Editorial

Heated Humidified High Flow Nasal Cannula (HHHFNC): A non-invasive respiratory support in Neonates

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Current practice in neonatology is directed toward the preference of noninvasive ventilation and limitation of oxygen exposure. Early use of nasal CPAP either immediately or after surfactant administration (INSURE strategy: intubation, surfactant, extubation) has thus been strongly recommended through the last 2 decades.[1, 2]

High-flow nasal cannula (HFNC) was introduced through the last decade in adult, pediatric, and perinatal care as an alternative to other noninvasive ventilatory interfaces. Its goal is to optimize spontaneous breathing through the reduction of dead space and the creation of positive distending airway pressure. High flow nasal cannula (HFNC) oxygen delivery, also sometimes called heated humidified high flow nasal cannula (HHHFNC), is a relatively new non-invasive respiratory support (NIRS) therapy that seems to be well tolerated in neonates with hypoxemic respiratory failure [3,4].

Earlier, the introduction of traditional HFNC had a maximum flow of 0.5–1 L/min for delivery of oxygen by nasal cannula was set in newborns, [4,5] where a maximum flow at 2 L/min was used for older children and adults in order to prevent drying and discomfort of nasal mucosa and other nasal mucosal complications.[6]

In the Cochrane Review from 2014, HHHFNC in children was defined as heated, humidified and blended air/oxygen delivered via nasal cannula at different flow rate >2 L/min delivering both light concentrations of oxygen and potentially continuous distending process.[7]

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Heated Humidified High Flow Nasal Cannula (HHHFNC):

In adults and children, the role of **HHHFNC** mainly remains for optimization of oxygen delivery, the impact of high flow in neonates and infants is, more importantly, the created PEEP, like CPAP.[6] Major indications for HHHFNC in neonates are thus the same as for nasal CPAP: respiratory distress syndrome, post extubation, and apnea of prematurity.[8] Among the various causes of neonatal intensive care unit (NICU) admission in infants, respiratory distress remains the most common one.[9]

However, according to US consortium on safe labor, approximately 15% of term neonates and 34% of late preterm infants require NICU admission after birth due to significant respiratory problems; this is even higher for preterm infants born before 34 weeks of gestation.[10] Respiratory distress syndrome (RDS) is by far the most common cause of respiratory distress in preterm infants (50.8%), followed by transient tachypnea of the newborn (4.3%) and pneumonia/sepsis 13 (1.9%).[11]

There has been an increased use of nasal continuous positive airway pressure (CPAP), and avoidance of intubation and mechanical ventilation due to its complications, as a primary mode of the treatment for respiratory distress in neonates.[12]

Further, the use of nasal CPAP (NCPAP) in neonates is also associated with some problems such as difficulty in maintaining the nasal prongs in the nostrils, difficulty in positioning the neonate, poor tolerance of the infant to the apparatus, and nasal trauma (ulceration, necrosis, and nasal vestibular stenosis).[13]

To avoid these problems with NCPAP, a newer modality is being used in the NICUs across the world, the use of heated and humidified HFNC to provide positive pressure support in infants with respiratory distress.[14]

HHHFNC has many effects on respiratory mechanics, by which it improves clinical outcomes such as washout of anatomic dead space and improved gas mixing in large airways; heating and humidification of inhaled gas; high nasal inspiratory flow; generation of positive airway pressure that results in increased endexpiratory lung volume; and increased alveolar PO_2.

Recent advances in HHHFNC usage including enhanced humidity and improved comfort factors have led to its widespread use, at times replacing nCPAP in many neonatal settings. Diverse research work was done related to safety & efficacy of HHHFNC with comparison to nCPAP in different countries but there is limited data of such type study in Bangladesh. An open, randomized, controlled trial was done at Dhaka Hospital, International Centre for Diarrheal Disease Research, Bangladesh. [15] Children younger than 5 years with severe pneumonia and hypoxemia receive oxygen therapy by either bubble CPAP (5 L/min starting at a CPAP level of 5 cm H2O), standard low-flow nasal cannula (90% on room air). HFNC had an increased risk of treatment failure compared with nCPAP in infants age 1-6 months with severe hypoxemia (SpO2 90% on supplemental oxygen. No significant differences were found in intubation rates and mortality between HFNC and standard oxygen therapy or nCPAP. HFNC had a lower risk of nasal trauma compared with nCPAP.[16]

In India, one randomized controlled trial in Jaipur, described that HHHFNC is equally efficacious to NCPAP as a primary mode of respiratory support for mild-to-moderate respiratory distress in preterm infants. Furthermore, HHHFNC is safer modality than NCPAP in terms of nasal trauma. Hence, HHHFNC can be used as a primary modality to treat preterm infants with mild-to-moderate respiratory distress.[17] Moreover, a Literature review, two reports (2016) described four serious cases of pneumothorax in children on HFNC; one 2 month old child treated for RSV bronchiolitis. Three studies have reported abdominal distension in children on HFNC, indicating that one should be careful with HFNC in children with intra-abdominal pathology. Mucosal injury with nasal bleeding and ulceration has 15 been reported in children on HFNC but in a randomized control trail including preterm infants below 32 weeks, nasal trauma was less frequent in the HFNC group than in the CPAP group.[18]

Further, in another meta-analysis based on clinical trials compared efficacy and safety of high-flow nasal cannula (HFNC) with continuous positive airway pressure (CPAP) as primary respiratory support in preterm infants she yielding the impact of clinical relevant parameters. Methods were searched for randomized controlled trials comparing HHHFNC with CPAP as primary respiratory support in preterm infants. The authors commented that the treatment failure was considered as primary outcome including some adverse events as secondary outcomes. They concluded that Despite a higher risk of treatment failure, considering no difference in intubation rates and a lower rate of nasal trauma using HHHFNC compared with CPAP, suggest that HHHFNC should be used as primary respiratory support in preterm infants.[19,20]

Bottom-line:

Until more evidence is available, HFNC may be used as a supplementary form of respiratory support in neonates, but with a critical approach regarding effective clinical responses and safety issues relating to early recognition of treatment failure, particularly when neonates are managed on HFNC outside of a Neonatal intensive care unit.

References:

1. Verder H, Robertson B, Greisen G, Ebbesen F, Albertsen P, Lundstrøm K, Jacobsen T. Surfactant therapy and nasal continuous positive airway pressure for newborns with respiratory distress syndrome. N Engl J Med 1994;331(16):1051-1055.
2. Hornik CP, Turner DA. High-flow nasal cannula for neonatal respiratory distress: is it enough? Respir Care 2011;56(12):1972-1974
3. Klingenberg C, Pettersen M, Hansen EA, Gustavsen LJ, Dahl IA, Leknessund A, et al. Patient comfort during treatment with heated humidified high flow nasal cannulae versus nasal continuous positive airway pressure: a randomised cross-over trial. Arch Dis Child Fetal Neonatal Ed. 2014;99:F134–F137. doi: 10.1136/archdischild-2013-304525. [PubMed] [Cross Ref] [Google Scholar]
4. Roberts CT, Dawson JA, Alquoka E, Carew PJ, Donath SM, Davis PG, et al. Are high flow nasal cannulae noisier than bubble CPAP for preterm infants? Arch Dis Child Fetal Neonatal Ed. 2014;99:F291–F295. doi: 10.1136/archdischild-2013-305033. [PubMed] [Cross Ref] [Google Scholar] Wilkinson D, Wilkinson D, Andersen C, O'Donnell CP, De Paoli AG. High flow nasal cannula for respiratory support in preterm infants. Cochrane Database Syst Rev. 2011;11(5): CD006405. [PubMed] [Google Scholar]

5. Dani C, Pratesi S, Migliori C, Bertini G. High flow nasal cannula therapy as respiratory support in the preterm infant. Pediatr Pulmonol. 2009;44:629–634. doi: 10.1002/ppul.21051. [PubMed] [CrossRef] [Google Scholar]

6. Myers TR. American Association for Respiratory C. AARC Clinical Practice Guideline: selection of an oxygen delivery device for neonatal and pediatric patients--2002 revision & update. Respir Care. 2002;47:707–716. [PubMed] [Google Scholar]

7. Mayfield S, Jauncey-Cooke J, Hough JL, Schibler A, Gibbons K, Bogossian F. High-flow nasal cannula therapy for respiratory support in children. Cochrane Database Syst Rev. 2014;3:CD009850. [PMC free article] [PubMed] [Google Scholar]

8. Spence KL, Murphy D, Kilian C, McGonigle R, Kilani RA. Highflow nasal cannula as a device to provide continuous positive airway pressure in infants. J Perinatol 2007;27(12):772- 775.

9. Edwards MO, Kotecha SJ, Kotecha S. Respiratory distress of the term newborn infant. Paediatr Respir Rev 2013;14:29-36

10. Hibbard JU, Wilkins I, Sun L, Gregory K, Haberman S, et al Consortium on Safe Labor,. Respiratory morbidity in late preterm births. JAMA 2010;304: 419-25.

11. Jackson JC. Respiratory distress in the preterm infant. In: Gleason CA, Devaskar SU, editors. Avery's Diseases of the Newborn. 9th ed. Philadelphia: Elsevier Saunders; 2012. p. 633-46.

12. Diblasi RM. Neonatal noninvasive ventilation techniques: Do we really need to intubate? Respir Care 2011;56:1273-94 26

13. McCoskey L. Nursing care guidelines for prevention of nasal breakdown in neonates receiving nasal CPAP. Adv Neonatal Care 2008;8:116-24

14. Mathai SS, Raju U, Kanitkar M. Management of respiratory distress in the newborn. Med J Armed Forces India 2007;63:269-72. 15. Chisti MJ, Salam MA, Smith JH, Ahmed T, Pietroni MA, Shahunja KM, et al. Bubble continuous positive airway pressure for children with severe pneumonia and hypoxaemia in Bangladesh: an open, randomised controlled trial. Lancet. 2015;386:1057–1065. doi: 10.1016/S0140 -6736 (15) 60249-5. [PubMed] [CrossRef] [Google Scholar] .

16. Jobayer Chisti, Trevor Duke . Use of Bubble CPAP and Humidified High Flow Nasal Cannula Oxygen Therapy in Children with Severe Pneumonia and Hypoxemia: A Systematic Review Bangladesh Crit Care J September 2014; 2 (2): 71- 78DOI: https:// doi.org/10.3329/bccj.v2i2.24085

17. Pravesh Kumar Sharma, Anil Kumar Poonia et al. Comparison of Efficacy of Nasal Continuous Positive Airway Pressure and Heated Humidified HighFlow Nasal Cannula as a Primary Mode of Respiratory Support in Preterm Infants. Department of Paediatrics, Santokba Durlabhji Memorial Hospital, Jaipur, Rajasthan, India

18. Ingvild Bruun Mikalsen, Peter Davis ,Knut Øymar ; Scandinavian Journal of Trauma, High flow nasal cannula in children: a literature review Resuscitation and Emergency Medicine volume 24, Article number: 93 (2016).

19. Shaam Bruet, Marine Butin ,Fred Dutheil - Systematic review of high-flow nasal cannula versus continuous positive airway pressure for primary support in preterm infants, May 2021. Archives of Disease in Childhood - Fetal and Neonatal Edition, DOI: 10.1136/archdischild-2020- 321094.

20. Jia Chen, Yingi Lin, Lanlan Du,The Comparison of HHHFNC and NCPAP in Extremely Low-Birth-Weight Preterm Infants After Extubation: A Single-Center Randomized Controll