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REVIEW ARTICLE

The use of high-flow nasal cannula in the pediatric emergency department☆

Katherine N. Slain[a,b], Steven L. Shein[a,b], Alexandre T. Rotta[a,b,*]

[a] UH Rainbow Babies & Children's Hospital, Division of Pediatric Critical Care Medicine, Cleveland, United States
[b] Case Western Reserve University, School of Medicine, Department of Pediatrics, Cleveland, United States

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Abstract

Objectives: To summarize the current literature describing high-flow nasal cannula (HFNC) use in children, the components and mechanisms of action of a HFNC system, the appropriate clinical applications, and its role in the pediatric emergency department (ED).

Sources: A computer-based search of PubMed/MEDLINE and Google Scholar for literature on HFNC use in children was performed.

Data summary: HFNC, a non-invasive respiratory support modality, provides heated and fully humidified gas mixtures to patients via a nasal cannula interface. HFNC likely supports respiration though reduced inspiratory resistance, washout of the nasopharyngeal dead space, reduced metabolic work related to gas conditioning, improved airway conductance and mucociliary clearance, and provision of low levels of positive airway pressure. Most data describing HFNC use in children focuses on those with bronchiolitis, although HFNC has been used in children with other respiratory disease. Introduction of HFNC into clinical practice, including in the ED, has been associated with decreased rates of endotracheal intubation. Limited prospective interventional data suggest that HFNC may be similarly efficacious as continuous positive airway pressure (CPAP) and more efficacious than standard oxygen therapy for some patients. Patient characteristics, such as improved tachycardia and tachypnea, have been associated with a lack of progression to endotracheal intubation. Reported adverse effects are rare.

Conclusions: HFNC should be considered for pediatric ED patients with respiratory distress not requiring immediate endotracheal intubation; prospective, pediatric ED-specific trials are

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* Corresponding author.
E-mail: alex.rotta@uhhospitals.org (A.T. Rotta).

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needed to better determine responsive patient populations, ideal HFNC settings, and comparative efficacy vs. other respiratory support modalities.

PALAVRAS-CHAVE
Cânula nasal de alto fluxo;
Crianças;
Departamento de emergência;
Bronquiolite

Uso de cânula nasal de alto fluxo no Departamento de Emergência Pediátrica

Resumo

Objetivos: Resumir a literatura atual que descreve o uso da cânula nasal de alto fluxo (CNAF) em crianças, os componentes e mecanismos de ação do sistema CNAF, as aplicações clínicas adequadas e o papel desse sistema no departamento de emergência pediátrico (DE).

Fontes: Realizamos uma pesquisa informatizada na PubMed/MEDLINE e utilizamos o Google Acadêmico para encontrar literatura sobre o uso da CNAF em crianças.

Resumo dos Dados: A CNAF, modalidade de suporte respiratório não invasiva, fornece misturas de gases aquecidas e totalmente umidificadas para pacientes por meio de uma cânula nasal. A CNAF provavelmente auxilia a respiração por meio da redução da resistência inspiratória, eliminação do espaço morto anatômico nasofaríngeo, redução do trabalho metabólico relacionado ao condicionamento de gás, melhora da condutância das vias aéreas e transporte mucociliar e fornecimento de baixos níveis de pressão positiva nas vias aéreas. A maior parte dos dados que descrevem o uso da CNAF em crianças é focada em crianças com bronquiolite, embora a CNAF tenha sido usada em crianças com outras causas de doenças respiratórias. A introdução da CNAF na prática clínica, incluindo o DE, foi associada à redução dos índices de intubação endotraqueal. Dados intervencionistas prospectivos limitados sugerem que a CNAF pode ser tão eficaz quanto a pressão positiva contínua nas vias aéreas (CPAP) e mais eficaz do que a oxigenoterapia padrão em alguns pacientes. As características dos pacientes, como melhora da taquicardia e taquipneia, foram associadas a uma ausência de progressão para intubação endotraqueal. Foram raros os efeitos adversos relatados.

Conclusões: A CNAF deve ser considerada para pacientes do DE pediátrico com insuficiência respiratória que não precisam de intubação endotraqueal imediata, contudo, são necessários ensaios clínicos prospectivos específicos para o DE pediátrico para determinar melhor as populações de pacientes que respondem ao tratamento, as configurações ideais da CNAF e a eficácia comparada a outras modalidades de suporte respiratório.

Introduction

High-flow nasal cannula (HFNC) is a non-invasive respiratory support modality that provides conditioned (heated and fully humidified) gas mixtures to patients via a nasal cannula interface. There is no universally accepted definition of the minimum flow rate that defines ''high'' flow. In neonates, high-flow may be defined as flow rates $\geq$2 L/min, whereas for older children, flow rates $\geq$4–6 L/min are commonly considered high.[1–3] Over the past decade, HFNC systems have gained increased acceptance and are now widely utilized to support critically-ill patients across the entire age spectrum, from premature neonates to adults. It has also found a role across various hospital sites, including the neonatal intensive care unit (NICU), pediatric intensive care unit (PICU), medical and surgical intensive care units (ICU), intermediate care units, and, more recently, the emergency department (ED). A recent randomized controlled trial has shown that HFNC may be superior to standard low-flow oxygen delivery in preventing treatment failure in children with bronchiolitis,[4] while other trials support that HFNC is equivalent to more traditional modalities of non-invasive ventilation support, such as continuous or bi-level positive airway pressure (CPAP or BiPAP).[5,6]

In this article, the authors review the rationale for utilizing HFNC in children, the basic anatomy of a HFNC system, its mechanisms of action, clinical application, and its role in the pediatric ED.

Rationale for using HFNC

Oxygen supplementation is a cornerstone of treating children with hypoxemia due to an acute respiratory process, typically through a facemask or a simple nasal cannula. The concentration of oxygen in the inspired gas increases as the flow rate of oxygen is increased and less atmospheric air is entrained during inspiration. Unlike atmospheric air, which is rich in water vapor, medical gases – including oxygen – are stored as a dehydrated substance. Prolonged administration of supplemental oxygen causes dryness and irritation of the mucus membranes and adversely affects mucociliary clearance, unless humidification is added.[7] It is routine in the