Improving Patient/Ventilator Synchrony!
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Thille ICM 2006;32:1515
• 62 consecutive pts, MV > 24 hrs, 11 VA/C, 51 PS
• Median episodes/pt VA/C 72 (13-215), PS 16 (4-47)/30 minute period, p=0.04
• A higher incidence of asynchrony was associated with a longer period of MV 25.5 vs. 7.5 days

De Wit CCM 2009;37:2740
• 60 consecutive pts, MV > 24 hrs, 10 min during the 1st 24 hours were analyzed
• 16 patients an asynchrony index >10%
• AI >10% predicted longer LOS (21 vs. 8 days p < 0.03)

Pressure vs Volume Ventilation

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal Volume</td>
<td>Variable</td>
</tr>
<tr>
<td>Peak Alv Press</td>
<td>Constant</td>
</tr>
<tr>
<td>Peak Air Press</td>
<td>Constant</td>
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<tr>
<td>Flow Pattern</td>
<td>Decelerating</td>
</tr>
<tr>
<td>Peak Flow</td>
<td>Variable</td>
</tr>
<tr>
<td>Inspir Time</td>
<td>Preset</td>
</tr>
<tr>
<td>Minimum Rate</td>
<td>Preset</td>
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</tbody>
</table>

- Volume Ventilation
  - Tidal Volume set
  - Inspiratory Time set
  - Flow Waveform set
  - Peak Flow set
- Pressure Ventilation
  - Pressure Level set
  - Inspiratory Time set (PA/C only)
  - Tidal Volume dependent upon
    - Pressure level and Inspiratory Time
    - Patient lung and chest wall compliance
    - Patient inspiratory demand
**Asynchrony**
- Flow asynchrony – Inadequate flow at onset of inspiration to meet patient demand
- Trigger asynchrony – Poor coordination of patients initiation of inspiration and ventilator response
  - Trigger delay
  - Double trigger
  - Missed trigger
  - Auto trigger
- Cycling asynchrony – Poor coordination of patients desire to exhale and ventilator response
  - Inappropriately short inspiratory time
  - Inappropriately long inspiratory time
- Mode Asynchrony – Inappropriate mode

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**Inspiratory Time**
- In spontaneous breathing patients, ventilator inspiratory time should equal patient desired inspiratory time.
- Spontaneous breathing - inspiratory time ≤ 1.0 seconds.
- Patients with high ventilatory demand, inspiratory time maybe as short as 0.5 seconds.

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*Nilsestuen, Hargett RC 2005;50:202*

*Martini ARRD 1986;134:902*

*Fernandez AJRCCM 1999;159:710*
Correct Rise Time

- Initial Pressure should not exceed set level
- No Delay in Initial Increase in Pressure
- Initial Pressure Rise should not be Concave
- If Ventilator does not have Rise Time, consider adjusting pressure
- The future – ventilators will automatically adjust rise time

- 20 pts with ARDS volume ventilation 6 ml/kg,
- Richman agitation scale averaged -4
- 2.3±3.5 times/minute
- Median tidal volume 10.1 (8.8 – 10.7) ml/kg PBW
- Required larger Vₜ 7 to 8 ml/kg PBW or sedation

POHLMAN CCM 2008;36:3015
Auto-PEEP – Work of Breathing

- Alveolar Pressure +10 cmH₂O
- Airway Pressure 0 cmH₂O
- Trigger Pressure -2 cmH₂O
- Patient Pressure change -12 cmH₂O needed to trigger

PEEP Application

If auto-PEEP measured, set PEEP at about 70% to 80% of measured level
If auto-PEEP unmeasured, set PEEP at 5 cmH₂O
If untriggered breathes still present, increase PEEP in 1 to 2 cmH₂O steps until patient rate and ventilator response rate are equal
PSV: Termination of Inspiration

- Primary-Patients Inspir Flow Decreases to a Predetermined Level
  - 25%, 5 LPM or 5% of Peak Flow
  - Newer ventilators 5% to 85%

- Secondary-End Inspir Pressure exceeds Target Level

- Tertiary-Lengthy Inspir Time (2 to 3 Sec)
Inappropriate PSV or PA/C Level

- To low a pressure level increases patient demand increasing patient work.
- To high a level causes dysynchrony: forced exhalation, air trapping and increased ventilatory demand.
- Frequently, decreasing PSV or PA/C level may be the correct choice.

Thille ICM 2008;34:1477

- 12 pts with > 10% ineffective triggering with PS.
- Reducing PS from 20 to 13 cm H2O decreased VT from 10.2 ml/kg to 5.9 ml/kg PBW and eliminated ineffective triggering.
- No change in RR 25.6 to 29.4/min, patient effort or PaCO2.

SIMV

- Potential for high level of dyssynchrony, and patient work of breathing.
- No data to demonstrate better outcome.
- Data does indicate that SIMV prolongs weaning from ventilatory support.
- When paired with Pressure Support does decrease WOB and Dyssynchrony but makes weaning more confusing.

<table>
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<tr>
<th>Spontaneous Breath</th>
<th>Mandatory Breath</th>
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<tr>
<td>Pressure (cm H2O)</td>
<td>Flow (L/min)</td>
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Marini ARRD 1988:138;1169
Kapasi Ped CCM 2001:2;9

- 7 stable, ventilated neonates
- 31.4±2 weeks gestation
- 1.49±0.38 kg
- Randomly applied IMV, SIMV, PS, PA/C for 20 min each
- Used clinician set FIO2, rate, PIP and PEEP

Thank You