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Best nursing review paper

Efficacy and safety of normal saline instillation and paediatric endotracheal suction: An integrative review

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ABSTRACT

Objective: To synthesise research findings regarding the efficacy and safety of normal saline instillation (NSI) during endotracheal suction in the paediatric intensive care unit.
Data sources: The Cochrane Library, PROSPERO, the National Health Service Centre for Reviews and Dissemination, PubMed and Cumulative Index to Nursing and Allied Health (CINAHL) databases were systematically searched. Subject headings included "suctioning, endotracheal", "suction", "sodium chloride", "normal saline" and "paediatrics". Additional references were sourced from hand searches of journal article reference lists and Google Scholar.
Method: An integrative, systematic approach was used to qualitatively synthesise study results in the context of paediatric intensive care nursing practice. Data were extracted using a standardised data extraction form. Quality assessment was performed independently by two reviewers.
Results: Three studies met pre-defined inclusion criteria. Quality of all study methods was 75% on the Mixed Method Appraisal Tool, although reporting quality varied. Overall, there was a scarcity of high quality evidence examining NSI and paediatric endotracheal suction. Outcome measures included oxygen saturation (SpO_2), serious adverse events (author/s defined) and ventilation parameters (author/s defined). Endotracheal suction with NSI was associated with a transient decrease in blood oxygen saturation; research protocols did not include interventions to mitigate alveolar derecruitment. Studies were not powered to detect differences in endotracheal tube (ETT) occlusion or ventilator associated pneumonia (VAP).
Conclusion: NSI was associated with a transient decrease in oxygen saturation. In children with obstructive mucous, NSI may have a positive effect. Practices which maximise secretion removal and mitigate the negative physiological interactions of ETS have been poorly evaluated in the paediatric population. High quality, powered, clinical trials are needed to determine the safety and efficacy of normal saline instillation and to inform clinical practice.

1. Introduction

Each year 50% of children (<18years) admitted to Australian and New Zealand intensive care units require intubation and mechanical ventilation.[1,2] Placement of the endotracheal tube (ETT), to facilitate mechanical ventilation impairs mucociliary clearance.[3] In combination with humidification of inspired gas, endotracheal suction (ETS) is a key secretion management technique in the

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paediatric intensive care unit (PICU).[4] Performed to maintain airway patency and prevent retained respiratory secretions,[5] ETS is not without complications. The adverse clinical effects of ETS may include hypoxia and atelectasis due to pulmonary derecruitment; hypotension related to increased intrathoracic pressure and reduced cardiac output; and bradycardia associated with vagal nerve stimulation.[6–8]

The effectiveness of ETS is impacted upon by the hydration of the airway mucous. If there is insufficient humidification of ventilator gas or obstructive mucous plugs the efficacy of ETS is reduced.[9] Normal saline instillation (NSI) with paediatric ETS is a long standing nursing intervention which has been practised for more than two decades.[10–12] NSI as an intervention is postulated to have several effects including: hydrating and mobilising airway secretions, stimulating the cough response and lubricating the suction catheter.[13,14] NSI is thought to enhance the removal of mucous plugs and reduce surface tension in the distal airways.[10,15] However, the majority of these claims are untested and effect of NSI on secretion rheology and airway mucosa is not clearly articulated in the literature.

2. Problem identification

In general, the prevalence of NSI use as an intervention with ETS in the PICU is largely unknown. Data obtained from a 1996 cross-sectional survey found more than 96% of PICU nurses used NSI as an intervention with ETS.[10] However, current usage rates are not published. Newer research has found NSI usage to be significantly associated with open suction when compared with closed suction (1397 vs 572, $p < 0.01$).[5] However given open suction is associated with improved secretion clearance,[16] and thick secretions are a key indication for NSI in the PICU,[17] the findings of this research are not surprising.

In adults, a number of studies explore NSI efficacy in patients without lung disease. In these studies researchers argue that NSI has a deleterious effect on oxygen saturation and does not increase secretion yield.[18–20] Consequently current ETS guidelines recommend the discontinuation of NSI,[13,21] however the application of these guidelines in the clinical environment have been poorly explored.

In paediatrics the benefits of NSI with ETS is uncertain and widely debated.[22] The generalisability of adult recommendations to the PICU population is problematic. Mechanically ventilated children have different diagnoses to adults, specifically a high incidence of respiratory disease and ETTs with small internal diameters which may be easily occluded by obstructive mucous.[17] In this population NSI may be both warranted and beneficial. The aim of this review was to synthesise research findings regarding the efficacy and safety of NSI as an intervention to improve pulmonary outcomes in intubated paediatric patients undergoing ETS.

3. Method

Due to the lack of randomised clinical trials (RCT) and the variability of study design an integrative approach was used to qualitatively synthesise research findings. The integrative method allows for the combination of diverse study methodologies, providing a comprehensive review of the topic as it pertains to clinical practice. The format for the review was based on Whittemore and Knafl's[23] five stage integrative review process of: problem identification, literature search, data evaluation, data analysis and presentation of findings. The use of this systematic process enhances review rigor.

3.1. Search strategy

A search of The Cochrane Library, PROSPERO and the National Health Service Centre for Reviews and Dissemination identified no reviews or registered protocols investigating the topic. A search of the National Institute of Health Clinical Trials, Australian and New Zealand Clinical Trials Registry and the World Health Organization International Clinical Trials Registry identified no clinical trials examining NSI and paediatric ETS. A systematic search was conducted in United States National Library of Medicine National Institutes of Health (PubMed), Cumulative Index to Nursing and Allied Health (CINAHL) and Google Scholar in February and repeated in April 2016. Following consultation with a Health Librarian, the review aim was broken into concepts which formed the basis of the search strategy. The PRESS guidelines were used to further refine the search strategy.[24] Search terms were developed for each concept and Boolean operators OR, AND and NOT were applied, Boolean operators were consistent across search services. Proximity operators were not applied. Subject headings (MeSH or CINAHL headings) were database specific and included "suctioning, endotracheal", "suction", "sodium chloride", "normal saline", "paediatrics" and "pneumonia, ventilator-associated"; some minor/subheadings were included. Key word and text word searching included pediatric; paediatric; infant; children; secretions and instillation. Truncation and wildcard symbols were database specific and included: CINAHL wildcard # (p#ediatric) and PubMed truncation * (paed* OR ped*). Truncation and wildcard symbols were not applied in google scholar searches. An English language limiter was applied to the search. Filter terms not applied within the search strategy included publication date and outcome measures. Database searches were supplemented by hand searches of article reference lists.

3.2. Selection criteria

Studies were included in the review upon satisfying predefined inclusion criteria: (1) paediatric patients aged 0–18years; (2) ETT airway in situ; and (3) investigated a clearly defined ETS solution intervention. Outcomes were not defined a priori due to the lack of evidence and desire for an inclusive review. A minimum level of acceptable study design was observational with no comparator as described by Merlin et al.[25] 'hierarchy of evidence for intervention studies'. No restrictions were placed on patients' principal diagnosis. Articles were excluded if: (1) study participants were adult or neonates; (2) paediatric data were not desegregated; (3) examined artificial airways other than ETT; (4) examined normal saline use in combination with another intervention; or (5) were not published in English.

3.3. Data extraction and assessment of study quality

Study data were extracted using a standardised data extraction form. Data extracted included study aim, setting, method, participant population, sample size, intervention and outcome measure and measure of effect (if empirical). The Mixed Methods Appraisal Tool (MMAT) as described by Pluye et al.[26] was used to appraise the methodological quality of each source. Comprised of screening questions and methodology specific criterion, the MMAT is a validated critical appraisal tool that facilitates systematic assessment for integrative reviews with studies using difference research methods.[27] Quality assessment for included studies was completed independently by JO and MM. Following discussion, any unresolved variances were resolved with the third author (MC) through discussion and consensus. Risk of bias assessment was performed on intervention and observational studies, guided by The Cochrane Collaboration's tool for assessing risk of bias.[28] No study was

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