Research article

HIGH FLOW OXYGEN THERAPY MACHINE USING HIGH FLOW NASAL CANNULATION-A HOPE FOR COVID-19 PATIENTS IN ACUTE RESPIRATORY FAILURE

Sikandar Munir Memon1, Adeel Mehadi2, Sehreen Moorat2, Ali Raza Khoso2, Maria Talpur2, Bakhtawar Hashim2, Falak Abro2

[1]Medical Research Centre, Liaquat University of Medical & Health Sciences, Jamshoro, Sindh, Pakistan.

[2] Biomedical Engineering Liaquat University of Medical & Health Sciences, Jamshoro Sindh,Pakistan

Correspondence:
Email: drsikandermemon@gmail.com
https://doi.org/10.38106/LMRJ.2021.3.2-03

Received: 03.06.2021
Accepted: 15.06.2021
Published: 30. 06.2021

ABSTRACT

OBJECTIVE: To provide humidified, heated and precise oxygen with high efficiency of Functional residual to acute respiratory distress syndrome patients caused by COVID-19.

METHODOLOGY: It was an observational research that took place at the LUMHS Hospital. In this study, 200 patients with severe respiratory distress, either caused by Covid-19 or other respiratory disorders, were enrolled. LUMHS hospital ICU ward was used as a data source. This study showed that subjects in their late 30s, both male and female. Patients with acute or chronic respiratory failure were included, but those with other pulmonary disorders were excluded.

RESULTS: A total of 200 patients were selected for this study. Out of them 122 (61%) were males and 78 (39%) were females with the Standard deviation of 2.33. Regarding age. 24%. Were below 30s. 20% patients were in 30s.and 57% belonged to above 30s. While the efficiency of HFNC was 65%. In 65% cases it was proved to be lifesaving and in 39% cases patients were sent for intubation. Oxygen delivery method using cannula was 65% in delivering SPO2 equal to or greater than 10 lpm while face mask method was only 35% successful, which determines that higher concentration cannulation is a more efficient method than facemask.

CONCLUSION: HFNC is a recent innovation that reduces the need for intubation and oxygen loss while also providing high-flow oxygen with optimum humidification and temperature to patients with respiratory failure

Key Words: COVID-19, Respiratory Distress, Syndrome, positive pressure respiration, cannula, chronic obstructive, respiration

INTRODUCTION

Various oxygen therapies are supposed to provide oxygen for oxygenation and breathing to respiratory failure patients, HFNC is an emerging and widely recommended oxygen therapy in developing countries these days. A modern technique that provides sufficient oxygen, adequate humidified and heated air with reduced complications and difficulties, since it is easy to run and high oxygen flow machines.[1] Clinically, this novel technique has gained considerable interest. For COVID-19 patients, most of the countries continued with this therapy because it provides highly saturated oxygen and successful quality makes this therapy exceptional and enhances its specialty. HFNC is a recent development in oxygen therapy. It supplies oxygen above 30L/mint with sufficient heating and humidification. For oxygen therapy, NIV and other oxygen therapies were previously incorporated while NIV and cop pairing proved to be very convenient for ventilation and NIV was also preferred for prolonged treatment of chronic obstructive pulmonary disease at home, although it can be exhausting and scary due to delivering high pressure in the airways, and it's too complicated to synchronize. Contrary to this, HFNC

is a recent advance in oxygen therapy with sufficient oxygen supply[2]. Although HFNC has been used for neonates since 2000 and since then it has been an important part of oxygen therapy in pediatrics, HFNC has also been successfully used for adults with acute respiratory failure, having been universally recognized as an inherent part in hospitals worldwide, High-flow nasal cannula (HFNC) oxygen therapy has gained attention as an innovative mechanical ventilation for severely sickly patients, particularly those with respiratory failure. At flow rate by up to 60 L/min, it provides adequate warmed and humidified medical gas and is proven to have a number of other advantages, which include anatomical elimination of empty space, positive end expiratory pressure (PEEP effects, continuous conservation of oxygen inspired fraction (FiO2) and heavy humidification effects.[3]. Oxygen treatment with high-flow nasal cannula (HFNC) is an oxygenation procedure first used in premature babies and most recently in intensive care units or patients that are postoperative. HFNC is able to provide up to 100% high and controlled FiO2, including during acute respiratory distress[4]. The benefits of HFNC over nasal persistent positive airway pressure, like its simplicity of utilization and enhanced tolerance for reduced nasal damage, have resulted in expanded use outside the intensive care unit as well[5].

In the early 2000s, HFNC was first adopted into clinical practice as a non-invasive system for the treatment of apnea in newborn infants and has since been well known in pediatrics, especially in respiratory failure triggered by bronchiolitis. Recently, this device is widely used in intensive care units particularly in respiratory units where it is commonly and frequently used, frequently replacing NIV in the superintendence of respiratory failure from a number of etiologies[2]. Earlier research on the feasibility of treatment with HFNC in the treatment of acute bronchiolitis comes mainly through observational work, although there are few randomized clinical trials that are significant. Furthermore, earlier studies compared HFNC treatment with less reliable, low-flow systems[6].

For initial respiratory management in young infants with mild to extreme AVB, we conducted a multicenter, randomized, non-inferiority study of HFNC compared with Ncpa[12]. Partial carbon dioxide pressure (PaCO2) declined in a lung-injured animal model as HFNC flow improved and PaCO2 decreased more successfully with enhanced gas release [7] .Different observational trials in infants with bronchiolitis have shown that HFNC therapy is practical, safe, and reliable, although further studies are needed to ensure evidence-based recommendations for its use. Latest publications show that a wider variety of ages and diagnoses could also be successful and safe to submit.[14]

METHODOLOGY

It was an observational research that took place at the Liaquat University of Medical & Health Sciences (LUMHS) Hospital. In this study, 200 patients with severe respiratory distress, either caused by Covid-19 or other respiratory disorders, were enrolled. LUMHS hospital ICU ward was used as a data source. This study showed that subjects in their late 30s, both male and female. Patients with acute or chronic respiratory failure were included, but those with other pulmonary disorders were excluded. The data analysis was performed on SPSS version 22.0. The variables like efficiency, gender ware categorical variables and their result have been shown in pie charts, the efficiency compression of oxygen delivery was also represented in pie chart, while age is presented in bar chart.

RESULTS

A total of 200 patients were selected for this study. Out of them 122 (61%) were males and 78 (39%) were females. Regarding age. 24%. Were below 30s. 20% patients were in 30s.and 57% belonged to above 30s.

Figure-I shows efficiency of HFNC was 65%. In 65% of cases it was proved to be lifesaving and in 35% cases patients were sent for intubation. Figure-II illustrates Oxygen delivery method using cannula was 65% in delivering SPO2 equal to or greater than 10 lpm while face mask method was only 35% successful, which determines that higher concentration cannulation is more efficient method than face mask.

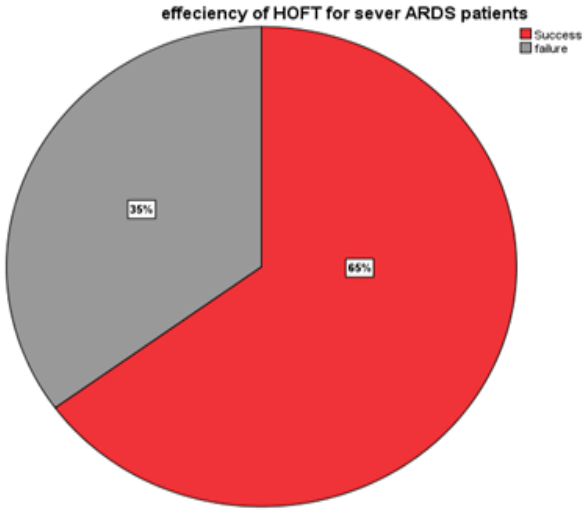

FIGURE I: Efficiency of HOFT for severe ARDS patients

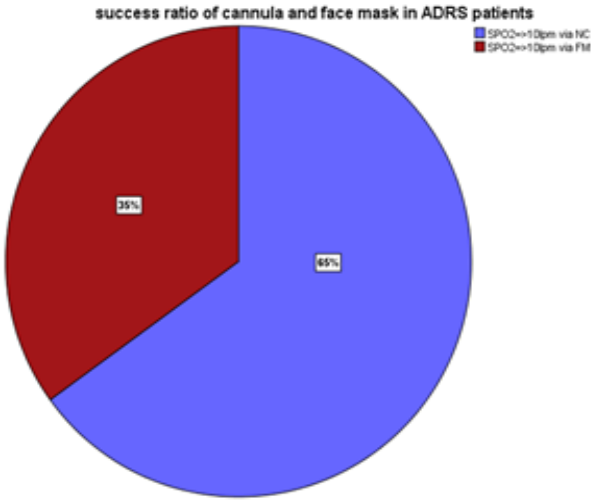

FIGURE II: Success ratio of cannula and face mask in ARDS patients

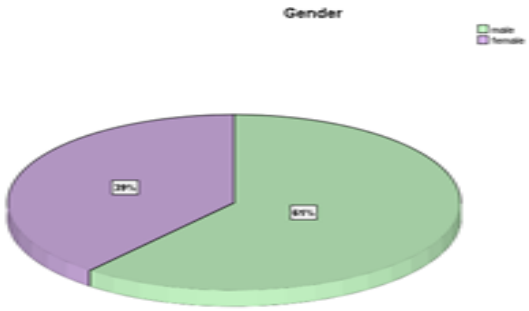

Figure III: Gender

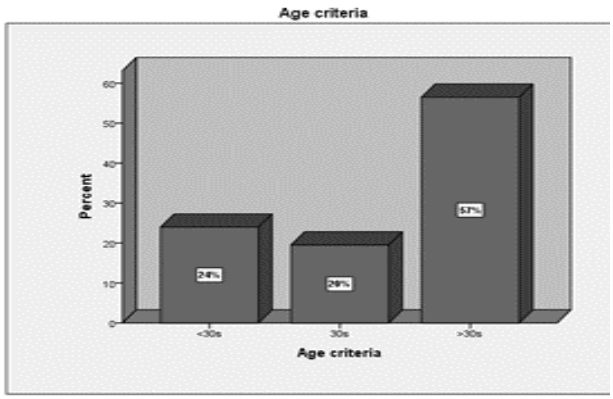

Figure IV: Age Criteria

DISCUSSION

The study was conducted to assess the use of HFOT for ADRS patients by using cannulation instead of facemask. Due to different delivery systems, high flow nasal cannula can provide up to 60 L/min whereas high-velocity nasal insufflation can only supply up to 40 L/min. The open air is where you exhale. HFNO decreases breathing frequency and labor of breathing while reducing dead space and providing low levels of PEEP[15] The is cannulation is more preferred in case of severe hypoxia and for delivery of more oxygen a very reliable option that has been seen is cannulation when we need to send more concentrated oxygen. HFNC, like CPAP, is a high-flow device that can provide positive end expiratory pressure, but unlike CPAP, it lacks a valve. The use of HFNC has been suggested as a strategy to reduce upper airway dead space and resistance. HFNC is thought to be a less invasive treatment than CPAP, as well as being better tolerated by patients and easier to manage by personnel. HFNC has been demonstrated to be more

effective than standard therapy (e.g., CPAP) in several trials[16]. Better tolerance, easier mobility, closer bonding between newborn and parents, and less nasal damage of HFNC have lately resulted in widespread usage of this form of NRS in most centers, particularly in preterm newborns[17]. During the COVID-19 pandemic, a large number of clinicians became sick, raising worries about using aerosol-generating methods. As a result, it looks like HFNC is being avoided. The scientific data of bio-aerosol formation and dispersion using HFNC summarized here demonstrates a danger comparable to that of regular oxygen masks. Thus, using HFNC prongs with a surgical mask over the patient's face might be a feasible approach that might help hypoxemic COVID-19 patients and avoid intubation[18]. Due to the pandemic of new coronavirus illness (COVID-19) in 2019, the global healthcare system is experiencing an unprecedented resource shortage. It is most commonly linked with fever, cough, dyspnea, myalgia, tiredness, and pneumonia. Invasive mechanical ventilation is used by between 29.1% and 89.9% of ICU patients. For the treatment of hypoxemic respiratory failure, supplemental oxygen therapy is the mainstay. In critically unwell patients, the high-flow nasal cannula (HFNC) is a unique non-invasive technique for improved oxygenation and breathing. In this bleak circumstance, HFNC can help reduce mechanical ventilation[19]. In patients with COVID-19, HFNC can lessen the need for intubation, as well as the duration of stay in the intensive care unit and problems associated with mechanical ventilation. HFNC can also help patients with apneic oxygenation during airway control. Aside from that, the use of high-flow oxygen cannulas might result in the formation of aerosols. As a result, HFNC therapy should be done in a negative pressure chamber if feasible; if this is not feasible, devices should be done in a single room[20]. The HFNC is very convincing high flow oxygen therapy, which can be obtained through invasive ventilation, but it is too heavy for the elderly and chronic. patients to endure. With our findings, we were able to discover that HFNC has a high efficiency and has proven to be very effective in ADRS patients. Face mask complications such as discomfort and oxygen leakage were very low in the cannulation oxygen delivery method, and patients were more comfortable. Furthermore, when we consider the age factor and the complications of using oxygen therapy, this device received positive feedback. HFNC has established itself as a well-known oxygen therapy, and more research into this technology is currently underway.

CONCLUSION

HFNC is a recent innovation that reduces the need for intubation and oxygen loss while also providing high-flow oxygen with optimum humidification and temperature to patients with respiratory failure

Conflict of Interest: There is no conflict of interest.
Funding: This study was not funded by any agency

REFERENCES

1. Frat JP, Coudroy R, Marjanovic N, Thille AW. High-flow nasal oxygen therapy and noninvasive ventilation in the management of acute hypoxemic respiratory failure. Ann Transl Med. 2017;5(14):1–8.
2. Spicuzza L, Schisano M. High-flow nasal cannula oxygen therapy as an emerging option for respiratory failure: the present and the future. Ther Adv Chronic Dis. 2020;11:1–15.
3. Kim ES, Lee H, Kim SJ, Park J, Lee YJ, Park JS, et al. Effectiveness of high-flow nasal cannula oxygen therapy for acute respiratory failure with hypercapnia. J Thorac Dis. 2018;10(2):882–8.
4. Macé J, Marjanovic N, Faranpour F, Mimoz O, Frerebeau M, Violeau M, et al. Early high-flow nasal cannula oxygen therapy in adults with acute hypoxemic respiratory failure in the ED: A before-after

study. Am J Emerg Med [Internet]. 2019;37(11):2091–6. Available from: https://doi.org/10.1016/j.ajem.2019.03.004
5. Bressan S, Balzani M, Krauss B, Pettenazzo A, Zanconato S, Baraldi E. High-flow nasal cannula oxygen for bronchiolitis in a pediatric ward: A pilot study. Eur J Pediatr. 2013;172(12):1649–56.
6. Banik S, Parrent AG, Noppens RR. Awake craniotomy in a super obese patient using high flow nasal cannula oxygen therapy (HFNC). Anaesthesist. 2019;68(11):780–3.
7. Nisa L, Giger R. Practice Clinical images - Lingua plicata. Cmaj. 2012;184(3):2012.
8. Nishimura M. High-flow nasal cannula oxygen therapy in adults. J Intensive Care. 2015;3(1):1–8.
9. Scala R. High-flow nasal oxygen therapy in acute respiratory failure. Geriatr Care. 2018;4(3):408–13.
10. Nishimura M. High-flow nasal cannula oxygen therapy in adults: Physiological benefits, indication, clinical benefits, and adverseeffects. Respir Care. 2016;61(4):529–41.
11. Betul Ergul A, Calıskan E, Samsa H, Gokcek I, Kaya A, Erturk Zararsiz G, et al. Using a high-flow nasal cannula provides superior results to OxyMask delivery in moderate to severe bronchiolitis: a randomized controlled study Fraction of inspired oxygen HFNC High-flow nasal cannula ICU Intensive care unit pCO 2 Partial pressure of car. Eur J Pediatr. 2018;177:1299–307.
12. Milési C, Essouri S, Pouyau R, Liet JM, Afanetti M, Portefaix A, et al. High flow nasal cannula (HFNC) versus nasal continuous positive airway pressure (nCPAP) for the initial respiratory management of acute viral bronchiolitis in young infants: a multicenter randomized controlled trial (TRAMONTANE study). Intensive Care Med. 2017;43(2):209–16.
13. Ito J, Nagata K, Morimoto T, Kogo M, Fujimoto D, Nakagawa A, et al. Respiratory management of acute exacerbation of interstitial pneumonia using high-flow nasal cannula oxygen therapy: A single center cohort study. J Thorac Dis. 2019;11(1):103–12.
14. Ballestero Y, De Pedro J, Portillo N, Martinez-Mugica O, Arana-Arri E, Benito J. Pilot Clinical Trial of High-Flow Oxygen Therapy in Children with Asthma in the Emergency Service. J Pediatr [Internet]. 2018;194(April):204-210.e3. Available from: https://doi.org/10.1016/j.jpeds.2017.10.075
15. Calligaro GL, Lalla U, Audley G, Gina P, Miller MG, Mendelson M, et al. The utility of high-flow nasal oxygen for severe COVID-19 pneumonia in a resource-constrained setting: A multi-centre prospective observational study. EClinicalMedicine [Internet]. 2020;28:100570. Available from: https://doi.org/10.1016/j.eclinm.2020.100570
16. Comparison of CPAP and HFNC in Management of Bronchiolitis in Infants and Young Children. Children. 2017;4(12):28.
17. Suffredini DA, Allison MG. A Rationale for Use of High Flow Nasal Cannula for Select Patients With Suspected or Confirmed Severe Acute Respiratory Syndrome Coronavirus-2 Infection. J Intensive Care Med. 2021 Jan;36(1):9–17.
18. Li J, Fink JB, Ehrmann S. High-flow nasal cannula for COVID-19 patients: Low risk of bio-aerosol dispersion. Eur Respir J [Internet]. 2020;55(5). Available from: http://dx.doi.org/10.1183/13993003.00892-2020
19. Singh A, Khanna P, Sarkar S. High-Flow Nasal Cannula, a Boon or a Bane for COVID-19 Patients? An Evidence-Based Review. Curr Anesthesiol Rep. 2021 Mar;1–6.
20. Gürün Kaya A, Öz M, Erol S, Çiftçi F, Çiledağ A, Kaya A. High flow nasal cannula in COVID-19: a literature review. Tuberk Toraks. 2020 Jul;68(2):168–74.