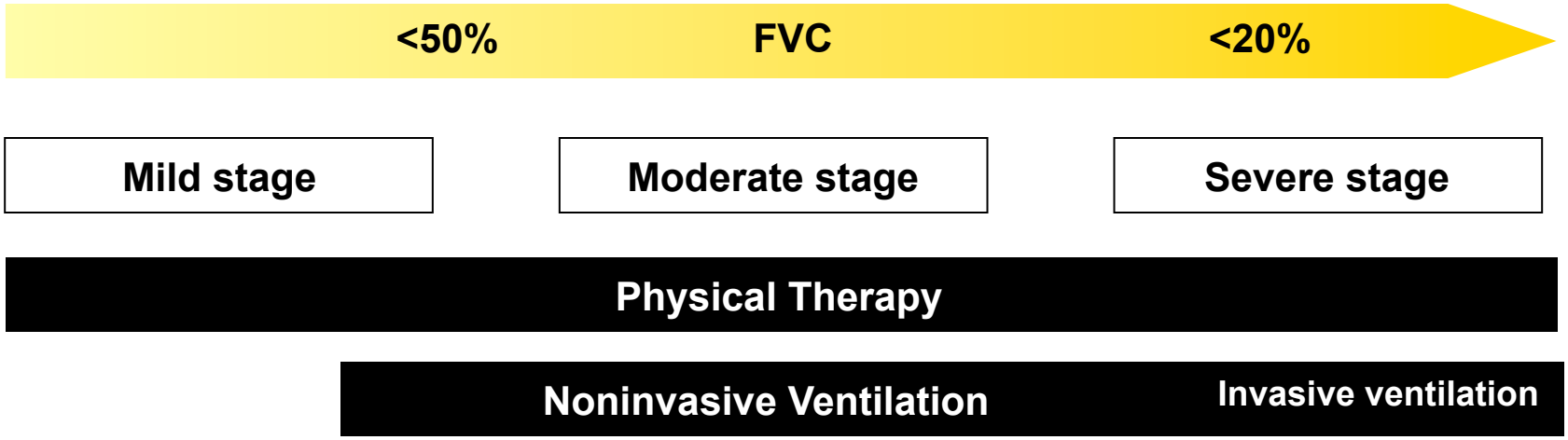
- Severe COPD and persistent symptoms despite medical therapy
- Substantial daytime CO_2 retention $PaCO_2$ > 55 mm Hg or
- $PaCO_2$ of 50-54 mmHg and hospitalization related to recurrent episodes of hypercapnic respiratory insufficiency (> 2 episodes in 1 year)
- Nocturnal oxygen desaturation: SaO_2 < 88% for > 5 min sustained while receiving oxygen therapy
- Motivated patient

Restrictive Patients and NIV

Restrictive Thoracic Disorders

- Chest wall deformities (Kyphoscoliosis)
- Neuromuscular disease (Muscular Dystrophy Amyotrophic Lateral Sclerosis, ALS)
- Central hypoventilation syndromes

Restrictive Patients
Pathology Progression



- Respiratory muscle weakness
- Sleep-disordered breathing
- Cor pulmonale
- Oxygen desaturation during exercise

Source: “Ventilator Assistance in the Home” D Robert, B.J. Make, P Léger, A. L. Goldberg, J. Paulus, T. Willig – 1994
Source: Consensus Conference, Chest 1999

Indications for NIV

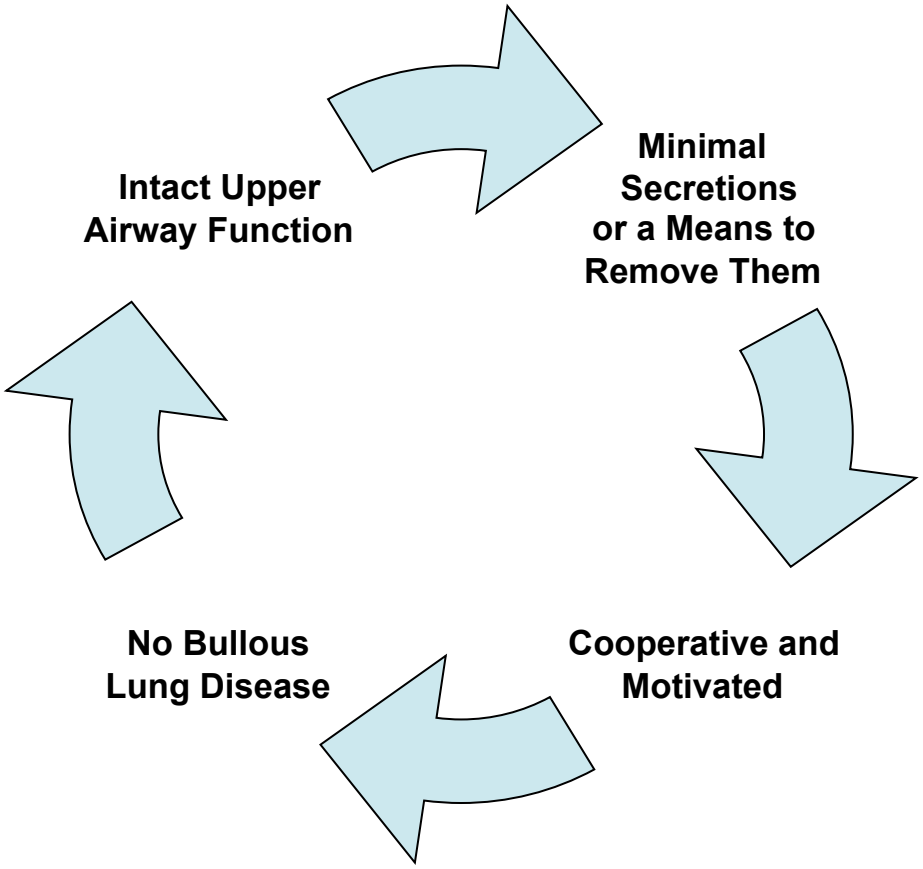
Symptoms

- Worsening of dyspnea or orthopnea
- Morning headaches
- Daytime hypersomnolence

Physiological Criteria

- Vital capacities below 50%
- Maximal inspiratory force less than 60 cm H_2O

Additional Indications for NIV



Home Ventilator Selection

Home Ventilator Selection

Portable Pressure-Limited Ventilators

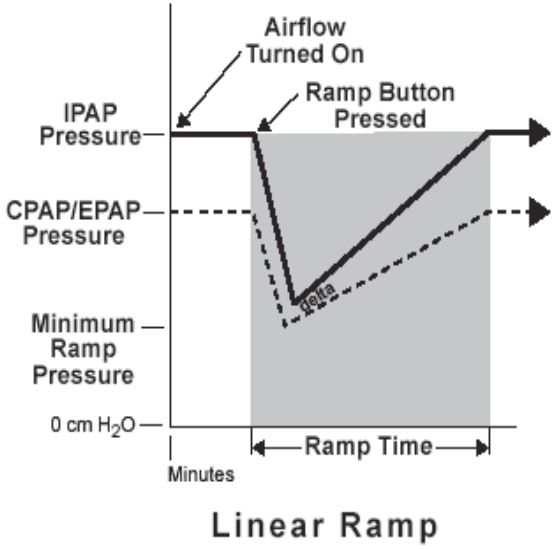
Portable Volume-Limited Ventilators

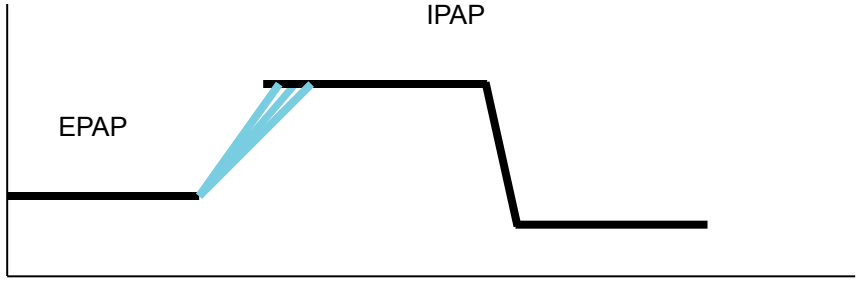
Portable Volume/Pressure Support Ventilators

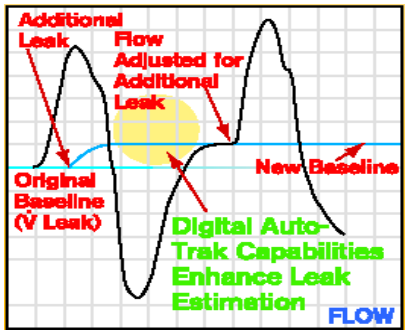
Home Ventilator Selection

Performance Capabilities

- Modes
- Leak Compensation
- Rise Time
- Ramp
- Sensitivity
- Average Volume Assured Pressure Support

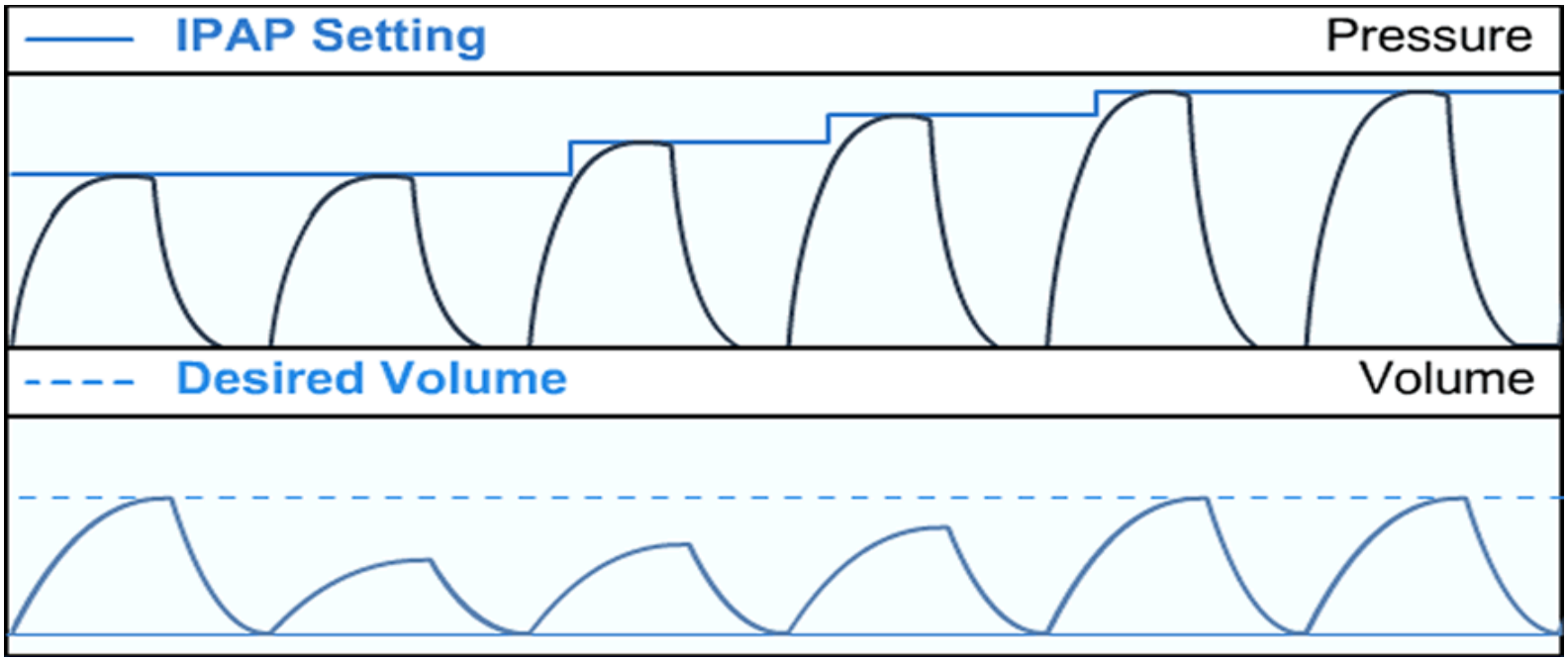






Performance Capabilities

AVAPS



Implementing Therapy

Initiation of NIV

- Hospital
- Home
- Sleep lab
- Physician office or clinic

Initiation of Successful NIV

Educate

- Explain NIV and the purpose of the mask
- Permit the patient to hold the mask
- Answer the patient’s questions
- Attempt to ease the patient’s anxiety
- Coach and encourage the patient

Initiation of Successful NIV

Properly size and fit the patient

Nasal Pillows

Nasal Mask

Full Face Masks

Initiation of Successful NIV

- Properly size and fit the patient
- Use the smallest mask possible
- Have the patient hold the mask to his/her face as therapy is applied
- Adjust headgear to minimize leaks
- Allow time for the patient to assimilate

Initiation of Successful NIV

Suggested Titration – Setting Pressures

- Ask the patient to sit or lay comfortably
- Initial settings

1. EPAP: 4-5 cm H_2O
2. IPAP: 8-10 cm H_2O
3. Look at the patient

Titration – Set Respiratory rate

Set back up rate 2 to 3 breaths below patient spontaneous breathing

Respiratory rate back up objective:

- Maintain efficient ventilation during central episodes
- Decrease work of breathing and maximize respiratory muscle rest

Obstructive Patient	Ti from 25 to 33%
Restrictive Patient	Ti from 33 to 50%

Ti (Second) = (60 / RR) x % Ti

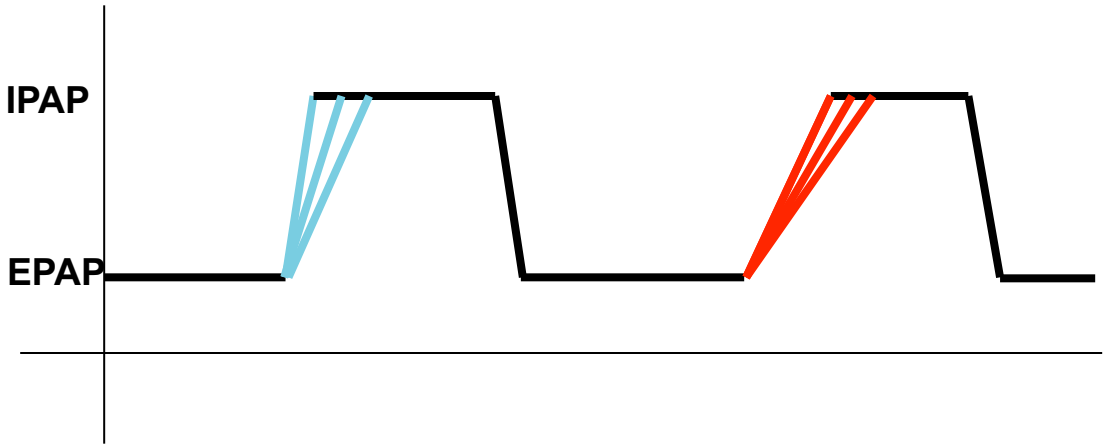
Titration – Set Rise Time

Rise Time — time from EPAP to IPAP

Obstructive patients: prefer short rise time from 100ms to 400ms (from 1 to 4)

Restrictive patients: prefer longer rise time from 300ms to 600ms (from 3 to 6)

Warning: long rise time with high respiratory rate maybe not compatible

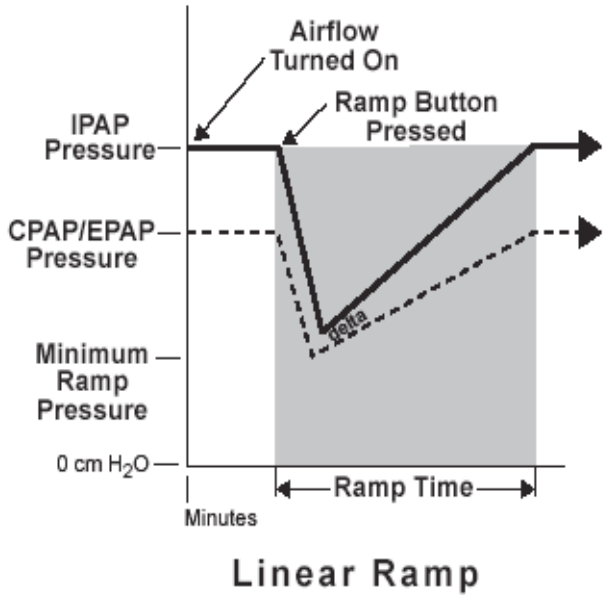


Titration – Ramp

Ramp is a feature that comfortably and progressively delivers pressure to the patient.

- Starting pressure
- Time

EPAP and IPAP gradually increase to the prescribed levels during the set time.



Set Alarms

- Disconnect Alarm
- Apnea Alarm
- Tidal Volume Alarm
- Low Minute Ventilation

Initiation of Successful NIV

Monitor Effectiveness of Therapy

- Compliance
- Patient comfort/interface
- Assess Waveforms, if available
- Add humidification as indicated
- Patient ventilator synchrony
- Improve gas exchange
- Relief of patient's symptoms
- Measure quality-of-life outcomes

NIV Complications

Mask Issues Related to NIV Use

Problem	Occurrence	Recommended Remedy
Discomfort	30-50%	Check fit, adjust straps, change interface
Excessive air leaks	80-100%	Realign interface, check strap tension, change to full face mask
Nasal bridge redness or ulceration	5-10%	Use artificial skin, minimize strap tension, use spacer, alternate interface
Rashes	5-10%	Use skin barrier lotion and/or topical corticosteroids, change to interface made from a different material
Claustrophobic reactions	5-10%	Reassure, try nasal interface or mouth piece

Pressure/Flow Issues Related to NIV Use

Problem	Occurrence	Recommended Remedy
Discomfort – too much pressure Sinus and ear pain	20-50% 10-20%	Reduce IPAP
Gastric insufflation	30-40%	Reduce pressure
Nasal/oral congestion	50%	Humidification, topical steroids, decongestants
Nasal/oral dryness	30-50-%	Reassure, try nasal interface or mouth piece
Eye irritation	33%	Reduce air leakage, adjusting strap tension, change masks

Major Complications

- Aspiration Pneumonia
- Hypotension
- Barotrauma

NIV Reimbursement in the Home

Driven by Medicare policy

Three categories of equipment

1. Respiratory Assist Devices (RADs) without a rate
2. Respiratory Assist Devices with a rate
3. Pressure Support Ventilator – Non-invasive or Invasive

NIV Reimbursement in the Home

Driven by Medicare policy

Five clinical categories

1. Restrictive thoracic disorders
2. COPD
3. Advancing Neuromuscular Disease
4. Central/complex sleep apnea
5. Obstructive sleep apnea

Study Supporting NIV Therapy in ALS

Effect of NIV assessed on QOL and survival in ALS patients

- 92 patients assessed every 2 months and randomly assigned to NIV or standard care
- 2 different QOL outcome scales were used

Results:

- NIV improved QOL and survival in all patients and in the subgroup who had better bulbar function
- The subgroup showed improvement in several measures of QOL and a median survival benefit of 205 days
- NIV improved some QOL indices in those with poor bulbar function, but conferred no survival benefit

- Bourke, SC. Et al., Lancet Neurology. 2006

Efficacy Of NIV Therapy in Central Hypoventilation

- 54 patients with obesity hypoventilation syndrome (OHS) treated with NIV to assess short and long-term effects
- Outcome measures were survival, clinical status and ABG results
- Follow-up period (50 months)

Results

- $Pa0_2$ increased and Co_2 decreased
- Improved subjective sleepiness and decrease in dyspnea in all but 4 patients
- 3 patients died during follow-up period

Perez de Llano, LA et al. Chest. 2005;128:587-594

Efficacy Of NIV Therapy in Central Hypoventilation

Conclusion

- NIV therapy is effective in the treatment of patients with OHS and provided a significant improvement in clinical status and gas exchange.

Perez de Llano, LA et al. Chest. 2005;128:587-594

Studies Demonstrating Success of NIV Therapy in Severe but Stable COPD

18 patients in 3 month cross-over trial received Bi-level ventilation spontaneous mode pressures of 18/2 cm H_2O

Results

- Showed a reduction in daytime $PaCO_2$, desaturations, and episodes of hypoventilation

Conclusion

- NIV improved sleep quality and nocturnal gas exchange and enhanced quality of life

Meecham-Jones, DJ, et al. AJRCC 1995 Aug;152(2):538-44.

Summary

- Goals
- Patient Selection
- Benefits
- Interface
- Ventilator Choice