Acute Hypercapnic Respiratory failure – BTS 2016 Guidelines

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NUH, Notts
Assumptions......

- Type 1 and Type 2 Respiratory Failure.
  (Can interpret ABG)

- Have seen NIPPY 3/3+/variations.

- Have treated AHRF in AECOPD.
Objectives

- Who to ventilate?
- How to ventilate?
- When/How to wean?
Let’s get started.....

Acute SOB &

Ø Ph- 7.28, PaCO₂ - 12.6, HCO₃- 34, PaO₂- 6.2

Ø Ph- 7.45, PaCO₂- 9.8, HCO₃- 32, PaO₂-9.6

Ø Ph- 7.36 , PaCO₂- 6.5, HCO₃-26, PaO₂ -5.8 ( on 10 cm)
Effect of high flow oxygen on mortality in chronic obstructive pulmonary disease patients in prehospital setting: randomised controlled trial

Michael A Austin,¹²³ Karen E Wills,¹ Leigh Blizzard,¹ Eugene H Walters,¹ Richard Wood-Baker¹²

- N=405
- 8 – 10 l/min v oxygen to achieve saturation 88 to 92%
- Titrated oxygen reduced risk of death by 58% (RR 0.42 95% CI 0.2 to 0.89, p=0.02)
- 78% in patients with known COPD
- No difference need for ventilation or length of stay
- 37% patients received treatment that did not comply with study protocol
YONIV study

- 118 pts NIV vs 118 pts standard (std)
- Setting: “inexperienced” medical wards
- End points
  - Intubation: 15.3 % (NIV) vs 27.1 % (std)
  - Mortality: 10.2 % (NIV) vs 20.3 % (std)
  - Breathlessness: rapid resolution in NIV
  - Mortality 22 % if pH < 7.3
REDUCED INTUBATION RATE; RR=0.42

REDUCED MORTALITY; RR=0.41

MORE IMPROVEMENT IN PHYSIOLOGY WITHIN 1 HR

REDUCED LOS

Keenan et al An Intern Med 2003
Marin et al, AJRCCM 2010
Eagle et al Neuromusc Dis 2002

Farrero et al; Chest 2005
Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema

Alasdair Gray, M.D., Steve Goodacre, Ph.D., David E. Newby, M.D.,
Moyra Masson, M.Sc., Fiona Sampson, M.Sc., and Jon Nicholl, M.Sc.,
for the 3CPO Trialists"
<table>
<thead>
<tr>
<th>Variable</th>
<th>Standard Oxygen Treatment (N = 367)</th>
<th>CPAP (N = 346)</th>
<th>NIPPV (N = 356)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial treatment — % of patients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason for not completing assigned treatment — no. (％)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient discomfort</td>
<td>1 (0.3)</td>
<td>18 (5.2)</td>
<td>30 (8.4)</td>
</tr>
<tr>
<td>Worsening arterial blood gas values</td>
<td>26 (7.1)</td>
<td>10 (2.9)</td>
<td>15 (4.2)</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>31 (8.4)</td>
<td>5 (1.4)</td>
<td>12 (3.4)</td>
</tr>
<tr>
<td>Other</td>
<td>18 (4.9)</td>
<td>24 (6.9)</td>
<td>29 (8.1)</td>
</tr>
</tbody>
</table>
BTS 2016.............

Acute SOB &

Ph- 7.28, PaCO2 - 12.6, HCO3- 34, PaO2- 6.2

Ph- 7.45, PaCO2- 9.8, HCO3- 32, PaO2-9.6

- Bronchiectasis
Patient presents to hospital acidotic with an acute exacerbation of COPD

Institution of standard medical therapy, particularly controlled oxygen (20% of patients acidotic) on arrival to hospital will correct their pH into the normal range, regardless of the severity of the initial acidosis

Repeat arterial blood gas analysis

pH > 7.35
V not indicated

pH < 7.35 but > 7.30
NIV advised

80% will get better with conventional treatment, but only 10 patients need to receive NIV to avoid one "treatment failure" (=ETI) [10]. NIV leads to more rapid resolution of dyspnoea [5, 13]

pH < 7.30
NIV strongly advised

Without NIV 50% will deteriorate to the point at which ETI indicated [10]. NIV improves survival [1]

Although 50% will fail with NIV there is a clear advantage both in hospital outcome and to one year [20]

pH < 7.20

Relative contraindications [18, 22]

Coma or confusion, inability to protect the airway, significant co-morbidity, vomiting, obstructed bowel, haemodynamic instability

M. ELLIOT ; ERR 2005
PS ventilation
Contraindications

- Excessive secretions
- Severe hypoxemia
- Burns, facial Injury etc.
- Pneumothorax
- Reduced GCS
- Hemodynamic Compromise

1. K.Hill et al 2010
2. ................
3. 
4. ‘Proceed with caution’
5. Diaz et Al – GCS <8
6. ‘Often less than IMV’

Evidence statement
There are few absolute contra-indications to a trial of NIV but some adverse features, especially when combined, require more caution and more intense monitoring. (Level 4)
Oxygenation & NIV

- No studies to guide oxygen enrichment.

- Target saturations – 88-92%

- Where to put oxygen.......
Patient end NOT ventilator end.

<table>
<thead>
<tr>
<th>FiO2</th>
<th>% DELIVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1L</td>
<td>31%</td>
</tr>
<tr>
<td>2L</td>
<td>37%</td>
</tr>
<tr>
<td>3L</td>
<td>40%</td>
</tr>
<tr>
<td>4L</td>
<td>47%</td>
</tr>
</tbody>
</table>

Level 3 recommendation

Monitoring during NIV.....

- Saturations - continuously

- Cardio - HR>120, dysrhythmia, cardiomyopathy

- pH and pCO2 - intermittently
  - CBG (Pitkin AD; Thorax 1994)
  - TOSCA (Van Oppen; 2015)
TOSCA
Using VBG Analysis in COPD Exacerbations – Prospective Cohort Study
D. Shaw et al 2015
Other bits ........

- Humidification - Level 4 recommendation


- Secretion clearance - manual, cough assist, mini-trach
Sedation during NIV

- BTS 2013 Audit
  - 2693 cases. Failure to reverse AHRF in 31%.
  - Agitation principal reason in 30%.
  - Sedation ‘attempted’ in 84%.
  - 91% NIV on wards!

i.v. Morphine 2.5-5mg (+- Benzodiazepine) in HDU/ITU settings
Practicalities....

- High Pressure versus High Intensity IPAP.
- EPAP max of 12.
- Semi-continuous NIV in 1st 24 hrs (7hrs-20hrs).
- Wean off 2-3 days (in Studies one Ph Normal and patient improves).
Patient Ventilator Asynchrony
Patient Ventilator Asynchrony

- In adequate Pressure support
  
  ( IPAP 15  -→  20-30 over 30 mins.      BTS 2016)

  - Patient Size

  - Degree of acidosis

  • Mask Leak.

  • Excessive Secretions.
Prognostication...

- APACHE II
- Pneumonia (43% Failure)
- Excess Secretions
- After 1 hr (pH inc 0.5, PaCO2 dec 10mm, RR)
- BMI (48% failure)
- ‘Compliance Score’

Soo Hoo Et Al; CCM 1994
Ambrosino; Thorax 1995
A word of caution......

- **BTS Survey 2013**
  
  Mean Ph -7.24
  
  91% ward based Intervention.

- **NCORP data for AECOPD**
  
  Overall mortality 28% in HDU/ITU settings
  
  Mortality 40% in ward settings
American experience....

NIV failures have 29% mortality 60% greater than immediate IMV
ICNARC Data

- 2775 definitely intubated
- ICU mortality 24% (v 20% all-comers)
- Hospital mortality – 40% (v 30% all-comers- of which 25% admitted electively after surgery)
- LOS ICU- 4 days (median)
- LOS hospital – 16 days (v 14)
For each variable in T1 (diagnosis, sex etc), write in the ‘Score’ column the weight given to the patient’s category.

For each variable in T2 (days since admission etc), write the patient’s value in the ‘raw value’ column. Transform to the ‘new’ value using the rules given. Thus:
- a ‘raw’ number of days of eg 9 is unchanged; anything above 9 becomes 9 (the maximum)
- a ‘raw’ age of eg 75 becomes 75 – 70 = 5; anything below 70 becomes 0 (the minimum)
- a raw MAC of eg 20 becomes 20 – 20 = 0; anything above 30 becomes 0 (the minimum).
- a raw Glasgow Coma Score of eg 12 becomes 15 – 12 = 3.

Multiply each ‘new’ value by its weight and put the answer in the ‘Score’ column.

For Acute Physiology Score in T3 there is no weight; just write the APS in the ‘Score’ column.

Calculate the Total Score and read off the estimated risk from T4.

### T1

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight (pick one)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis at time of decision to admit to critical care</td>
<td>COPD 25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>COPD + asthma 18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>asthma only 0</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>male 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>female 0</td>
<td></td>
</tr>
<tr>
<td>Physical function in 2 weeks before hospital admission</td>
<td>bedbound or chairbound 45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>housebound 17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>restrict(2) 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fully mobile and living without assistance 0</td>
<td></td>
</tr>
<tr>
<td>Arrial fibrillation</td>
<td>yes 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>no 0</td>
<td></td>
</tr>
</tbody>
</table>

### T2

<table>
<thead>
<tr>
<th>Raw value</th>
<th>Transform</th>
<th>New value</th>
<th>Weight (multiply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days since hospital admission</td>
<td>(maximum 6)</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Age – 70 (minimum 0)</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Mid arm circumference (cms)</td>
<td>30 – MAC (minimum 0)</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Glasgow Coma Score</td>
<td>15 - GCS</td>
<td>1.6</td>
<td></td>
</tr>
</tbody>
</table>

### T3

COPD Acute Physiology Score

### T4

<table>
<thead>
<tr>
<th>Total Score</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.9%</td>
</tr>
<tr>
<td>10</td>
<td>2.7%</td>
</tr>
<tr>
<td>20</td>
<td>3.9%</td>
</tr>
<tr>
<td>30</td>
<td>5.6%</td>
</tr>
<tr>
<td>40</td>
<td>8.0%</td>
</tr>
<tr>
<td>50</td>
<td>11.2%</td>
</tr>
<tr>
<td>60</td>
<td>15.5%</td>
</tr>
<tr>
<td>70</td>
<td>21.0%</td>
</tr>
<tr>
<td>75</td>
<td>24.3%</td>
</tr>
<tr>
<td>80</td>
<td>27.9%</td>
</tr>
<tr>
<td>85</td>
<td>31.8%</td>
</tr>
<tr>
<td>90</td>
<td>36.0%</td>
</tr>
<tr>
<td>95</td>
<td>40.5%</td>
</tr>
<tr>
<td>100</td>
<td>45.0%</td>
</tr>
<tr>
<td>105</td>
<td>49.7%</td>
</tr>
<tr>
<td>110</td>
<td>54.4%</td>
</tr>
<tr>
<td>115</td>
<td>59.0%</td>
</tr>
<tr>
<td>120</td>
<td>63.4%</td>
</tr>
<tr>
<td>125</td>
<td>67.7%</td>
</tr>
<tr>
<td>130</td>
<td>71.6%</td>
</tr>
<tr>
<td>135</td>
<td>75.3%</td>
</tr>
<tr>
<td>140</td>
<td>78.6%</td>
</tr>
<tr>
<td>150</td>
<td>84.2%</td>
</tr>
<tr>
<td>160</td>
<td>88.6%</td>
</tr>
<tr>
<td>170</td>
<td>91.9%</td>
</tr>
<tr>
<td>180</td>
<td>94.3%</td>
</tr>
<tr>
<td>190</td>
<td>96.0%</td>
</tr>
<tr>
<td>200</td>
<td>97.2%</td>
</tr>
</tbody>
</table>

1. Cannot get out of house unassisted or gets out of the house rarely, able to perform self-care but unable to do heavy chores such as house cleaning, cannot live alone, may be institutionalized.
2. Able to live on their own and get out of the house to do basic necessities but severely limited in exercise ability.
Acute NIV for Neuromuscular disease

J. Colt