“Why Do We Avoid Noninvasive Ventilation In The Medical ICU?”

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Conflict of Interest Disclosure
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I disclose the following financial relationships with commercial entities that produce healthcare-related products or services relevant to the content I am presenting:

Company	Relationship	Content Area
Orange Medical	Consultant	Mechanical Ventilation
Covidien	Research Grant	Mechanical Ventilation
Venner Medical	Research Grant	Airways

Clinicians Unwilling to Change their Practice?

- Insufficient evidence based education
- Scientific/clinical bias
- Lack of financial incentives
- Lack of belief in the research evidence
  - Taubes G. Science 1996;272:22-24.
  - Whitcomb ME. Acad Med 2002;77:1067-1068
  - Kalassian KG et al. Crit Care 2002;6:11-14.

Clinicians Unwilling to Change their Practice?

- Integration of innovation into practice takes 10 to 15 years!
- Innovation that makes management easier/better for clinicians is easier to integrate into practice than innovation that is better for patients!
- The use of NIV in the MICU requires more time and effort than invasive mechanical ventilation!
- Failure during initial applications!

Who – Indications for NIV

Undisputed indications

- Acute Exacerbation of COPD
- Acute Cardiogenic Pulmonary Edema
- Weaning from mechanical ventilation

General Indications for Use

- Postoperative respiratory failure
- Hypoxemic Respiratory Failure
- Patients with DNI Status
- Neurological/Neuromuscular Disease

Controversial Indications

- ALI/ARDS
- Asthma

NIV Acute Exacerbation of COPD

- Over 20 RCT's NIV in COPD
  - Prevents intubation
  - Decreases length of MV
  - Decreases ICU and Hosp stay
  - Decreases cost
  - Decreases mortality

Ramsey, Hart Curr Opin Pulm Med 2013;19:626-630

Hess RC 2013;58:950-9971

Ram Cochrane Syst Rev 2004;1:CD004104

NIV Acute Exacerbation of COPD

- Standard of Care
- Should be available as first line therapy in all setting caring for COPD patients

Masip JAMA 2005;294:3124

- Mets-analysis of the use of NIV/CPAP for the management of acute cardiogenic pulmonary edema
- 17 RCT's, both approaches over whelmingly positive
- Both avoided intubation
- No differences between the two approaches

MV and Heart Failure

- CPAP - standard
- NIV - ventilatory failure
- Intubation and invasive ventilation
  - Active cardiac ischemia (infarction)
  - Hemodynamic instability
  - Arrhythmias
  - Depressed mental status

NIV Acute Hypoxemic RF

- Post Operative Respiratory Failure
- Immunosurpressed Patients
- Patients Awaiting Transplantation
- Patients Post Lung Resection
- Acute Lung Injury
- Acute Respiratory Distress Syndrome

NIV-Hypoxemic Respiratory Failure

- Hilbert NEJM 2001;344:481
  - 52 Immunosuppressed patients NIV vs. St Rx
  - Required intubation, Serious complications, Died in the ICU: better with NIV $p < 0.05$
- Antonelli JAMA 2000; 283:235
  - 40 Patients awaiting transplantation NIV vs. St Rx
  - Intubation, Length of hospitalization, Complications, ICU mortality: better with NIV $p < 0.05$
- Squadrone ICM 2010;36:1666
  - 40 pts Hematological Malignancy O_2 vs. O_2 + CPAP
  - ICU + inubation 2 vs. 14, $p < 0.00001$
- Auriant AJRCCM 2001;164:1231
  - 48 patients post lung resection
  - Intubation, Hospital mortality: better with NIV $p < 0.05$

Agarwal RC 2010;55:1653

- Meta-analysis of the use of NIV in ARDS
- 14 RCT's included
- No difference in rate of intubation or mortality

Schettino CCM 2008;36:459

- 458 pt with ARF 38% failed NIV
- Mortality failing 47% vs. 5.4%, $p < 0.0001$
- 144 with hypoxemic ARF (not CHF)
  - 60% failed NIV, 64% (55) died
- CPE 18% intubated, mortality 39%
- COPD 24% intubated, mortality 33%
- Hypercapnia 38% intubated, mortality 0.0%
- Extubation failure 40% intubated, mortality 32%

Elective Extubation to NIV

- COPD, failed T-piece trial 48-72 hr after intubation
- Randomized to PSV vs. extubation to NIV
- Better outcome NIV

  Nava Ann Intern Med 1998; 128:721

- No difference in outcome

  Girault AJRCCM 1999;160:86

- Failed weaning trial 3 consecutive days, 50% of patients COPD, better outcome NIV

  Ferrier AJRCCM 2003;168:70

- No difference in outcome, largest trial 13 centers 208 pts

  Girault 2011;184:672-679

Pass SBT - High Risk of Reintubation

Nava CCM 2005;33:2465

- COPD, CHF, ineffective cough and excessive secretions, ≥ one weaning failure, more than one comorbid condition or upper airway obstruction: NIV > 8 hrs/day for 48 hrs , decreased reintubation rate

Ferrer AJRCCM 2006;173:164

- Age > 65, Cardiac failure cause of intubation or APACHE II > 12 day of extubation: All high risk patients but mostly COPD, NIV 24 hrs
- NIV decreased reintubation, less ICU/Hosp mortality

Ferrer Lancet 2009;374:1082

- 106 pts, chronic RF who passed a SBT
- RF less NIV 8 (15%) vs. 25 (48%), $p<0.0001$
- 90 day mortality less NIV 21(39%) vs 47(87%), $p<0.0146$

NIV Post-Extubation Failure

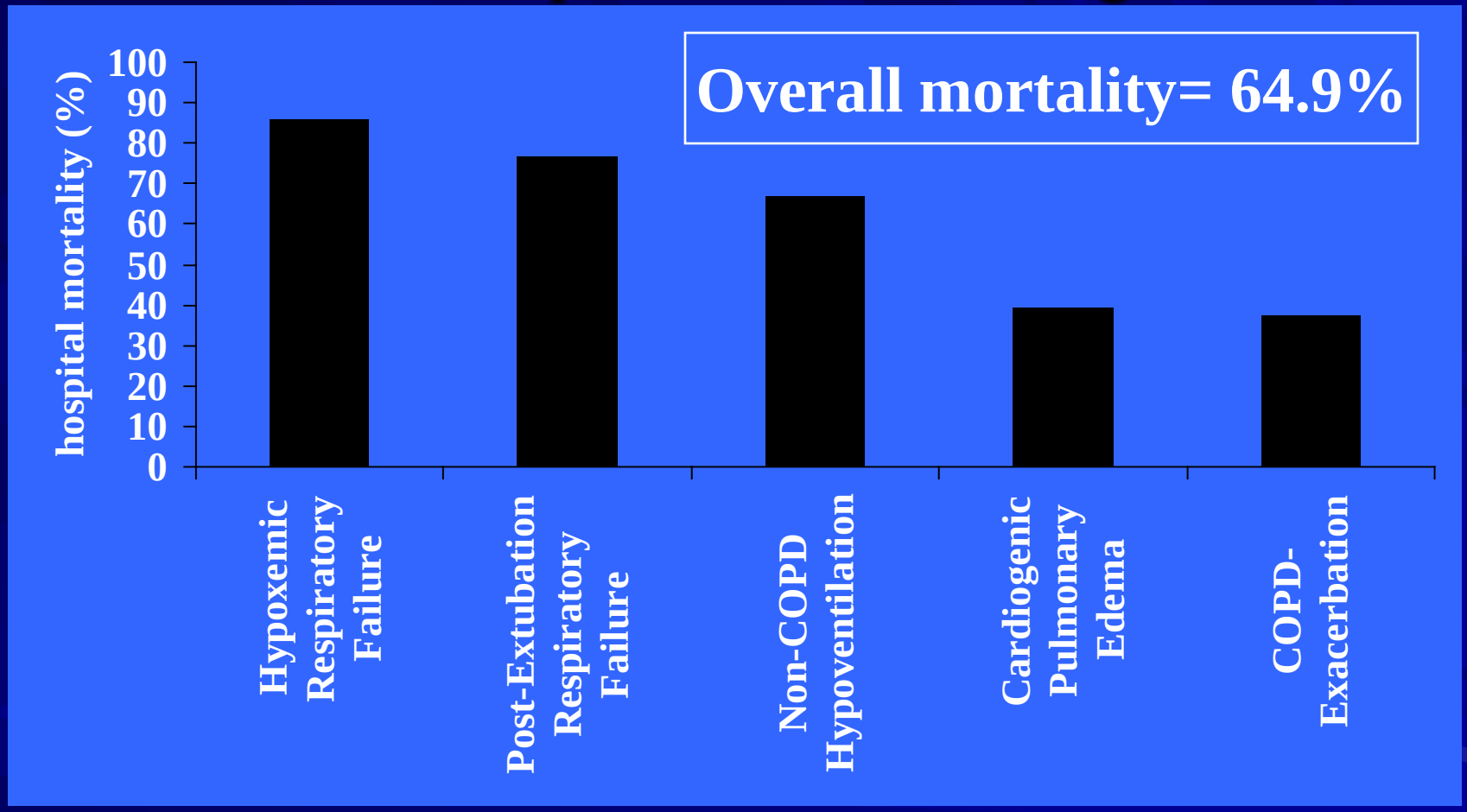
- Weaned non-COPD patients developing AHRF < 48 hours after extubation (n=81)
  - Reintubation 72 vs. 69%, LOS, mortality ND

Keenan JAMA 2002;287:3238

- Patients AHRF (n=244), 37 centers, 8 countries
  - Reintubation 48% both groups
  - ICU mortality 25% NIV vs. 14% p=0.048
  - Time to intubation 12 hr NIV vs. 2.5 hr p=0.02

Esteban NEJM 2004;350:2452

Diagnosis and Hospital Outcome: DNI/DNR patients receiving NIV



Schettino CCM 2005;33:1976

Successful Application of NIV

- The Clinician
- The Ventilator
- The “MASK”

Ventilator Settings

- PEEP - initially zero
- Peak pressure - 5 cmH_2O
- Volume - 100-200 mL
- Adjust the ventilator from these basic settings based on the patients response and the goals of therapy!
- Strap the mask only when the patient is comfortable!
- Clinician time $\geq$1 hour

Ventilator Settings

- PEEP 3-10 cmH_2O to offset auto-PEEP or manage hypoxemia
- Peak pressure $\leq$ 20 cmH_2O
- Tidal Volume 300-500 mL
- Inspiratory time < 1.0 sec

Final setting individualized based on the specific patient's response!!!

Successful Application of NPPV in Acute Respiratory Failure

- $PaCO_2$ decrease
- pH increase
- PaO_2 increase

Unsuccessful Application of NPPV in Acute Respiratory Failure

- Cardiopulmonary stress unchanged
  - RR, V_T
  - HR, BP
  - accessory muscle use
- $PaCO_2$/pH/ PaO_2 unchanged
- If the above unchanged in 1 - 2 hrs of NPPV, especially in hypoxemic ARF, intubate!

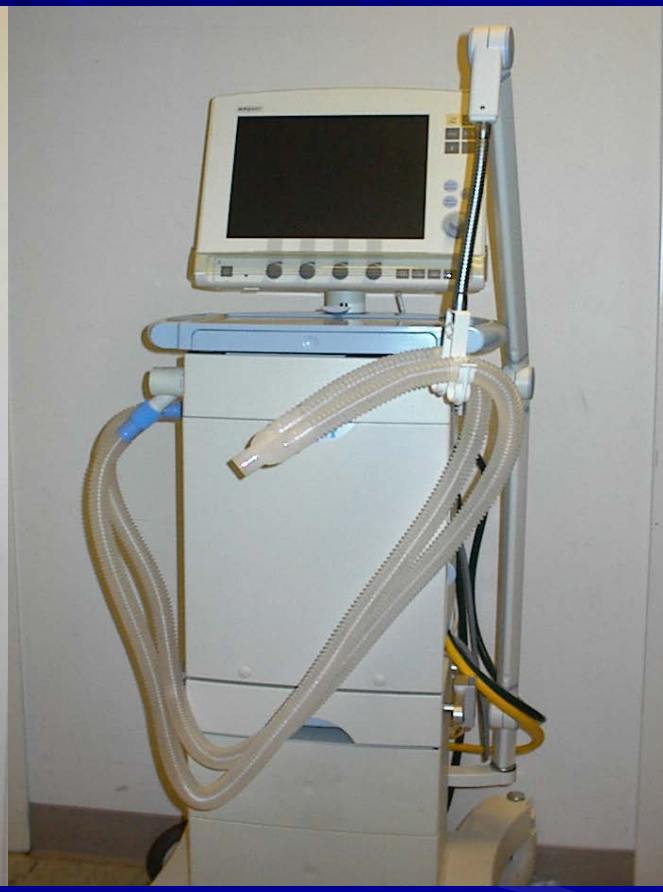

BiPAP S/T-D30
Auto Trak


PHILIPS
RESPIRONICS
V60
Concha


SULLIVAN

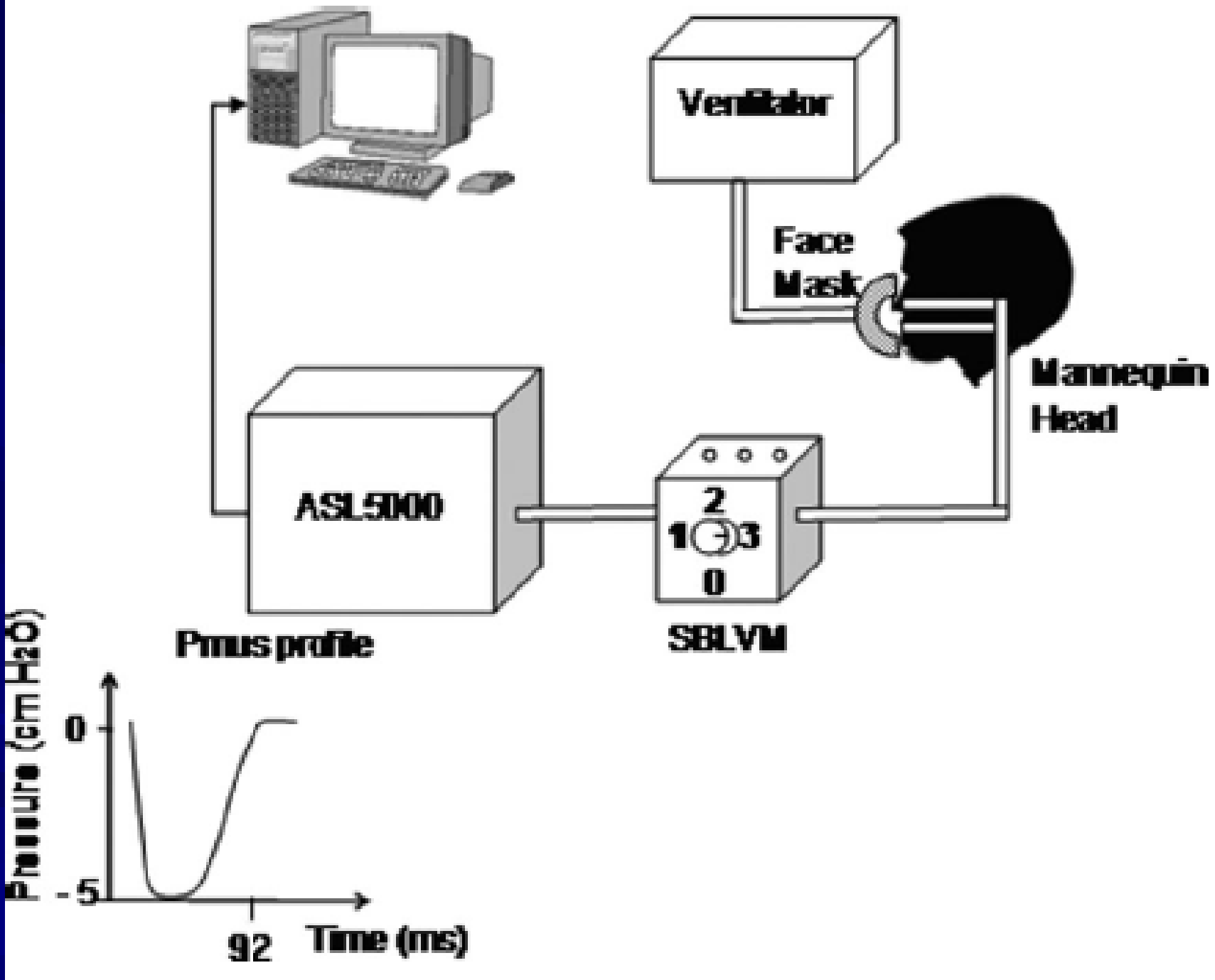

BiPAP Vision





Oto RC 2013;58: 2027-2037

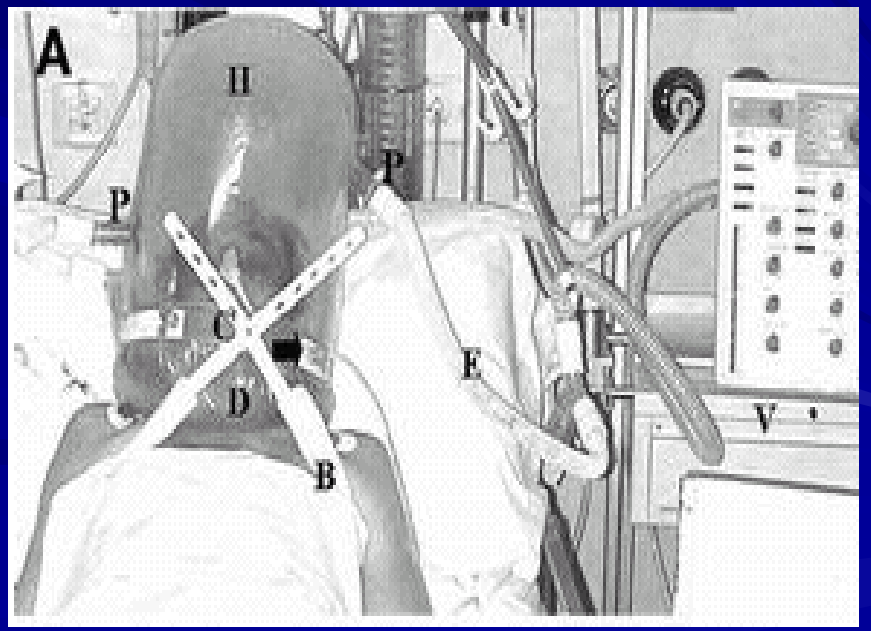
- ASL5000: invasive and non-invasive modes
- Maquet Servo-i, Drager V500, Respironics V60, Covidien 840, General Electric Care Station, Hamilton C3 and G5, and Care Fusion AVEA
- Leaks BL 3-4 l/min, L1 9-10 l/min, L2 26-27 l/min, L3 36-37 l/min. Increasing (n=6) and decreasing (n=6) leaks.
- Lung model I and E: R 10 and 20 cmH_2O/L/sec respectively C 60 mL/cmH_2O.
- Lung model RR 15/mim and inspir time 0.9 sec
- PIP/PEEP 17/5 cmH_2O


Ventilator
Face Mask
Mannequin Head
ASL5000
2
1
3
0
Pmus profile
SBLVM
Pressure (cm H2O)
0
-5
92
Time (ms)

Oto RC 2013;58: 2027-2037

- Breaths to synchronization
- Auto-triggered breaths
- Missed triggered breaths
- Breaths to reestablish breathing pattern
- Results:

840 and V60 preformed best followed by Servo I, G3 and G5, then Care Station and V500 last Avea


A
H
P
P
C
D
B
F
V


FlexiFit405

Humidification

- Essential in acute application of NIV
- High flows and high F_IO_2 result in dried retained secretions
- Use heated pass over humidifier
- System temperature about 30 degrees C
- Adjust to patient comfort
- Should not use an HME because of high gas flow and air leak!!!

Successful Use of NIV in the MICU

- Select the correct patients!
- Ventilator that compensates for leak well!
- Variety of masks and interfaces!
- Slow meticulous application!
- Spend **sufficient time** to insure success!

Thank You