BTS Guideline for diagnosing and monitoring paediatric sleep disordered breathing

Online Appendix 5 Question 5 Evidence Review and Protocol

Q5 What is the diagnostic accuracy of oximeters with and without motion artefact removal and oximeters with long and short averaging times for children with suspected sleep disordered breathing?

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Question Evidence Review

Q5 What is the diagnostic accuracy of oximeters with and without motion artefact removal and oximeters with long and short averaging times for children with suspected sleep disordered breathing?

Background

In the last 10-15 years there have been significant developments in signal processing and measuring technology for oximeters aimed at improving the estimation of blood oxygen saturation and the more accurate exclusion of movement artefact. Although there are a number of studies which highlight the benefits of using oximeters that exclude motion artefact and have short averaging times to accurately predict sleep disordered breathing, there is limited data directly comparing these oximeters with conventional oximeters without motion artefact removal and longer averaging times. Hence, this review aims to determine the diagnostic accuracy of oximeters with and without motion artefact removal and oximeters with long and short averaging times in children less than 17 years of age with suspected sleep disordered breathing (SDB).

Outcomes

Diagnostic accuracy of oximeters with and without motion artefact removal and oximeters with long and short averaging times

Evidence Review

The initial literature search identified seven papers, but only one was deemed relevant.[1] This paper compared the effects of two oximeters, one with motion artefact removal and one without motion artefact removal, to detect sleep desaturation in children with suspected SDB, but diagnostic accuracy data was not reported. There were no studies that investigated the effects of different oximeters with differing averaging times (long and short) for diagnosing SDB.

Trang et al determined the number of respiratory event-related desaturations ≥3% or ≥5% and found significantly more true events and significantly fewer artefactual events with motion artefact removal for respiratory event-related desaturations ≥3% and ≥5% (p <0.001 and p = 0.01 respectively for both) when compared with no motion artefact removal. A summary of the results is shown in Table 5a.

Table 5a: Comparison of respiratory event-related desaturations ≥3% or ≥5% between an oximeter with motion artefact removal and an oximeter without motion artefact removal

Oximeter	Events detected	Artefactual events	True events
	Respiratory event-related desaturations ≥3%		
With motion artefact removal	664	13	651
Without motion artefact removal	483	127	356
p	<0.001	<0.001	<0.001
	Respiratory event-related desaturations ≥5%		
With motion artefact removal	252	10	242
Without motion artefact removal	243	115	128
p	NS	0.01	0.01

NS – not significant

Evidence Statement

Based on the limited evidence, the addition of motion artefact removal to oximeter signal analysis appears to improve the detection of true desaturation events (**Ungraded**)

Recommendation

- Pulse oximetry should be undertaken using an oximeter with a software algorithm to minimise the influence of motion artefact (**Conditional** – by consensus)

Good Practice Point

- ✓ Based on the Australasian Sleep Association's 'Overnight oximetry for evaluating paediatric obstructive sleep apnoea: Technical specifications and interpretation guidelines'[2], a short pulse oximetry averaging time of 2-3 seconds should be used when diagnosing OSA in children

Research Recommendation

- Research is needed to determine the impact of different averaging times and motion artefact rejection algorithms on the diagnostic accuracy of oximetry to determine sleep disordered breathing across the paediatric spectrum from infancy to older childhood

References

1. Trang H, Boureghda S, Leske V. Sleep desaturation: comparison of two oximeters. *Pediatric Pulmonology.* 2004;37:76-80.
2. Twiss J, Chawla J, Davey MJ, et al. Overnight oximetry for evaluating paediatric obstructive sleep apnoea: Technical specifications and interpretation guidelines. *J Paediatr Child Health.* 2019;55:1279.

Question Protocol

Field	Content
Review Question	For children with suspected sleep disordered breathing, what is the diagnostic accuracy of oximeters with and without motion artefact removal and oximeters with long and short averaging times?
Type of review question	Diagnostic accuracy
Objective of the review	This review aims to determine whether modern oximeters that use short averaging times and motion artefact removal are better at detecting OSA than those that do not.
Eligibility criteria – population / disease / condition / issue / domain	Children (<17 years) with suspected sleep disordered breathing
Eligibility criteria – intervention(s)	Oximeters with motion artefact removal Oximeters without motion artefact removal Oximeters with short averaging time Oximeters with long averaging time
Eligibility criteria – comparators(s)	Polysomnography
Outcomes and prioritisation	Diagnostic accuracy
Eligibility criteria – study design	Randomised controlled trials
Other inclusion /exclusion criteria	Non-English language excluded unless full English translation Conference abstracts, Cochrane reviews, systematic reviews, reviews 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 Children 2-16 years

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 — Meta-analysis data input. Evidence review/considered judgement. Storing Guideline text, tables, figures, etc. MetaDTA — Data meta-analyses Gradepro — Quality of evidence assessment / Recommendations
Information sources – databases and dates	MEDLINE, Embase, PubMED, Central Register of Controlled Trials and Cochrane Database of Systematic Reviews No date restrictions
Methods for assessing bias at outcome / study level	RevMan5 diagnostic accuracy full review template (based on QUADAS2) (follow instructions in '*BTS Guideline Process Handbook - Diagnostic Accuracy*')
Methods for quantitative analysis – combining studies and exploring (in)consistency	If 3 or more relevant studies: RevMan5 for forest plots, summary ROC plot MetaDTA to combine studies (pooled specificity, sensitivity, likelihood ratios, diagnostic odds ratio and confidence intervals) and calculate RevMan parameters for summary ROC plot (follow instructions in '*BTS Guideline Process Handbook - Diagnostic Accuracy*')
Meta-bias assessment – publication bias, selective reporting bias	GRADEpro — Diagnostic accuracy quality of evidence assessment for each index test (follow instructions in '*BTS Guideline Process Handbook - Diagnostic Accuracy*')
Rationale / context – what is known	There are a number of studies highlighting the benefits of using monitors that exclude motion artefact and have short averaging times, but there is limited data directly comparing these modern oximeters with other oximeters in their capacity to accurately predict OSA