TITLE: CO-Oximetry Involving Continuous Monitoring of Carboxyhemoglobin, Methemoglobin, and Oxygen Saturation: Clinical Effectiveness

DATE: 24 August 2009

RESEARCH QUESTIONS:

1. What are the benefits and harms of CO-oximetry that involves continuous monitoring of carboxyhemoglobin, methemoglobin, and oxygen saturation levels for the diagnosis of carbon monoxide poisoning?

2. What is the diagnostic accuracy of using CO-oximetry to diagnose carbon monoxide poisoning?

METHODS:

A limited literature search was conducted on key health technology assessment resources, including PubMed, the Cochrane Library (Issue 3, 2009), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI, EuroScan, international health technology agencies, and a focused Internet search. The search was limited to English language articles published between 2004 and August 2009. Filters were applied to limit the retrieval to health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, controlled clinical trials, observational studies, and safety data for Question 1. For Question 2, filters to limit retrieval to health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, controlled clinical trials, and observational studies, were applied. Internet links were provided, where available.

The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.
RESULTS:

HTIS reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, controlled clinical trials, and observational studies.

Five observational studies were identified regarding the benefits and harms of CO-oximetry that involves continuous monitoring of carboxyhemoglobin, methemoglobin, and oxygen saturation levels for the diagnosis of carbon monoxide poisoning and the diagnostic accuracy of using CO-oximetry to diagnose carbon monoxide poisoning. No relevant health technology assessments, systematic reviews, meta-analyses, randomized controlled trials or controlled clinical trials were identified from the literature search results. Additional articles of interest may be found in the appendix.

OVERALL SUMMARY OF FINDINGS:

Five observational studies\(^1\text{-}\text{5}\) were identified regarding the benefits and harms of CO-oximetry that involves continuous monitoring of carboxyhemoglobin, methemoglobin, and oxygen saturation levels for the diagnosis of carbon monoxide poisoning and the diagnostic accuracy of using CO-oximetry to diagnose carbon monoxide poisoning. Two observational studies\(^4\text{-}\text{5}\) tested the ability of the Masimo Rad-57 pulse oximeter to measure carbon monoxide (CO) in the blood of healthy volunteers. Barker et al.\(^4\) observed 20 healthy volunteers who were exposed to either CO (to elevate carboxyhemoglobin levels) or intravenous sodium nitrite (to induce the production of methemoglobin). All volunteers were fitted with both an arterial cannula and six pulse oximeter sensors. Arterial blood was analyzed in the laboratory and the carboxyhemoglobin and methemoglobin levels were compared to those obtained from the pulse oximeter sensors. The authors concluded that the device was effective and will be added to their oxygenation monitoring equipment.\(^4\) Hampson et al.\(^5\) tested pulse oximeters on 23 non-smokers and 15 smokers exposed to cigarette smoke in a bingo hall. Carboxyhemoglobin levels were measured pre and post-exposure. The authors determined that the pulse oximeter was conducive to use in an ambulatory setting.\(^5\)

Three studies were conducted in hospital emergency departments (EDs).\(^1\text{-}\text{3}\) Chee et al.\(^1\) conducted a retrospective chart review to determine the CO-oximeter’s ability to detect elevated carboxyhemoglobin levels indicating CO poisoning. When used at triage in an ED, the Rad-57 was helpful in identifying CO poisoning in seven patients. The authors determined the pulse CO-oximeter could be a useful triage tool for patients presenting with nonspecific symptoms.\(^1\) Suner et al.\(^3\) also screened carboxyhemoglobin levels in 10,856 adult patients presenting to an ED with non-specific symptoms. Eleven patients were identified as having CO toxicity after presenting with symptoms inconsistent with CO toxicity. The authors concluded the CO-oximeter is acceptable for CO toxicity screening even in a busy ED setting.\(^3\) Coulange et al.\(^2\) tested the reliability of the CO-oximeter in patients with suspected CO poisoning. Twelve patients were included and all carboxyhemoglobin levels were assessed by both the pulse oximeter and blood sampling. No significant difference was observed between the two assessments. The authors concluded that the results obtained with the CO-oximeter are reliable and may be useful in the ED environment.\(^2\)

All five studies\(^1\text{-}\text{5}\) found the non-invasive CO-oximeters to be useful for measuring CO levels. These devices are conducive to use in an ambulatory setting\(^5\) and may represent a useful tool for triage and screening in the ED.\(^1\text{-}\text{3}\)
REFERENCES SUMMARIZED:

Health technology assessments
No literature identified

Systematic reviews and meta-analyses
No literature identified

Randomized controlled trials
No literature identified

Controlled clinical trials
No literature identified

Observational studies


5. Hampson NB, Scott KL. Use of a noninvasive pulse CO-oximeter to measure blood carboxyhemoglobin levels in bingo players. Respir Care 2006;51(7):758-60. PubMed: PM16800910

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APPENDIX – FURTHER INFORMATION:

Review articles


Additional references