CSIM annual meeting - 2018

Acute respiratory failure

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Disclosures

- None relevant to this presentation.
- Also no conflicts of interest.
Objectives

- Differentiate between the different types of respiratory failure.
- Discuss ARDS identification and management in the ICU.
- Discuss weaning strategies in the ICU.
- Explain the role and rationale for different non-invasive ventilation strategies.
The Goldilocks principle in ICU (c2016)

- IV FLUID
- BLOOD PRESSURE
- BLOOD TRANSFUSION
- SUGARS
- OXYGEN THERAPY
- VENTILATION

Clinical case

- 78M PMH CLL
- admitted with bladder obstruction due to stones with obstructive uropathy (creat 185), AGMA and newly diagnosed DM.
- foley insertion resulted in *significant* hematuria and three-way foley catheter placed.
- To washroom and prescient RN waited outside the door. Thump. Back to bed, CODE BLUE called. Nurses and RT's found him to have a decreased level of consciousness and saturations in the low 80s. He had a low but measurable blood pressure. Sinus tachycardia on monitor.
Clinical case

- I came up to find him in the same condition and we wheeled him down using bag valve mask and high flow oxygen to the intensive care unit.
- Resuscitation: tubes, lines, norepi infusion
- At no time did we lose pulse/bp.
- ABG from Art line: pH 7.05, PCO2 66, PO27, Bicarb 18. FiO2 1.0
- Bedside USS showed large, hypokinetic RV.
- Aa gradient = 620.
Clinical case

ECG HR approx. 150

SaO2 approx. 75%

ART MAP 73

ETCO2 20 (running at ¼ speed)
Q.

A. Shunt? $V:Q = 0$
   - Blood bypassing the aerated lung

B. Dead space ventilation? $V:Q = \infty$
   - Ventilation OK but no blood flow

C. VQ mismatch? $V:Q \neq 1$

D. All of the above?
Clinical case
Types of resp failure

- **Acute vs chronic**

- **Type 1 – hypoxemic respiratory failure**
  - Failure of alveolar unit
    - Pneumonia, CHF, ARDS, hemorrhage

- **Type 2—hypercapnic respiratory failure**
  - Drive deficit (as in overdose)
  - Weak muscles
  - Stiff chest wall, obesity hypoventilation, distended abdomen, volume loss (inc in Vd/Vt, ie rapid shallow breathing pattern).

- **Type 3—perioperative**

- **Type 4—respiratory failure in the setting of shock state**
  - Can overlap as in our case or as in some COPD cases.
ARDS
–what is it?

JAMA. 2018;319(7):698-710.
ARDS –what is it?

- 3M cases per year worldwide
- 75k deaths per year in USA
- Mortality rate of 35-45%
- Berlin definition (2012)
  - Acute (within one week of insult)
  - Hypoxemic as defined by:
    - P:F ratio 200-300 = mild, 100-200 = moderate, <100 = severe
      - On at least 5 PEEP.
  - ‘severe’ in trial often means P:F <150 to boost N.
  - Mortality: mild = 27%, moderate = 32%, severe = 45%.
  - Bilateral infiltrates not better explained by....
  - No left atrial hypertension, CHF (rule out with ECHO, BNP).

- No good biomarkers to date.
ARDS—what is it?


This official clinical practice guideline of the American Thoracic Society (ATS), European Society of Intensive Care Medicine (ESICM), and Society of Critical Care Medicine (SCCM) was approved by the ATS, ESICM, and SCCM, March 2017
ARDS – how to treat it?

- No good pharmacotherapy
  - ASA
  - Statins
  - Steroids

- Address underlying trigger

- Prevent *patient-induced* worsening due to high effort / pressure swings/diaphragmatic injury – “myotrauma”, dyssynchrony

- Prevent ventilator induced lung injury (VILI)
ARDS – how to treat it?

- **Good evidence for:**
  - Low tidal volume (6 ml/kg of PBW)
  - Limit Pplat to <30 cmH2O
  - Prone positioning >12 hours per day
  - Moderate PEEP where high >15 and low is <8 cmH2O

- **Weaker support for:**
  - ECMO
  - Recruitment manoeuvres
  - High PEEP
  - Deep sedation/paralysis

- **Hard pass on oscillator ventilation (possible exception for PF ratio <64).**

- MIBW = 50 kg + 2.3 kg for each inch over 60. FIBW = 45.5 kg + 2.3 kg for each inch over 60.
ARDS – how to treat it?

- **Practical approach might be:**

  - **Mild** ARDS: observe on BiPAP
  
  - **Moderate/Severe**, ETT plus controlled mode of ventilator until improving. Vt <8 mL/kg, ideally <6 mL/kg. Moderate PEEP for moderate ARDS. **Increase PEEP for severe ARDS** to 15 (but keep Pplat <30).

  - Moderate ARDS, sedate to prevent large Vt, breath stacking, dyssynchrony.

  - Prone severe ARDS >12 hours/day until improving. These folks will need deep sedation and likely some NMB.

  - Unadjusted 90-day mortality was 23.6% in the prone group versus 41.0% in the supine group (P<clinical trials 0.001), N Engl J Med. 2013;368(23):2159.

  - ECMO as part of for SEVERE ARDS.
Weaning strategies

Liberation From Mechanical Ventilation in Critically Ill Adults: An Official American College of Chest Physicians/American Thoracic Society Clinical Practice Guideline

Inspiratory Pressure Augmentation During Spontaneous Breathing Trials, Protocols Minimizing Sedation, and Noninvasive Ventilation Immediately After Extubation
• Early mobilization (evidence that it increases vent free days)
• Ventilator weaning protocol (lower quality evidence) can reduced vent time by 25%
• Cuff leak test for higher risk (traumatic intubation, ETT>6d, large ETT, female, reintubated) individuals prior to extubation
• Spontaneous breathing trials PSV 5-8 or ‘tube compensation’
  • 30-120’
• Minimize sedation (comments above re ARDS not withstanding).
• Extubate patients at high risk of failing direct to BiPAP.
  • Lower mortality and lower reintubation rates.
  • Low risk if pass 1st SBT, PCO2 is N, and low comorbidity, severity of illness.
Weaning strategies - modes

- Pressure support ventilation (PSV)
- Proportional assist ventilation (PAV)
- Neurally adjusted ventilatory assist (NAVA)
Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure

Bram Rochwerger, Laurent Brochard, Mark W. Elliott, Dean Hess, Nicholas S. Hill, Stefano Nava and Paolo Navalesi (members of the steering committee); Massimo Antonelli, Jan Brozek, Giorgio Conti, Miquel Ferrer, Kalpalatha Guntupalli, Samir Jaber, Sean Keenan, Jordi Mancebo, Sangeeta Mehta and Suhail Raoof (members of the task force)

Eur Respir J 2017; 50: 1602426
Non-Invasive

- For AECOPD:
  - No good for ‘prevention’ of respiratory failure
  - For hypercapnia.acidosis, helps avoid intubation
  - Even in cases of severe acidosis (pH < 7.2) can be helpful but higher risk of failure. OK to try in hypercapnic coma.
  - Use common sense: don’t try in impending resp arrest, shock, severe brady, severely agitated.

- Asthma? No good evidence.

- For AECHF:
  - NIV decreases intubation, reduces hosp mortality
  - CPAP also pretty good for this indication.
  - Also good in pre-hospital setting

- For post operative setting. Likely reduces reintubation rate.
Application of NIV strategies

- Hypercapnic Respiratory Failure
  - Mild → Severe
  - O₂, HFNC, NIV, ECCO₂R*, Intubation

- Hypoxemic Respiratory Failure
  - Mild → Severe
  - O₂, HFNC, NIV, Intubation, ECMO*

- Eur Respir J 2017; 50: 1602426  *Not widely available, ‘investigational’
My simplified NIV strategy

- Hypercapnic / mixed Resp Failure
  - Mild \(\rightarrow\) Severe
  - \(O_2,\ NIV,\ Intubation\)

- Hypoxemic Resp Failure
  - Mild \(\rightarrow\) Severe
  - \(O_2,\ HFNC,\ Intubation\)
A Systematic Review of the High-flow Nasal Cannula for Adult Patients

Yigal Helviz and Sharon Einav

Critical Care
• High-Flow Nasal Cannula in Critically Ill Subjects With or at Risk for Respiratory Failure: A Systematic Review and Meta-Analysis
  • Respiratory Care January 2017, 62 (1) 123-132

• HFNC=NIV for intubation rate for hypoxemic resp failure

• HFNC=NIV for mortality rate for hypoxemic resp failure

• At 60 lpm with mouth closed theoretically can generate up to 7 cmH2O ‘PEEP’

• At 40 lpm with mouth closed approx 4 cmH2O

• HFNC better tolerated than NIV

• Take-home: TRY IT for hypoxemic (type 1) resp failure. Probably good for post-extubation with moderate risk of failure.

• NIV preferred for AECOPD with hypercapnia. NIV or CPAP for CHF.
Back to the clinical case

- 2 nights after admission to ICU, down on FiO2 to 0.75. Still on norepi. Nurse calls (having done routine neurochecks) to report a change in the pupillary size where left is greater than right and less responsive to light...
Clinical case
Thanks

- For your attention
- To the organizers for invitation.
- Questions?