The Role of the VDR Ventilator

OBJECTIVES

• Describe how the VDR was chosen for Legacy Emanuel Hospital and its use in various ICU’s
• Review the HFPV wave forms
• Describe the potential advantages of the Percussive form of High Frequency Ventilation
• Discuss ECMO applications

How did its use expand?
• “We” - 75 Dedicated Emanuel Respiratory Therapists
  – Respiratory Specialists at Legacy, Jennifer Ulrich, Jeff Heltborg, Denny Gish
  – Respiratory Care Medical Director, Dr. Bernie Sperley

Oregon Burn Center Medical Director, Dr. Phil Parsley

Who Chose the VDR?
• Oregon Burn Center Medical Director, Dr. Phil Parsley

Contributors
• National Burn Centers
  – LAC – USC
  – Via Christi
  – Santa Clara
  – Lehigh Valley
  – Mercy St John’s
  – CoxHealth
  – Memorial Hermann – Texas Medical Center

• But, Most of all

Two Presidents – Two Presidential Medals

Emmanuel R. White, Jr., M.D., Ph.D., F.A.H.A.,
Born in Springfield, Massachusetts
June 8, 1927
A physician, pathologist, educator, leader,
 emulate many great with teachers across just what it takes.
 Right instruction, right inspiration.
Education, CARE, CARE.
Where the Percussionaire Devices Originated

What is a VDR?
- High Frequency Percussive Ventilation (HFPV) is a hybrid form of high frequency ventilation.
- It is a combination of convective style ventilation and percussive high frequency linked together.

VDR waveform

Capnography
- Muscle relaxants (curare cleft)

Translation
- Dr Bird says -
  "This concept of pneumatic diffusive / convective protocols is not related to high frequency vibration, jet insufflation or electronically controlled crank or magnetically servoed dynamic oscillators."
- Denny says -
  "High Frequency Percussive Ventilations isn’t like the other types of High Frequency Ventilation”

Oscillator – 3100A & B
Jet – Bunnell
Flow Interrupter - VDR
### Starting Settings:

- **Keep ABG's in ordered range utilizing setting changes listed below.**

**Use the following settings when initiating VDR therapy.**

#### Patient Selection:

- **(ALL LISTED ORDERS ARE IN EFFECT UNLESS CROSSED OUT. at e: TIME:**

- ** REQUIRE A**
  - Increase **CO2 only**
  - Decrease **PCO2**
  - Raise **CO2** with low **PIP**
  - Increase Oxygenation if **Blood Gas Change Desired**

#### Other Settings:

- **It has been recommended that a leak around the endotracheal tube cuff be heard; however, this can complicate CO2 control and may not be indicated with many patients.**

#### Pneumatics

- **If PIP is >50 cmH2O and Oxygenation in range, decrease PIP from 500 to 350. Do this with great caution as it may cause airway damage.**

#### Oscillation

- **If FIO2 requirement is low and CPAP level is high, patient may be set at 11 – routinely kept at this setting.**

#### Ventilation

<table>
<thead>
<tr>
<th>Setting Change</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inspiratory Time : Expiratory Time</strong></td>
<td>15 : 30</td>
</tr>
<tr>
<td><strong>Pulsatile Flowrate</strong></td>
<td>Control Adult Pediatric</td>
</tr>
<tr>
<td><strong>Oscillatory PEEP</strong></td>
<td>Setting to 0-2 cmH2O (approx. 9 on knob)</td>
</tr>
<tr>
<td><strong>Pulse Frequency</strong></td>
<td>7200 BPM</td>
</tr>
<tr>
<td><strong>PEEP Level Display</strong></td>
<td><strong>Actual PEEP</strong></td>
</tr>
</tbody>
</table>

**Technology:**

- **The Phasitron:**
  - **The patient interface**
  - **Accelerating Laminar Flow**
  - **The Phasitron:**
    - **A Sliding Venturi:**
      - "Floating" exhalation valve
      - Enters during inspiratory
      - Exhales up to 1:5
      - Pneumatic clutch – "feels" backpressure
      - Open to ambient during expiration
      - Flow to pressure / pressure to flow converter
      - No transition penalty
      - Allows theoretical rates up to 7200 bpm

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**Note:** This document contains medical information and should not be used for diagnostic purposes. Always consult with a healthcare professional for accurate medical advice.
Inspired gas streams into the airways with high velocity, but low pressure. It streams down the airways, splitting at bifurcations, always seeking the path of least resistance in the train of tiny tidal volumes. It moves high pO2 gas toward the alveoli, while CO2 is compressed against airway walls.

Patented Phasitron and Gas Flow

1. Airways stay open at low Paw.
2. Exhaled gas swirls out along airway walls, facilitating mucociliary and CO2 clearance.

IPV for Post OHS

Post OHS Patients

- Start IPV treatment if:
  - Patient has not been extubated within 48 hrs. of admit to ICU (unless patient is already on a VDR)
  - or -
  - Patient has Hx of RAD/COPD with home nebulizer use.

LEH IPV Applications

Before IPV
After One 20min. IPV Rx

**IPV**

- Thermal Lung Injury
- Secretion Management
- Airway Restriction
- Rescue
  - H1N1 and ECMO ventilation
  - When all others fail

**Ventilation Strategy**

- Anticipated short-term need for ventilatory support or otherwise stable patient with DNI status
- Place on conventional ventilation
- Does patient improve?
- Does pt have non-compliant lungs, ARDS or meet moderate criteria for ISS?
- Is pt on appropriate PEEP, recruitment maneuvers, and/or appropriate fluid / volume support?
- Apply combination of optimal PEEP, recruitment maneuvers, and/or cardiovascular support.
- Pt improvement over the past 12 hours? (P/F ratio >200)
- Continue with conventional ventilation
- Patient improved P/F ratio over 8-12 hours
- Consider APRV, ARDS Network Protocol or VDR
- Place on VDR
- Place on APRV or ARDS Network Protocol
- Patient improvement over 8-12 hours? (P/F ratio >200)
- Continue APRV

**P/F ratio**

0.00
0.25
0.50
0.75
1.00
0
50
100
150
200

Analysis time (days)

**Conventional ECMO**

- Kaplan-Meier survival estimates, by allocation
  - 63%
  - 47%
  - RR 0.69
  - 95% CI 0.05 – 0.97
  - p=0.03
6. Adjust VT and RR to achieve pH and plateau pressure goals below.

5. Set initial rate to approximate baseline minute ventilation (not > 35 bpm).

4. Females = 45.5 + 2.3 [height (inches) - 60]

1. Calculate predicted body weight (PBW)

VENTILATOR SET-UP

NOTE: We should avoid mask BIPAP as it is relatively ineffective, and with H1N1 virus causes a significant addition to our practice.

If assisted ventilation is required, initiate with standard modes:

1. PaO2/FiO2 < 300 (corrected for altitude)
2. Bilateral (patchy, diffuse, or homogeneous) infiltrates consistent with ALI/ARDS
3. No clinical evidence of left atrial hypertension (nl CVP or Paw)

ALI/ARDS Inclusion Criteria:

- Bilateral Infiltrates
- PaO2/FiO2 < 300 (ALI)

Adult H1N1 ARDS Ventilator Strategy

- Conventional Ventilation
- Place on APRV See Page 3

- Consider Consultation or Place on HFOV: See page 4

Evaluate for Proning, Paralytics, Nitric Oxide

- Consider for Recruitment Maneuvers*
- Consider CT scan: evaluate for reversible issues

Temporary LEH Consensus Respiratory Protocol

- Efficacy of NIPPV
- Evaluate for paralytics
- Set PEEP above Lower Inflection Point with PEEP 10cm above LIP

- No increase in plateau pressure or VT
- Must be approved by physician

- Evaluate for massive air leak
- Massive Secretions/Lobar collapse
- Massive Secretions/Obstructed airway

- Acute onset of –

- Need for ventilatory support

- Consensus ECMO Protocol

- ECMO Service
- American College of Surgeons Level I
- Oregon Health Division I
- initiated in 1988
- 2770 admissions

Cardiac Program
- Full spectrum – congenital, coronary, complex aortic
- Pediatric and adult

ECMO program
- neonatal 1987
- pediatric 1998
- adult 1986
Table 1. Risk Factors for Complications of Influenza A H1N1 Virus Infection

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Examples and Comments</th>
</tr>
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<tbody>
<tr>
<td>Age &lt;5 yr</td>
<td>Increased risk especially for children of age, highest hospitalization rates among children &lt;5 yr.</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>Risk of hospitalization increased by factor of 3-7, as compared with age-matched nonpregnant women, with highest risk in third trimester.</td>
</tr>
<tr>
<td>Chronic cardiovascular condition</td>
<td>Congestive heart failure or atherosclerotic disease, hypertension not shown to be an independent risk factor</td>
</tr>
<tr>
<td>Chronic lung disorder</td>
<td>Asthma or COPD, cystic fibrosis</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Neurologic condition</td>
<td>Neuromuscular, neurodegenerative, or seizure disorder</td>
</tr>
<tr>
<td>Immunosuppression</td>
<td>Associated with H1N1 infection, organ transplantation, receipt of chemotherapy, or maintenance of renal or hematopoietic transplant</td>
</tr>
<tr>
<td>Alcohol (excess)</td>
<td>Suggests that use is a predictor for complications requiring hospitalization or ICU admission and possibly for death</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Sickle cell anemia</td>
</tr>
<tr>
<td>Chronic renal disease</td>
<td>Renal dialysis or transplantation</td>
</tr>
<tr>
<td>Chronic hepatic disease</td>
<td>Cirrhosis</td>
</tr>
<tr>
<td>Long-term antiretroviral therapy</td>
<td>Suggests but not yet proved to be an independent risk factor</td>
</tr>
<tr>
<td>Long-term aspirin therapy in children</td>
<td>Risk of Reye’s syndrome, drugs containing salicylates should be avoided in children with influenza</td>
</tr>
<tr>
<td>Age ≥65 yr</td>
<td>Highest case fatality, variable based on case of infection</td>
</tr>
</tbody>
</table>

* COPD denotes chronic obstructive pulmonary disease, HIV human immunodeficiency virus, and ICU intensive care unit. A body mass index (BMI) greater than or equal to 30 kg/m² is defined as obesity.
A man suffered from insomnia and dyslexia. He was also an agnostic. What did he do?

- He stayed up all night wondering if there was a DOG.