Q9 For children receiving home mechanical ventilation, is pulse oximetry with carbon dioxide monitoring as good as multichannel study monitoring when monitoring mechanical ventilation at home?

Contents

Question Evidence Review ................................................................. 2
  Background .................................................................................. 2
  Outcomes .................................................................................... 2
  Evidence Review ........................................................................... 2
  Evidence Statements ..................................................................... 2
  Recommendations ......................................................................... 3
  Good Practice Points ...................................................................... 3
  Research Recommendations ......................................................... 3

References ..................................................................................... 3

Question Protocol ............................................................................ 4
Question Evidence Review

Q9 For children receiving home mechanical ventilation, is pulse oximetry with carbon dioxide monitoring as good as multichannel study monitoring when monitoring mechanical ventilation at home?

Background

Children receiving home mechanical ventilation are a clinically varied group with a significant range of underlying problems such as neuromuscular diseases, bronchopulmonary dysplasia, cerebral palsy, congenital central hypoventilation syndrome and obstructive sleep apnoea. For those who have significant disability, bringing them to hospital for complex testing can be a major undertaking, so the ability to perform mechanical ventilation monitoring at home using pulse oximetry and carbon dioxide (CO$_2$) monitoring could be of significant benefit. This review will investigate if pulse oximetry with CO$_2$ monitoring is as good as multichannel study monitoring for monitoring children who are receiving home mechanical ventilation.

Outcomes

Adherence to treatment, sleep quality, quality of life, improved efficiency of care and the need for repeat monitoring.

Evidence Review

The initial literature search identified 12 studies, of which two were deemed relevant but no study directly compared pulse oximetry with CO$_2$ monitoring against multichannel study monitoring for monitoring mechanical ventilation at home.

Adherence to treatment, sleep quality, quality of life, improved efficiency of care and the need for repeat monitoring

There were no studies that reported on adherence to treatment, sleep quality, quality of life, improved efficiency of care or the need for repeat monitoring. Because of the lack of supporting evidence, the review has been extended to include the feasibility of pulse oximetry and CO$_2$ monitoring to detect respiratory events associated with non-invasive ventilation (NIV).

One study investigated whether pulse oximetry and transcutaneous CO$_2$ changes were associated with the occurrence of respiratory events during continuous positive airway pressure (CPAP) therapy. Defining abnormal gas exchange as an oxygen saturation (SpO$_2$) ≤90% for at least 2% of night time and/or a transcutaneous carbon dioxide (PtCO$_2$) ≥50 mmHg for at least 2% of night time and/or an oxygen desaturation index ≥1.4/h, the sensitivity and specificity of abnormal gas exchange to detect abnormal polygraphy (defined as total respiratory events >1.5/h) were 0.64 and 0.47 respectively. However, no patients with moderate/severe polygraphy results (total respiratory events >5/h) had normal gas exchange.$^1$

A second study reported on the polygraphic respiratory events of children on NIV. The polyographies of 39 children with mixed diagnoses (13 with neuromuscular disease, 15 with obstructive sleep apnoea (OSA) and 11 with lung disease) were analysed. When the predominant respiratory event exceeded 50 events/h, NIV settings were adjusted and a second polygraphy was performed after 2–4 weeks. Unintentional leak and patient-ventilator asynchrony were the most common events. Unintentional leaks were most frequently associated with autonomic arousals, whereas patient ventilator asynchronies were rarely associated with autonomic arousal or >3% desaturation. For the eight children who had their ventilatory settings adjusted, the respiratory events significantly decreased on the repeat polygraphy ($p = 0.005$).$^2$

Evidence Statements

Based on the very limited supporting evidence, pulse oximetry with CO$_2$ monitoring at home may be inferior to inpatient polygraphy for monitoring respiratory events during mechanical ventilation (Ungraded).
Recommendations

Based on the limited evidence, no recommendations can be made on the use of pulse oximetry with carbon dioxide monitoring for home monitoring of children receiving home mechanical ventilation

Good Practice Points

✓ If children are receiving continuous positive airway pressure therapy (CPAP) and bi-level positive airway pressure (BiPAP), regular monitoring should be provided with a minimum of pulse oximetry and carbon dioxide monitoring

✓ When deciding on which type of sleep study to perform, the relative risks and benefits of each should be discussed with the patient and/or carer

✓ Data download from a continuous positive airway pressure (CPAP) device or ventilator can help complement results from a sleep study, but operators should note that many ventilator algorithms, such as apnoea hypopnoea index (AHI), have not been validated in children

Research Recommendations

▪ Further research is needed into assessing the clinical outcomes of pulse oximetry and CO₂ monitoring against multichannel study monitoring for monitoring children receiving home mechanical ventilation

▪ Continuous positive airway pressure (CPAP) device and ventilator algorithms need to be validated in children

References


### Question Protocol

<table>
<thead>
<tr>
<th>Field</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Review Question</strong></td>
<td>For children receiving home mechanical ventilation, is pulse oximetry with CO\textsubscript{2} monitoring as good as multichannel study monitoring when monitoring mechanical ventilation at home?</td>
</tr>
<tr>
<td><strong>Type of review question</strong></td>
<td>Intervention review</td>
</tr>
</tbody>
</table>
| **Objective of the review**   | Children receiving home mechanical ventilation are a clinically very varied group with a significant range of underlying problems. Many have very significant disability and bringing them to hospital for complex testing is a major undertaking. However, many will have a care package with trained professionals and therefore pulse oximetry/CO\textsubscript{2} monitoring may be feasible at home. Their clinical status may change over time and monitoring and adjustment of support is likely.  
  - Is pulse oximetry/CO\textsubscript{2} monitoring testing feasible for such children?  
  - Does pulse oximetry/CO\textsubscript{2} monitoring result in more changes in care?  
  - Is there a difference in the identification of inappropriate ventilation settings when using pulse oximetry/CO\textsubscript{2} monitoring? |
| **Eligibility criteria – population / disease / condition / issue / domain** | Children (<17 years) receiving home mechanical ventilation                                                                                   |
| **Eligibility criteria – intervention(s)** | Pulse oximetry and CO\textsubscript{2} monitoring alone                                                                                   |
| **Eligibility criteria – comparators(s)** | Multichannel studies                                                                                                                         |
| **Outcomes and prioritisation** | Adherence to treatment  
  Sleep quality  
  Quality of life  
  Improved efficiency of care  
  Clinical outcomes  
  Need for repeat monitoring |
| **Eligibility criteria – study design** | Randomised controlled trials  
  Observational studies  
  Case series  
  Superiority studies |
### Other inclusion / exclusion criteria

- Non-English language excluded unless full English translation is provided.
- Conference abstracts, Cochrane reviews, systematic reviews, and reviews are included.
- Cochrane reviews and systematic reviews can be referenced in the text but **DO NOT** use in a meta-analysis.

### Proposed sensitivity / subgroup analysis, or meta-regression

- Children <2 years with neuromuscular paralysis
- Children 2-16 years with neuromuscular paralysis
- Children <2 years with congenital central hypoventilation syndrome (CCHS)
- Children 2-16 years with CCHS
- Children <2 years with airway disorders
- Children 2-16 years with airway disorders

### Selection process – duplicate screening / selection / analysis

Agreement should be reached between Guideline members who are working on the question. If no agreement can be reached, a decision should be made by the Guideline co-chairs. If there is still no decision, the matter should be brought to the Guideline group and a decision will be made by consensus.

### Data management (software)

- **RevMan5**
  - Pairwise meta-analyses
  - Evidence review/considered judgement.
  - Storing Guideline text, tables, figures, etc.
- **Gradeprofiler**
  - Quality of evidence assessment
- **Gradepro**
  - Recommendations

### Information sources – databases and dates

- MEDLINE, Embase, PubMed, Central Register of Controlled Trials and Cochrane Database of Systematic Reviews
- No date restriction

### Methods for assessing bias at outcome / study level

- **RevMan5** intervention review template and NICE risk of bias checklist

### Methods for quantitative analysis – combining studies and exploring (in)consistency

- If 3 or more relevant studies:
  - **RevMan5** for meta-analysis, heterogeneity testing, and forest plots

### GRADEprofiler

- Intervention review quality of evidence assessment for each outcome
<table>
<thead>
<tr>
<th>Meta-bias assessment – publication bias, selective reporting bias</th>
<th>(follow instructions in 'BTS Guideline Process Handbook – Intervention Review')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale / context – what is known</td>
<td>There are thought to be varying practices and models of care across the UK. It is thought likely that the evidence base is small.</td>
</tr>
</tbody>
</table>