Cochrane
Library

Cochrane Database of Systematic Reviews

Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants (Review)

Pritchard MA, Flenady V, Woodgate PG

Pritchard MA, Flenady V, Woodgate PG.
Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants.
Cochrane Database of Systematic Reviews 2001, Issue 1. Art. No.: CD000427.
DOI: [10.1002/14651858.CD000427](https://doi.org/10.1002/14651858.CD000427).

www.cochranelibrary.com

TABLE OF CONTENTS

HEADER	1
ABSTRACT	1
PLAIN LANGUAGE SUMMARY	2
BACKGROUND	3
OBJECTIVES	3
METHODS	3
RESULTS	5
DISCUSSION	5
AUTHORS' CONCLUSIONS	6
ACKNOWLEDGEMENTS	6
REFERENCES	7
CHARACTERISTICS OF STUDIES	8
DATA AND ANALYSES	9
Analysis 1.1. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 1 Hypoxemia end of first suction (TcPO ₂ <40mmHg).	10
Analysis 1.2. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 2 Hypoxemia end of second suction (TcPO ₂ <40mmHg).	10
Analysis 1.3. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 3 Hypoxemia 120 seconds post-suction (TcPO ₂ <40mmHg)..	11
Analysis 1.4. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 4 TcPO ₂ end of first suction (mmHg)..	11
Analysis 1.5. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 5 TcPO ₂ end of second suction (mmHg).	11
Analysis 1.6. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 6 TcPO ₂ 120 seconds post-suction (mmHg).	11
Analysis 1.7. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 7 Recovery time in minutes.	12
Analysis 1.8. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 8 One or more episodes of bradycardia.	12
WHAT'S NEW	12
HISTORY	12
CONTRIBUTIONS OF AUTHORS	13
DECLARATIONS OF INTEREST	13
SOURCES OF SUPPORT	13
INDEX TERMS	13

[Intervention Review]

Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants

Margo A Pritchard¹, Vicki Flenady², Paul G Woodgate³

¹Perinatal Research Centre Women's & Newborn Services, Royal Women's Hospital, Herston, Australia. ²Mater Mother's Research Centre, Mater Health Services, Woolloongabba, Australia. ³Dept of Neonatology, Mater Mothers' Hospital, South Brisbane, Australia

Contact address: Margo A Pritchard, Perinatal Research Centre Women's & Newborn Services, Royal Women's Hospital, Bowen Bridge road, Herston, Brisbane, 4029, Australia. m.pritchard@uq.edu.au.

Editorial group: Cochrane Neonatal Group

Publication status and date: New search for studies and content updated (no change to conclusions), published in Issue 1, 2010.

Citation: Pritchard MA, Flenady V, Woodgate PG. Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants. *Cochrane Database of Systematic Reviews* 2001, Issue 1. Art. No.: CD000427. DOI: [10.1002/14651858.CD000427](https://doi.org/10.1002/14651858.CD000427).

Copyright © 2010 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

ABSTRACT

Background

Endotracheal suctioning for mechanically ventilated infants is routine practice in neonatal intensive care. However, this practice is associated with serious complications including lobar collapse, pneumothorax, bradycardia and hypoxaemia. Increasing the inspired oxygen immediately prior to suction (preoxygenation) has been proposed as an intervention that may minimise the risk of these complications.

Objectives

To compare the effects of preoxygenation with no preoxygenation for endotracheal suctioning on ventilated newborn infants. To conduct subgroup analyses by i) by gestational age and by underlying disease (infants with or without chronic lung disease) and; ii) by different techniques of endotracheal suctioning.

Search methods

Updated searches of MEDLINE (search via PubMed), CINAHL, EMBASE and *The Cochrane Library* from 2007 to January 31, 2009. Search terms: oxygen*, suction*, preoxygenation, pre-oxygenation. Limits: human, newborn infant and clinical trial. No language restrictions were applied.

Selection criteria

Random or quasi-random controlled trials of mechanically ventilated neonates in which endotracheal suctioning with preoxygenation was compared to suctioning without preoxygenation.

Data collection and analysis

Standard methods of the Cochrane Collaboration and the Neonatal Review Group were used, including independent assessment of trial quality and extraction of data by the authors. Data were analysed using relative risk (RR) and risk difference (RD) for dichotomous outcomes and mean difference (MD) for data measured on a continuous scale with the use of 95% confidence intervals.

Main results

One cross-over trial involving outcomes for 16 preterm neonates was included in this review (Walsh 1987). Preoxygenation prior to an endotracheal suctioning procedure involving two suctionings resulted in a statistically significant reduction in infants with hypoxaemia (Tc PO₂ <40 mmHg) at the end of the first suction (RR 0.18, 95% CI 0.05, 0.69), at the end of the second suction (RR 0.23, 95% CI 0.08, 0.66) and also at 120 seconds after the second suction (RR 0.10, 95% CI 0.01, 0.69). Mean Tc PO₂ was statistically significantly higher in the

preoxygenation group at the end of the first suction (MD 25.00 mmHg, 95%CI 14.20, 35.80), second suction (MD 24.80, 95% CI 14.80, 34.80) and also at 120 seconds after the second suction (MD 29.10, 95% CI 14.96, 43.24). The time taken to return to baseline oxygenation status was shorter than the group not receiving preoxygenation (MD -2.12 minutes, 95% CI -3.82, -0.42).

Authors' conclusions

This review does not provide sufficient evidence on which to base practice. Although preoxygenation was shown to decrease hypoxemia at the time of suctioning, this result comes from only one small poor quality trial in which other clinically important outcomes were not assessed. Further studies are needed.

PLAIN LANGUAGE SUMMARY

Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants

There is not enough evidence to demonstrate the effects of giving oxygen before tracheal suctioning for preterm babies receiving mechanical ventilation. A baby born too early (before 34 weeks gestation) often has immature lungs. This is a major cause of breathing failure and death. Mechanical ventilation (machine assisted breathing) keeps the baby breathing and reduces the risk of lung injury and disease. Endotracheal suctioning (removing unwanted fluid through the windpipe) is a routine part of mechanical ventilation, but can have serious complications such as pneumothorax (air in the lung cavity) and bradycardia (slow heart rate). Giving oxygen just before suctioning (preoxygenation) may minimise the risk of these complications. The review of trials did not find enough evidence on the effects of preoxygenation. More research is needed.

BACKGROUND

Description of the condition

Assisted mechanical ventilation is the mainstay of management of a variety of conditions affecting the neonate. However, there are a number of potential hazards associated with this life saving intervention. The presence of an endotracheal tube causes soft tissue irritation and increased secretions which increases the likelihood of tube blockage and lobar collapse. Endotracheal suctioning aims to reduce the problems resulting from build-up of secretions and tube obstruction such as discomfort, hypoxemia, hypercapnia and lobar collapse. The practice of endotracheal suctioning is therefore routine practice in neonatal intensive care.

However, there are a number of complications associated with this procedure that have been well documented (Downs 1978; Vaughan 1978; Simbruner 1981; Hill 1982; Perlman 1983; Alpan 1984; Drew 1986; Prendiville 1986; Macpherson 1988; Mehrabani 1991; Shorten 1991), including hypoxemia, bradycardia, tachycardia, atelectasis, pneumonia, fluctuations in blood pressure and intracranial pressure, localised trauma to the airway, sepsis and tube dislodgement.

Description of the intervention

Protocols for endotracheal care vary widely between institutions and, in general, are not based on sound evidence. Practices vary in relation to the use of normal saline instillation, chest wall vibrations and percussion, adaptors to enable closed methods of suction, increasing of ventilatory pressures and rate, manual ventilation, number of operators, suctioning frequency, and preoxygenation (Turner 1983; Tolles 1990).

How the intervention might work

Preoxygenation is a technique of increasing inspired oxygen immediately prior to the suction procedure to increase arterial oxygen saturation. It has been suggested that preoxygenation may minimise the hypoxemia and other adverse effects associated with endotracheal suctioning (Young 1984; Cheng 1989). However, this intervention may cause hyperoxia, which is associated with oxygen free radical damage. There is emerging data to suggest that oxygen free radical damage is associated with major morbidity (periventricular leukomalacia, retinopathy of prematurity, chronic lung disease) with the potential for major long-term sequelae (Tolles 1990; Taylor 1999; Inder 2000).

Why it is important to do this review

This review updates the existing review "Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants" published in the Cochrane Database of Systematic Reviews.

OBJECTIVES

To compare the effects of preoxygenation with no preoxygenation for endotracheal suctioning in ventilated newborn infants.

Subgroup analyses are planned to determine whether the results differ by:

Population (newborn infants) :

- by gestational age < 30 weeks, < 34 weeks and < 37 weeks; and

- by disease, infants with chronic lung disease compared to those without.

Intervention (different techniques of endotracheal suctioning):

- with or without disconnection from the ventilator;
- increased mechanical ventilation; and
- use of manual ventilation and chest wall vibrations or percussion.

METHODS

Criteria for considering studies for this review

Types of studies

All trials using random or quasi-random patient allocation, in which preoxygenation prior to tracheal suctioning was compared to suctioning without preoxygenation.

Types of participants

Newborn infants receiving ventilatory support via an endotracheal tube who received endotracheal suctioning.

Types of interventions

Preoxygenation immediately prior to endotracheal suctioning.

Types of outcome measures

Primary outcomes

- Severe retinopathy of prematurity (Stage III and IV)
- Retinopathy of prematurity (ROP) (Stages 1 to IV)
- Severe Intraventricular haemorrhage (IVH) (Grades 3 and 4)
- Intraventricular haemorrhage (Grades 1 to 4)
- Cerebral cystic formations (Periventricular leukomalacia, porencephalic cysts)

Secondary outcomes

- Chronic lung disease [infant receiving any respiratory support (supplemental oxygen or any form of assisted ventilation) for a chronic pulmonary disorder i) on the day they reached 36 weeks' post menstrual age; and ii) at 28 days postnatal age].
- Hypoxemia (TcPO₂ < 50 mmHg or SaO₂ < 90%)
- Hyperoxemia (TcPO₂ > 95 mmHg or SaO₂ > 98%)
- Blood pressure change (percentage change from the baseline to during suction)
- Bradycardia (decrease in heart rate to < 30% of baseline, or < 100 beats per minute)

Search methods for identification of studies

See: Collaborative Review Group search strategy. The standard search methods of the Cochrane Neonatal Review Group were used.

Electronic searches

Searches included the Oxford Database of Perinatal Trials, Cochrane Central Register of Controlled Trials (CENTRAL, The Cochrane Library, Issue 2, 2007), MEDLINE (1966 - September 2007), CINAHL (1982 - September 2007) using MeSH term infant-newborn and text terms oxygen*, suction*, preoxygenation, pre-oxygenation and premature.

In January of 2009 we updated the search as follows:
MEDLINE (search via PubMed), CINAHL, EMBASE and *The Cochrane Library* were searched from 2007 to January 31, 2009.
Search terms: oxygen*, suction*, preoxygenation, pre-oxygenation.
Limits: human, newborn infant and clinical trial.
No language restrictions were applied.

Searching other resources

The search included previous reviews including cross references, abstracts in conferences and symposia proceedings, and contact with expert informants.

Clinical trials registries were also searched for ongoing or recently completed trials (clinicaltrials.gov; controlled-trials.com; and who.int/ictpr)

Data collection and analysis

Standard methods of the Cochrane Collaboration as discussed in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2006) and the Cochrane Neonatal Review Group were used.

Selection of studies

All randomized and quasi-randomized controlled trials fulfilling the selection criteria described in the previous section were included. The investigators reviewed the results of the search and separately selected the studies for inclusion. The review authors resolved any disagreement by discussion.

Data extraction and management

Two review authors (MP, VF) independently extracted data, then compared and resolved differences. For each study, final data was entered into RevMan by one review author and then checked by a second review author.

Assessment of risk of bias in included studies

Four major sources of potential bias and methods of avoidance of these biases were considered when assessing trial quality; 1) Selection bias - blinding of randomization; 2) Performance bias - blinding of intervention; 3) Attrition bias - complete follow-up; 4) Detection bias - blinding of outcome assessment. The Cochrane Neonatal Group bases its quality assessments on systematic assessment of the opportunity for each of these biases to arise. Thus, the review authors judged from the report of the trial whether each of the criteria (methods of avoidance) was met. Each criterion was given a rating of either A if Yes (Adequate), B if Can't Tell (Unclear), or C if No (Inadequate). The quality assessment rating included in the Table of Included Studies refers to blinding of randomization alone.

The methodological quality of each trial was reviewed by two review authors (MP, VF) who then compared and resolved differences. Additional information was sought for all identified potentially eligible studies on randomization method. However, at the time of the review no correspondence was received.

For the update in 2009, the risk of bias table was completed in order to address the following questions:

1. Sequence generation: Was the allocation sequence adequately generated?

2. Allocation concealment: Was allocation adequately concealed?
3. Blinding of participants, personnel and outcome assessors: Was knowledge of the allocated intervention adequately prevented during the study? At study entry? At the time of outcome assessment?
4. Incomplete outcome data: Were incomplete outcome data adequately addressed?
5. Selective outcome reporting: Are reports of the study free of suggestion of selective outcome reporting?
6. Other sources of bias: Was the study apparently free of other problems that could put it at a high risk of bias?

Measures of treatment effect

Relative risk (RR) was computed for categorical data and Mean difference (MD) for data measured on a continuous scale, with 95% confidence intervals (CI) presented for all reported outcomes.

Assessment of heterogeneity

If multiple trials were identified, we planned to estimate the treatment effects of individual trials and examine heterogeneity between trials by inspecting the forest plots and quantifying the impact of heterogeneity using the I-squared statistic. If we detected statistical heterogeneity, we planned to explore the possible causes (for example, differences in study quality, participants, intervention regimens, or outcome assessments) using *post hoc* sub group analyses.

Data synthesis

If multiple studies were identified and meta-analysis was judged to be appropriate, the analysis would have been performed using Review Manager software (RevMan 5, Cochrane Collaboration). For estimates of typical relative risk and risk difference, we planned to use the Mantel-Haenszel method. For measured quantities, we planned to use the inverse variance method. All meta-analyses were to be done using the fixed effect model. However, due to insufficient data, meta-analysis was not able to be conducted.

Subgroup analysis and investigation of heterogeneity

Subgroup analyses are planned to determine whether the results differ by:

Population (newborn infants) :

- by gestational age < 30 weeks, < 34 weeks and < 37 weeks; and
- by disease, infants with chronic lung disease compared to those without.

Intervention (different techniques of endotracheal suctioning):

- with or without disconnection from the ventilator;
- increased mechanical ventilation; and
- use of manual ventilation and chest wall vibrations or percussion.

RESULTS

Description of studies

Results of the search

Four studies were identified as potentially eligible for inclusion in this review. Two studies were excluded ([Cabal 1979](#) and [Graff 1987](#)) and one study is awaiting further classification ([Gonzalez 2005](#)). Therefore, this review includes one trial ([Walsh 1987](#)).

Included studies

[Walsh 1987](#): The included study utilised a cross-over design and involved 21 infants. Participants were preterm infants with gestational age 31.4 ($\pm$ 2.5) weeks, birthweight 1586 ($\pm$ 682) grams and postnatal age at enrolment 4 ($\pm$ 4.5) days [(Mean (SD))]. All infants were mechanically ventilated for respiratory distress with $FiO_2 > 0.30$.

In this study, two suctioning procedures were compared. Procedure A included the following sequence of events: chest vibration using a hand held vibrator for two minutes, instillation of normal saline, reconnection to ventilator for 30 seconds, endotracheal tube suctioning with infant's head to one side, returned to ventilator for 30 seconds, second endotracheal suctioning with head on the opposite side, and then returned to ventilator. Procedure B included the same sequence of events as described in procedure A with the addition of preoxygenation, which involved an increase in FiO_2 until Tc PO₂ reached between 90-100 mmHg and stabilised for two minutes. Following suction the FiO_2 was gradually reduced to base line setting. Each infant was studied for one suction in each of the two procedures.

The trial measured effects of preoxygenation prior to suctioning on hypoxemia and bradycardia. Transcutaneous oxygen (Tc PO₂) values were reported at ten time points over a suctioning procedure. In this review, data is presented for three of these measurement points, chosen because of clinical relevance. These points are: 1) end of first endotracheal suction 2) end of second endotracheal suction and 3) at 120 seconds from the end of second suction.

The number of infants with hypoxemia (defined as Tc PO₂ <40 mmHg) and mean Tc PO₂ were measured at these points. Other outcomes include Tc PO₂ recovery (time taken for Tc PO₂ to return to baseline values) and the numbers of infants experiencing bradycardia (heart rate < 100 beats per minute during the suctioning procedure).

For further details see characteristics of included studies.

Excluded studies

Two studies were excluded ([Cabal 1979](#) and [Graff 1987](#)) as the methods of allocation was unknown and no correspondence has been received from the authors to requests for this information in 2000. One trial ([Gonzalez 2005](#)) is awaiting classification pending further information from the authors on the method of allocation to treatment and additional data.

Risk of bias in included studies

The included trial ([Walsh 1987](#)) is considered to be of poor quality: blinding of randomization and outcome assessment are unknown;

of the 21 infants enrolled in this study five were excluded from analysis; three infants had only one procedure performed and two were considered too ill to receive the full suction procedure.

Effects of interventions

SUCTIONING WITH PREOXYGENATION VS. WITHOUT PREOXYGENATION (COMPARISON 01):

One study contributed data to this review ([Walsh 1987](#)). This study reported outcomes of oxygenation status and bradycardia over the suction episode.

Oxygenation (Outcomes 01.01 - 01.06):

Preoxygenation prior to suctioning resulted in a statistically significant reduction in the number of infants with hypoxemia (Tc PO₂ < 40 mmHg) at the end of the first suction (RR 0.18, 95% CI 0.05, 0.69) and at the end of the second suction (RR 0.23, 95% CI 0.08, 0.66) and also at 120 seconds post second suction (RR 0.10, 95% CI 0.01, 0.69).

The mean Tc PO₂ was statistically significantly higher in the preoxygenation group at the end of first suction (MD 25.00 mmHg, 95%CI 14.20, 35.80), second suction (MD 24.80, 95% CI 14.80, 34.80) and at 120 seconds after the second suction (MD 29.10, 95% CI 14.96, 43.24). Episodes of hyperoxia were not reported.

Recovery time (Outcome 01.07):

Recovery time (time taken to return to baseline oxygenation status) was shorter than in the group not receiving preoxygenation (MD -2.12 minutes, 95% CI -3.82, -0.42).

Bradycardia (Outcome 01.08):

No episodes of bradycardia were experienced by infants during the suction procedure in either of the study groups.

Due to insufficient data, this review was unable to assess the effects of preoxygenation on other important outcomes (retinopathy of prematurity, intraventricular haemorrhage, chronic lung disease, hyperoxia, blood pressure) or on specified subgroups (gestational age groups, acute or chronic neonatal respiratory failure, use of different suctioning techniques)

DISCUSSION

Although this review shows some benefit in terms of oxygenation status at the time of suction, these results should be interpreted with caution as the only eligible study had major limitations. The limitations include:

1. the small number of infants studied in the single included trial
2. limited generalisability - the included study was published 14 years ago
3. poor quality of the included study
4. limited short-term and no long-term outcomes assessed

The suction procedure used in this trial involved two minutes of chest vibration using a hand held vibrator, instillation of normal saline into the endotracheal tube and disconnection of the ventilator circuit. This regimen for endotracheal suctioning is no longer considered routine practice in many neonatal intensive care units.

There have been many changes in clinical care since the trial included in this review was undertaken. Many of these changes

may render the results of this review redundant and difficult to generalize to today's population of ventilated infants. Changes in neonatal care over this time include the use of humidification, exogenous surfactant, physiotherapy, new ventilation modes and a move towards individualised rather than routine care procedures including endotracheal suctioning.

The use of systems that enable delivery of some ventilatory support during suction (usually by an adapter allowing suctioning without disconnection from the ventilator) are now widely available for use in most countries. In this review, subgroup analysis of disconnection from the ventilator could not be undertaken due to insufficient data. The effects of tracheal suctioning without disconnection in intubated ventilated neonates are addressed as the primary objective in another Cochrane Neonatal Review (Woodgate 2002). The effects of other techniques used with preoxygenation for endotracheal suctioning were also not able to be assessed in this review. These techniques include the use of saline instillation, one or two operators, use of manual ventilation, and use of chest wall vibration or percussion.

This review demonstrates benefit in terms of hypoxemia at the time of endotracheal suctioning with preoxygenation. Hypoxemia and its relationship with other alterations in systemic and cerebral hemodynamic changes during endotracheal suctioning may place the preterm infant at risk of intraventricular haemorrhage and possible long-term sequelae. The potentially serious side effects of hyperoxemia which may be associated with the technique of preoxygenation is of concern and could not be addressed in this review. The cross-over design of this study precludes the meaningful exploration of long-term outcomes. As the population of infants included in this review may differ substantially from today's intensive care nursery populations, the generalisability of these findings is somewhat limited. The decision whether or not to use preoxygenation for tracheal suctioning in preterm ventilated infants cannot be adequately answered by this review.

AUTHORS' CONCLUSIONS

Implications for practice

This review does not provide sufficient evidence on which to base practice. Although the results of this review indicate preoxygenation decreases hypoxemia at the time of suctioning, the relationship of this short-term outcome to clinically relevant longer-term outcomes could not be assessed. Furthermore, the small numbers of infants studied and concerns about generalisability and methodological quality of the included study prohibits valid implications for practice.

Implications for research

Further studies investigating the role of preoxygenation for endotracheal suctioning in the care of mechanically ventilated infants and the different methods used need to be undertaken. These studies should also consider the effect of other techniques for endotracheal suctioning such as the use of normal saline instillation, the frequency of suctioning, the use of closed suction techniques and the use of chest wall vibrations. Participants in these studies must be representative of the current population of ventilated newborns and enable adequate assessment of the effects on preterm infants, particularly the extremely low birthweight population. Future studies should use a randomised controlled trial methodology and be designed appropriately to adequately assess clinically important differences in short and long term outcomes such as hyperoxia, hypoxia, retinopathy of prematurity, cerebral cystic lesions, intraventricular haemorrhage, and developmental outcomes.

ACKNOWLEDGEMENTS

The reviewers would like to acknowledge David Henderson-Smart and Karen New for assistance with this review.

The Cochrane Neonatal Review Group has been funded in part with Federal funds from the Eunice Kennedy Shriver National Institute of Child Health and Human Development National Institutes of Health, Department of Health and Human Services, USA, under Contract No. HHSN267200603418C.

REFERENCES

References to studies included in this review

Walsh 1987 {published data only}

Walsh C, Bada H, Korones S, Carter M, Wong S, Arheart K. Controlled supplemental oxygenation during tracheobronchial hygiene. *Nursing Research* 1987;**36**:211-5.

References to studies excluded from this review

Cabal 1979 {published data only}

Cabal L, Devaskar S, Siassi B, Plajstek C, Waffarn F, Blanco C, Hodgman J. New endotracheal tube adaptor reducing cardiopulmonary effects of suctioning. *Critical Care Medicine* 1979;**7**:552-5.

Graff 1987 {published data only}

Graff M, France J, Hiatt M, Hegyi T. Prevention of hypoxia and hyperoxia during endotracheal suctioning. *Critical Care Medicine* 1987;**15**:1133-5.

References to studies awaiting assessment

Gonzalez 2005 {published data only}

Gonzalez-Cabello H. Evaluation of antihypoxic maneuvers before tracheal aspiration in mechanically ventilated newborns. *Pediatric Pulmonology* 2005;**39**:46-50.

Additional references

Alpan 1984

Alpan G, Glick B, Peleg O, Amit Y, Eyal F. Pneumothorax due to endotracheal tube suction. *American Journal of Perinatology* 1984;**1**:345-8.

Cheng 1989

Cheng M, Williams PD. Oxygenation during chest physiotherapy of very low birth weight infants: Relations among fraction of inspired oxygen levels, number of hand ventilations and transcutaneous oxygen pressure. *Journal of Pediatric Nursing* 1989;**4**:411-8.

Downs 1978

Downs J, Goldberg A. Airway Management, Mechanical Ventilation and Cardiopulmonary Resuscitation,. In: Scarpelli E, Auld P, Goldman H editor(s). *Pulmonary Disease of the Fetus, Newborn and Child*. Philadelphia: Lea and Febiger, 1978:99-131.

Drew 1986

Drew JH, Paddoms K, Clabburn SL. Endotracheal tube mangement in newborn infants with hyaline membrane disease. *Australian Journal of Physiotherapy* 1986;**32**:3-5.

Higgins 2006

Higgins JPT, Green S (Editors). *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.0.2 [updated September 2009]. The Cochrane Collaboration, 2009. Available from www.cochrane-handbook.org.

Hill 1982

Hill A, Perlman JM, Volpe JJ. Relationship of pneumothorax to occurrence of intraventricular hemorrhage in the premature newborn. *Pediatrics* 1982;**69**:144-9.

Inder 2000

Inder TE, Volpe JJ. Mechanisms of perinatal brain injury. *Seminars in Neonatology* 2000;**5**:3-16.

Macpherson 1988

Macpherson TA, Shen-Schwarz S, Valdes-Dapena M. Prevention and reduction of iatrogenic disorders in the newborn. In: Guthrie RD editor(s). *Neonatal Intensive Care*. 1988:271-92.

Mehrabani 1991

Mehrabani D, Gowan CW Jr, Kopleman AE. Association of pneumothorax and hypotension with intraventricular haemorrhage. *Archives of Disease in Childhood* 1991;**66**:48-51.

Perlman 1983

Perlman JM, Volpe JJ. Suctioning in the preterm infant: Effects on cerebral blood flow velocity, intracranial pressure and arterial blood pressure. *Pediatrics* 1983;**72**:329-34.

Prendiville 1986

Prendiville A, Thomson A, Silverman M. Effect of tracheobronchial suction on respiratory resistance in intubated preterm babies. *Archives of Disease in Childhood* 1986;**61**:1178-83.

ROP Committee 1984

International Committee for the Classification of Retinopathy of Prematurity. An international classification of retinopathy of prematurity. *Pediatrics* 1984;**74**:127-33.

Shorten 1991

Shorten DR, Byrne PJ, Jones RL. Infant responses to saline instillations and endotracheal suctioning. *Journal of Obstetric Gynaecological and Neonatal Nursing* 1991;**20**:464-9.

Simbruner 1981

Simbruner G, Coradello H, Fodor M, Havelec L, Lubec G, Pollak A. Effect of tracheal suction on oxygenation, circulation an lung mechanics in newborn infants. *Archives of Disease in Childhood* 1981;**56**:326-30.

Taylor 1999

Taylor DL, Edwards AD, Mehmet H. Oxidative metabolism, apoptosis and perinatal brain injury. *Brain Pathology* 1999;**9**:93-117.

Tolles 1990

Tolles CL, Stone KS. National survey of neonatal endotracheal suctioning practices. *Neonatal Network* 1990;**9**:7-14.

Turner 1983

Turner B. Endotracheal suction in premature infants. *Journal of the California Perinatal Association* 1983;**3**:104.

Vaughan 1978

Vaughan RS, Menke JA. Pneumothorax: A complication of endotracheal suctioning. *Journal of Pediatrics* 1978;**92**:633-4.

Woodgate 2002

Woodgate PG, Flenady VJ. Tracheal suctioning without disconnection in intubated ventilated newborns. *Cochrane Database of Systematic Reviews* 2002, Issue 2. [DOI: [10.1002/14651858.CD003065](https://doi.org/10.1002/14651858.CD003065)]

Young 1984

Young CS. Recommended guidelines for suction. *Physiotherapy* 1984;**70**:106-8.

References to other published versions of this review

Pritchard 2001

Pritchard M, Flenady V, Woodgate P. Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants. *Cochrane Database of Systematic Reviews* 2001, Issue 3. [DOI: [10.1002/14651858.CD000427](https://doi.org/10.1002/14651858.CD000427)]

Pritchard 2003

Pritchard MA, Flenady V, Woodgate P. A systematic review of the role of preoxygenation for tracheal suctioning in ventilated newborn infants. *Journal of Paediatric and Child Health* 2003;**39**:163-5.

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Walsh 1987

Methods	Concealment at randomization- can't tell; Blinding of intervention- no; Completeness of followup-no (5 of the 21 enrolled were excluded); Blinding of outcome assessment - can't tell.
Participants	21 preterm infants born at 27 to 35 weeks gestation receiving tracheal intubation and mechanical ventilation for respiratory distress with FiO ₂ >0.3.
Interventions	Experimental(B). FiO ₂ increased until TcPO ₂ was between 90-100 mmHg. Infant left to stabilise for two minutes. Chest vibration, instillation of normal saline, suctioning with head to the left, reconnection of ETT for 30 seconds, second suction with head to the right, returned to ventilator. Control(A). As in Experimental group but without preoxygenation.
Outcomes	Hypoxemia: Mean TcPO ₂ and hypoxaemia (TcPO ₂ <40 mmHg) at ten different time points during the suctioning procedure and TcPO ₂ recovery: time (in minutes) to return to baseline. Bradycardia (HR < 100bpm).
Notes	Pre-trial power calculations-not stated. Cross-over study design used. 5 post randomization exclusions.

Risk of bias

Bias	Authors' judgement	Support for judgement
Adequate sequence generation?	Unclear risk	Can't tell
Allocation concealment?	Unclear risk	Can't tell
Blinding? All outcomes	High risk	Blinding of intervention: no Blinding of outcome assessment: can't tell
Incomplete outcome data addressed? All outcomes	High risk	Completeness of follow-up: no (5 of the 21 enrolled were excluded)

ETT- endotracheal tube

TcPO₂ - transcutaneous oxygen tension

FiO₂ - fraction of oxygen in expired air

mmHg -millimeters of mercury (1 mmHg = 0.1333 kPa.)

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Cabal 1979	Method of allocation unknown
Graff 1987	Method of allocation unknown

Characteristics of studies awaiting assessment *[ordered by study ID]*

[Gonzalez 2005](#)

Methods	González-Cabello and coworkers investigated the usefulness of hyperoxia and/or hyperventilation as antihypoxemic maneuvers before tracheal aspiration in newborn infants. The study was a prospective, randomized, multiple crossover study conducted in the NICU of a pediatric hospital in Mexico City. Method of allocation to "antihypoxemic" maneuvers is unclear.
Participants	Fifteen newborn infants undergoing mechanical ventilation were enrolled.
Interventions	Within a 12-hr period, every patient received, in random order, three "antihypoxemic" maneuvers during 1 minute prior to tracheal aspiration: hyperoxia (10% increase of baseline FiO ₂), hyperventilation (50% increase of ventilator cycling rate), or both. Additionally, a control (sham) maneuver was also applied.
Outcomes	Pulse oximeter saturation (SpO ₂) was recorded before and after each antihypoxemic maneuver, and at 0, 15, 30, 60, and 300 sec after tracheal aspiration.
Notes	

DATA AND ANALYSES

Comparison 1. Suctioning with preoxygenation vs without preoxygenation

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hypoxemia end of first suction (TcPO₂ <40mmHg)	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.18 [0.05, 0.69]
2 Hypoxemia end of second suction (TcPO₂ <40mmHg)	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.23 [0.08, 0.66]
3 Hypoxemia 120 seconds post-suction (TcPO₂ <40mmHg).	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.1 [0.01, 0.69]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4 TcPO ₂ end of first suction (mmHg).	1	32	Mean Difference (IV, Fixed, 95% CI)	25.0 [14.20, 35.80]
5 TcPO ₂ end of second suction (mmHg)	1	32	Mean Difference (IV, Fixed, 95% CI)	24.8 [14.80, 34.80]
6 TcPO ₂ 120 seconds post-suction (mmHg)	1	32	Mean Difference (IV, Fixed, 95% CI)	29.10 [14.96, 43.24]
7 Recovery time in minutes	1	32	Mean Difference (IV, Fixed, 95% CI)	-2.12 [-3.82, -0.42]
8 One or more episodes of bradycardia	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Analysis 1.1. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 1 Hypoxemia end of first suction (TcPO₂ <40mmHg).

Analysis 1.2. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 2 Hypoxemia end of second suction (TcPO₂ <40mmHg).

Analysis 1.3. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 3 Hypoxemia 120 seconds post-suction (TcPO2 <40mmHg)..

Analysis 1.4. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 4 TcPO2 end of first suction (mmHg)..

Analysis 1.5. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 5 TcPO2 end of second suction (mmHg).

Analysis 1.6. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 6 TcPO2 120 seconds post-suction (mmHg).

Analysis 1.7. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 7 Recovery time in minutes.

Analysis 1.8. Comparison 1 Suctioning with preoxygenation vs without preoxygenation, Outcome 8 One or more episodes of bradycardia.

WHAT'S NEW

Date	Event	Description
17 August 2009	New search has been performed	<p>This review updates the existing review "Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants" published in the Cochrane Database of Systematic Reviews, Issue 1, 2001 (Pritchard 2001).</p> <p>Updated search found no new trials.</p> <p>No changes to conclusions.</p>

HISTORY

Protocol first published: Issue 1, 2001

Review first published: Issue 1, 2001

Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants (Review)

Copyright © 2010 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

Date	Event	Description
13 February 2008	Amended	Converted to new review format.
11 September 2007	New search has been performed	<p>This review updates the existing review "Preoxygenation for tracheal suctioning in intubated, ventilated newborn infants", published in the Cochrane Database of Systematic Reviews, Issue 3, 2001 (Pritchard 2001).</p> <p>One new trial was identified in the search dates July 2007. We are currently seeking information from the author. At this stage, the study is awaiting assessment and, therefore, no substantive changes have been made.</p>
21 October 2000	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Vicki Flenady (VF) and Paul Woodgate prepared the protocol.

Margo Pritchard (MP) and Vicki Flenady conducted the search, extracted and entered data, and compiled the review.

All review authors assessed trial quality, checked data and edited the review.

The January 2009 update was conducted centrally by the Cochrane Neonatal Review Group staff (Yolanda Montagne, Roger Soll, Diane Haughton) and reviewed and approved by MP.

DECLARATIONS OF INTEREST

None

SOURCES OF SUPPORT

Internal sources

- Perinatal Research Centre, Royal Brisbane & Women's Hospital, Queensland, Australia.
- Centre for Clinical Studies, Mater Mothers' Hospital, South Brisbane, Queensland, Australia.
- The University of Queensland, Australia.

External sources

- No sources of support supplied

INDEX TERMS

Medical Subject Headings (MeSH)

*Respiration, Artificial; Infant, Premature; Oxygen Inhalation Therapy [*methods]; Suction [adverse effects] [*methods]

MeSH check words

Humans; Infant, Newborn