Implementing Volume Targeted Ventilation to Decrease Hypocarbia in ELBW Neonates During the First Week of Life

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Introduction

❖ Hypocarbia in neonates increases the risk of poor neurodevelopmental outcomes
❖ A significant cause of hypocarbia is mechanical ventilation
❖ Pressure limited ventilation, commonly used in the NICU is associated with wide swings in pCO2 levels
❖ Volume targeted ventilation (VTV) may decrease hypocarbia risk due to self-weaning properties

Setting

❖ Academic level IV NICU, 50 intensive care beds and 21 step down beds
❖ 100 ELBW neonates admitted yearly
❖ 68% of babies <30 weeks GA treated with CPAP before intubation in the delivery room
❖ CLD rates – 53.6% in babies < 30 weeks

Aim

❖ To decrease the incidence of hypocarbia (a single blood gas with pCO2 <35 mmHg) in ELBW infants during the first week of life by 50%

Measures

Outcome measure
❖ Incidence of hypocarbia

Process measures
❖ Use of VTV as initial mode of ventilation
❖ Staff education
❖ Acquisition of addition units of VTV capable ventilators

Balancing measure
❖ Rate of reintubation in the first week of life

Results

Patient characteristics and outcomes by first mode of mechanical ventilation

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>VTV (N = 61)</th>
<th>Other mode (N = 44)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age (weeks)</td>
<td>26 (25, 27)</td>
<td>25 (24, 26)</td>
<td>0.001</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>800 (745, 970)</td>
<td>730 (625, 860)</td>
<td>0.008</td>
</tr>
<tr>
<td>Betamethasone complete</td>
<td>29 (49%)</td>
<td>19 (49%)</td>
<td>0.394</td>
</tr>
<tr>
<td>Age at intubation (d)</td>
<td>0 (0, 3)</td>
<td>0 (0, 2)</td>
<td>0.274</td>
</tr>
<tr>
<td>Duration of first intubation (d)</td>
<td>3 (1, 3)</td>
<td>7 (1, 7)</td>
<td>0.003</td>
</tr>
<tr>
<td>Number of gas samples in first 7 d of life</td>
<td>30 (4, 17)</td>
<td>20 (14, 29)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Reintubation within 7 d of life</td>
<td>22 (30%)</td>
<td>4 (9%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Hypocarbia within 7 d of life</td>
<td>32 (57%)</td>
<td>30 (68%)</td>
<td>0.361</td>
</tr>
<tr>
<td>Timing of first hypocarbia episode (d)</td>
<td>0 (1, 1)</td>
<td>0 (0, 3)</td>
<td>0.372</td>
</tr>
<tr>
<td>Number of hypocarbia episodes</td>
<td>3 (0, 2)</td>
<td>1 (0, 3)</td>
<td>0.188</td>
</tr>
</tbody>
</table>

❖ Observations censored at 7 days of life. Hypocarbia was defined as pCO2 <35 mmHg.

Discussion

❖ Neonates with VTV as initial mode were larger and more mature
❖ Use of VTV was increased and maintained above goal
❖ No difference in hypocarbia in the first week of life – incidence, timing or number of episodes
❖ Shorter initial ventilation courses but higher reintubation rates for neonates on VTV
❖ Fewer blood gases needed – ventilator is self-weaning
❖ Education and multi-disciplinary input crucial to achieving and maintaining goal

Key drivers

Primary drivers
❖ VTV as initial mode of ventilation
❖ Provider education and awareness
❖ Unit culture

Secondary drivers
❖ Available units of VTV capable ventilators
❖ Means of disseminating information and results
❖ Multi-disciplinary involvement in decision making
❖ Availability and use of ventilator policy

Change cycles

PDSA 1 Literature review
Collection of baseline data and identification of drivers and selection of measures

PDSA 2 Education of staff
Implementation of intervention

PDSA 3 Strategic reserving of VTV capable ventilators

PDSA 4 Survey of staff to assess attitudes and identify problems

PDSA 5 Re-education of staff

PDSA 6 Additional ventilators purchased

References

❖ Brown MK, Dibbell RM. Mechanical ventilation of the premature neonate. Respir Care. 2011;56:1286-1291