

Humidified High Flow Nasal Cannula (HHFNC) Therapy in Critically Ill Children: Nation-Wide Survey

SAIRA ABRAR¹, SHAIKH ALI MASOOD², ANWARUL HAQ³, HEERA NAND RATHORE⁴, SYED QUTUB JAMAL⁵

¹Senior registrar, pediatric department of Liaquat National Hospital and Medical College Karachi

²Resident, pediatric department of Liaquat National Hospital and Medical College Karachi

³Professor, pediatric department of Liaquat National Hospital and Medical College Karachi

⁴Senior registrar, pediatric department of Indus medical College TM Khan

⁵Student at Liaquat National Hospital and Medical College Karachi

Corresponding author: Saira Abrar, Email: sairabrar.ahmed@gmail.com

ABSTRACT

Objective: To determine the experience regarding current practices of HHFNC in terms of techniques uses, indications and complications among severely ill children.

Material and methods: This prospective online survey was conducted to examine current HHFNC practice in neonatal and paediatric intensive care units of the Pakistan. There was no agreement in this survey on how to define HFNC in paediatric patients or how to establish or alter flow. An online questionnaire was used for data collection to assess the current HHFNC practice in Pakistan. The survey questionnaire was based on information regarding the hospital, HHFNC use, indications, and the consequences. Furthermore, questions were raised about individual practice and whether or not HHFNC had been established as a safe therapeutic intervention. If a respondent, such as a physician, nurse or the resident had used HHFNC before, additional questions have been asked concerning the indications for usage and the weaning procedure. Statistical analysis was performed using SPSS version 26.

Results: The response was received from 204 physicians and nurses. Majority of responders 85% has experienced to used HFNC. 63% of the responders have been using HFNC for more than 3 years. Acute respiratory failure was considered a good indication for HFNC by all 193(95%). Many Physicians used HFNC initiation and weaning protocol. According to the complications the abdominal distension was experienced by 9.8% preteritions, followed by nasal mucosal by 29.4%, irritability 19.16% and Pneumothorax/Barotrauma experienced by 22.5% of the pediatricians, while sedation have experienced while on HFNC by the 15.2% of the participants. According to respondent's experience the 89% of the parents were satisfied with the use of HFNC and 98.5% of physicians recommended to other colleagues.

Conclusions: As per study conclusion this survey presented the first national assessment of the increasing usage of HFNC as a source of oxygen for children, with HFNC being largely acknowledged as a noninvasive and safe technique. There were a variety of indicators. This was the first national review of HFNC's expanding usage in paediatric critical care.

Keywords: Pediatric ICU, HHFNC, indication, complications, satisfaction

INTRODUCTION

The most prevalent reason for admission to a paediatric intensive care unit is the acute respiratory distress¹. For acute respiratory distress, invasive mechanical ventilation is a well-established and effective supportive treatment. It is, however, linked to an increased risk of nosocomial infections, lung and airway traumas, stay in the hospital, and sedation-related consequences.^{1,2} Because of the disadvantages and greater risk of complications linked to the invasive mechanical ventilation, non-invasive respiratory support systems have grown more acceptable.³ HHFNC becoming more popular as a non-invasive respiratory support alternative for newborns and children in intensive care.^{4,5} Although high-quality information on the therapeutic efficacy of HHFNC compared to traditional low-flow oxygen treatment has begun to emerge, HHFNC has recently been adopted into paediatric hospitals in UK, primarily for the management of bronchiolitis.⁴ High-flow gas is described as a flow that equals or exceeding the participant's inspiratory flow. When compared to typical low flow oxygen treatment, the quantity of gas flow through to the nasal cannula is restricted due to poor tolerance of the patients, as it dries the nasal mucosa and raises the upper airway permeability.⁶ HHFNC minimizes work of breathing and enhances ventilation performance through a various mechanisms, including nasopharyngeal dead space washout, which improves alveolar ventilation, reduced inspiratory resistance linked to the nasopharynx, development in conductance and pulmonary regulations by providing appropriately warmed and humidified gas, and facilities of favorable distending pressure for recruitments of lungs.^{4,7} In children, a suitable the flow rate has been estimated to be 1 to 2 L/kg/min up to 10 kg, accompanied by a 0.5 L/kg/mi rise. The size of the cannula varies depending on the patient's age and weight. Due to the potential of unanticipated spikes in airway pressure and the subsequent the risk of an air leak, manufacturers recommend that the cross-sectional area of the cannula be no more than 50% that of the nares. That implies the cannula's outer

diameter should be no more than two-thirds the size of the nares.⁸ Furthermore, there are no established weaning strategies for HHFNC, which might lengthen the stay in hospital. There are relatively few observational studies that describe the supportive treatment of HHFNC individuals (e.g., nasogastric (NGT) or nasojejunal tubes (NJT) vs. oral feeding, aerosol delivery strategies for inhalational medicine administration, and sedation while being on HHFNC).^{4,9,10} This method is now gradually being utilized throughout all paediatric age groups, with adult cases being considered as well. Because of the expanding usage of HFNC in paediatric critical care units and the lack of local data, this survey has been done to assess the current practices of HHFNC in terms of techniques uses, indications and complications experience among severely ill children.

This prospective online survey was conducted to examine current HHFNC practice in the pediatric and neonatal intensive care units of the Pakistan. There was no agreement in this survey on how to define HFNC in paediatric patients or how to establish or alter flow. An online questionnaire was used for data collection regarding assessment of the current HHFNC practice, in all over the Pakistan. The survey questionnaire was based on information regarding the hospital, HHFNC use, indications, and the consequences. Among health-care providers, only physicians and nurse were included. All the health care providers those were not agreeing to share their experience and information were excluded. Furthermore, questions were raised about individual practice and whether or not HHFNC had been established as a safe therapeutic intervention. If a respondent, such as a physician, nurse or the resident had used HHFNC before, additional questions have been asked concerning the indications for usage and the weaning procedure. Statistical analysis was performed using SPSS version 26.

RESULTS

There was 204 of the health care providers gives regarding current HHFNC practice in the pediatric and neonatal intensive care units

from different provinces of Pakistan as 146 (71.6%) from Sindh, 44 (21.6%) from Punjab, 10 (4.9%) KPK, 4 (2%) from Baluchistan, in which 174 (85.4%) used HFNC while 30 (14.7%) had no experience. Majority of pediatricians 128 (62.8%) having experience of more than three years with HFNC, whereas 76 (37.2%) having experience less than 3 years. 94.6% physicians concentrate on HFNC as a respiratory disease in paediatric, according to the proportion distribution in the various types of indications. Other applications described included linking to intubation and providing respiratory assistance after extubating and cardiac failure. Table.1

The majority of the respondents 80.3% agreed to feed while on a high flow nasal cannula. Only 15% of the respondents used sedation on HFNC. 58% followed the HFNC initiation protocol and 66% of the respondents have the HFNC weaning and escalation protocol. According to the complications the abdominal distension was experienced by 9.8% preteritions, followed by nasal mucosal by 29.4%, irritability 19.16% and Pneumothorax/Barotrauma experienced by 22.5% of the pediatricians, while sedation have experienced while on HFNC by the 15.2% of the participants. According to the 89% of the respondent's experience the of parents were satisfied with the use of HFNC and 98.5% of physicians recommended to other colleagues. Table.1

Table 1: Survey questionnaires characteristics (n=204)

Variables		Frequency	%
Province	Sindh	146	71.6%
	Punjab	44	21.6%
	Baluchistan	10	4.9%
	KPK	4	2.0%
Health-care Providers	Physicians	185	90.6%
	Nurses	19	9.3%
Well experienced		174	85.3%
Patients receive respiratory support via HFNC per year	20-50	53	26.0%
	50-100	57	27.9%
	100-200	40	19.6%
	>200	54	26.5%
Age group of the patients underwent HFNAC administration	<1 year	97	47.5%
	1-5 year	85	41.7%
	>5yr	22	10.8%
Utilization	<100 /year	110	54.0%
	>100/year	94	46.0%
Protocol Exist: initiation		118	57.8%
Protocol Exist: weaning or Escalation		135	66.2%
Indications	Acute Respiratory illness	193	94.6%
	Post extubation	101	49.5%
	Cardiac failure	33	16.2%
	Others	23	11.3%
Estimated complications of HFNC have experienced in hospital till present	None	38	18.6%
	Abdominal distention	20	9.8%
	Irritability	40	19.6%
	Nasal mucosal	60	29.4%
	Pneumothorax/Barotrauma	46	22.5%
Feeding status	May start NG feed	142	69.6%
	May start oral feed	22	10.8%
	Strictly NPO	40	19.6%
Sedation have experienced while on HFNC	Yes	31	15.2%
	No	173	84.8%
Parental satisfaction		182	89.0%
Recommendation to others		201	98.5%

DISCUSSION

Humidified High Flow Nasal Cannula (HHFNC) is being more widely used as a novel kind of respiratory assistance across the worldwide. Furthermore, there is a scarcity of data to back up its effectiveness and safety.¹¹ This survey has been done to assess the current practices of HHFNC in terms experience among severely ill children. In this survey respondents showed different types of indications among pediatric patients and most of the physician's 193 (94.6%) rely on HFNC for the respiratory illness. Other applications described included linking to intubation and providing respiratory assistance after extubating, furthermore the majority of the respondents 80.3% agreed to feed while on a high flow nasal cannula, only 15% of the respondents used sedation on HFNC. 58% followed the HFNC initiation protocol and 66% of the respondents have the HFNC weaning and escalation protocol and according to the 89% of the respondent's experience the of parents were satisfied with the use of HFNC and 98.5% of physicians recommended to other colleagues. On other hand according to the survey of Hough JL et al¹¹ indicated that HHFNC use is extensive and clinical practices are various in Australia and New Zealand in 2010, revealing that HHFNC use is prevalent and clinical practices are varied. Although there is minimal data to support its effectiveness and safety, the most of neonatologists are

willing to engage in research trials to determine the optimal way to provide HHFNC.¹¹ In another survey of Hosheh O et al¹² revealed that there is widespread support for producing paediatric-specific national advice on the use of HHFNC on wards, their survey priorities list may be useful in guiding future joint research efforts in this field. Despite pediatricians' acknowledgement of a paucity of research on the therapeutic effectiveness and safety of HHFNC, over two-thirds of pediatricians in Pakistan are actively utilizing it, according to this survey. Many investigations of HFNC treatment in children with bronchiolitis have been published.^{13,14} HFNC treatment has also been used for asthma, pneumonia, sleep apnea, critical pediatric patient transfer, and post-extubation respiratory support, according to research. There are very few research on HFNC treatment in the paediatric critical care unit in the literature.¹³ In a retrospective research conducted by Schibler et al.¹⁵ on critical care cases with viral bronchiolitis, it was discovered that individuals' intubation rates fell from 37% to 7% when given HFNC medication. Because of the distending pressure created by high flow rates, numerous clinicians now regard HFNC devices as a potentially less intrusive alternative to nCPAP.¹⁶ There did not inquire about the criteria used to establish HFNC failure; nonetheless, it is critical to detect when HFNC is failing and escalate to the appropriate level of assistance. When commencing

HFNC, the team should establish significant clinical goals and escalation criteria, as well as whether NIV, CPAP, or intubation will be the next step. In children with asthma, a delay in escalation to NIV could be linked to worse results.^{17,18} In a survey by Sadasivam K et al¹⁹ reported that the most prevalent reason for employing HHFNC was respiratory distress related to bronchiolitis (97.2%), following by the asthma (63.9%) and pneumonia (87.5%). Sixty-eight (94.4 percent) of PICUs used HHFNC as a respiratory support while weaning patients off invasive ventilation.¹⁹ Above survey done to determine whether HHFNC is used in PICUs and HHFNC, as previously stated, is safe, well tolerated, and may offer a greater oxygen concentration,¹⁹ and these findings almost similar to this survey and according to that study this was also the first nationwide survey to look at how HHFNC is used in Pakistan and to identify the challenges that arise from it and according to our findings imply that, despite the lack of evidence for HHFNC's effectiveness and cost limits, it is nonetheless frequently used and regarded safe.

CONCLUSION

Current survey provided the first national overview of the progressively widespread use of HFNC as an oxygen supply for children and HFNC observed as widely accepted as a noninvasive and safe procedure. There were several different indications. This was a first nationwide overview about the expanded use of HFNC in pediatric critical care.

REFERENCES

- Chang CC, Lin YC, Chen TC, Lin JJ, Hsia SH, Chan OW, Lee EP. High-Flow Nasal Cannula Therapy in Children with Acute Respiratory Distress with Hypoxia in A Pediatric Intensive Care Unit-A Single Center Experience. *Frontiers in Pediatrics*. 2021;9:375.
- Fedor KL. Noninvasive respiratory support in infants and children. *Respir Care* 2017;62:699–717.
- Yaman A. High flow nasal oxygen therapy in pediatric intensive care unit. *Bagcilar Med Bull* 2021;6(1):42-47
- Hosheh O, Edwards CT, Ramnarayan P. A nationwide survey on the use of heated humidified high flow oxygen therapy on the paediatric wards in the UK: current practice and research priorities. *BMC pediatrics*. 2020;20(1):1-9.
- Ramnarayan P, Schibler A. Glass half empty or half full? The story of highflow nasal cannula therapy in critically ill children. *Intensive Care Med*. 2017;43(2):246–9
- Jain A, Rajan SK, Patel K, Garg P, Agrawal V, Kakkar D, Gajjar T, Mishra A, Patel S, Doshi C. Concomitant pulmonary valve replacement with intracardiac repair for adult tetralogy of Fallot. *Annals of Pediatric Cardiology*. 2021;14(3):323.
- Ejiofor BD, Carroll RW, Bortcosh W, Kacmarek RM. PEEP Generated by High-Flow Nasal Cannula in a Pediatric Model. *Respiratory Care*. 2019;respcore.06470
- Kwon JW. High-flow nasal cannula oxygen therapy in children: a clinical review. *Clinical and Experimental Pediatrics*. 2020;63(1):3.
- Al-Subu AM, Hagen S, Eldridge M, Boriosi J. Aerosol therapy through high flow nasal cannula in pediatric patients. *Expert review of respiratory medicine*. 2017;11(12):945-53.
- Slain KN, Shein SL, Rotta AT. The use of high-flow nasal cannula in the pediatric emergency department. *Journal de pediatria*. 2017;93;1:36-45
- Hough JL, Shearman AD, Jardine LA, Davies MW. Humidified high flow nasal cannulae: current practice in Australasian nurseries, a survey. *Journal of paediatrics and child health*. 2012 Feb;48(2):106-13.
- Hosheh O, Edwards CT, Ramnarayan P. A nationwide survey on the use of heated humidified high flow oxygen therapy on the paediatric wards in the UK: current practice and research priorities. *BMC pediatrics*. 2020 Dec;20(1):1-9.
- Yaman A. High flow nasal oxygen therapy in pediatric intensive care unit. *Bagcilar Med Bull* 2021;6(1):42-47
- Kwon JW. High-flow nasal cannula oxygen therapy in children: a clinical review. *Clin Exp Pediatr* 2020;63(1):3-7.
- Schibler A, Pham TM, Dunster KR, Foster K, Barlow A, Gibbons J, et al. Reduced intubation rates for infants after introduction of high-flow nasal prong oxygen delivery. *Intensive Care Med* 2011;37(5):847-852
- Schmid F, Olbertz DM, Ballmann MJRm. The use of high-flow nasal cannula (HFNC) as respiratory support in neonatal and pediatric intensive care units in Germany—A nationwide survey. 2017;131:210-4.
- Pilar J, i Alapont VM, Lopez-Fernandez Y, Lopez-Macias O, Garcia-Urabayen D, Amores-Hernandez IJMi. High-flow nasal cannula therapy versus non-invasive ventilation in children with severe acute asthma exacerbation: an observational cohort study. 2017;41(7):418-24
- Miller AG, Gentile MA, Tyler LM, Napolitano N. High-flow nasal cannula in pediatric patients: a survey of clinical practice. *Respiratory Care*. 2018 Jul 1;63(7):894-9.
- Sadasivam K, Ramachandran B. A Survey of Humidified High-flow Nasal Cannula Usage in Indian Pediatric Intensive Care Units. *Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine*. 2020 Oct;24(10):996.