Jalalabad Medical Journal

Editorial

Helmet CPAP (hCPAP)

The provision of ventilatory assistance without the use of an intrusive artificial airway (Tracheostomy or endotracheal tube) is known as noninvasive ventilation (NIV). During the past 20 years, there has been a noticeable growth in the use of noninvasive ventilation. Today, noninvasive ventilation is a vital tool for managing both acute and chronic respiratory failure, both at home and in critical care units. One kind of interface for administering NIV is helmet continuous positive airway pressure (hCPAP). Helmet continuous positive airway pressure (hCPAP) maintains the airway open during the breathing cycle, which increases oxygenation[1].

The discovery of helmet CPAP stands as one of the most critical advances in medical history. Italian inventor Maurizio Borsari created the CPAP helmet in 1991. In the late 1990s, Europeans promoted its use in non-invasive ventilation. With a success rate of 60-70%, helmet continuous positive airway pressure (hCPAP) is currently one of the alternate interfaces used as oxygen delivery devices to support patients with acute respiratory failure (ARF) in emergency departments and wards. The helmet interface has also been shown to be beneficial in minimising the risk of endotracheal intubation and mortality[1]. During COVID-19, helmet CPAP technology was approved by the US Food and Drug Administration (USFDA) for use in hyperbaric oxygen treatment.

The transparent helmet uses a collar-neck seal to cover the entire head and supplies oxygen and air through a ventilator, high-flow device, or wall flow meters. Since there are no pressure points on the face of the helmet, there is less chance of skin necrosis, which improves device tolerance and lessens patient discomfort[2]. Compared to conventional NIV breathing equipment, the patient can see, read, speak, and interact more easily through the helmet. It comes in a range of sizes to suit both adults and little children. Its silicon polyvinyl chloride collar, which is soft and devoid of latex, forms a pneumatic seal around the patient's neck. Standard inspiratory and expiratory limb tubing connections are made possible by the availability of two or more inlet and exit ports. On the circuit's inspiratory limb is a high-efficiency particle filter. A distal variable CPAP valve is also present. The additional ports provide a sealed area for nasogastric tube insertion or nebulizer delivery. The patient is also able to sip with a straw through this port[3]. Temperature, FiO_2, and gas flow within the helmet are all managed via a monitor. The helmet's zipper makes it simple to access when necessary. Helmet CPAP demands a patient who is pretty compliant and has an intact neuromuscular system. However, tolerance seems to be very good, especially for patients who have claustrophobia while wearing a face mask that fits tightly. For increased patient comfort, armpit straps can be swapped out for a counterweight system, and the system can also be equipped with humidification. It could occasionally be required to give a very mild sedative to alleviate anxiety[4]. The implementation of a heat-moisture exchange filter on the inspiratory and expiratory limbs of the helmet provides a safe method of containing droplets and aerosolizing virus particles. In comparison to a high-flow nasal cannula or face mask, which have an unknown and uncontained aerosolization potential, the helmet enclosure greatly lowers the risk of aerosolization.

Therefore, it is believed that using hCPAP will reduce viral propagation and transmission to healthcare professionals[5]. When compared to endotracheal intubation, the comfort of the helmet also reduces the requirement for sedation and the subsequent inotropic support. When the helmet is worn, it is frequently possible to safely postpone the need for an immediate intubation while keeping a close eye on the patient in case their condition worsens or their sickness improves[6]. The administration of hCPAP is not free from pitfalls. Compared with the face mask, the helmet, due to its larger internal volume, might facilitate CO_2 concentration rebreathing[7]. The inspired CO_2 concentration was found to be constantly higher when CPAP was delivered by means of a continuous flow CPAP helmet (For flow ranging from 20 to 60 L and PEEP from 0 to 15 cm H_2O) than with a face mask (Mean±standard deviation; 3.1±0.15 versus 0.8±0.3 mmHg, $p<0.01$)[8]. This was also true when the helmet was tested during pressure support ventilation[9]. However, higher flow rates corresponded to a lower inspired concentration of CO_2[8].

There are many advantages to using hCPAP, however, there are a few side effects. When compared to mask CPAP, helmet CPAP reduced the length of stay and the requirement for intubation in patients with mild to severe adult respiratory distress syndrome (ARDS) in 2016, according to research from a significant American academic center[2]. A meta-analysis by Luo et al. on helmet CPAP versus oxygen therapy in hypoxemic acute respiratory failure concluded that arterial oxygenation was better with hCPAP compared to standard oxygen therapy[10]. Oxygenation was also better with hCPAP than standard oxygen therapy in specific hypoxemic respiratory failure conditions such as acute cardiogenic pulmonary oedema (ACPE) and pneumonia.

Dr. Mahfuzul Islam Chowdhury
Associate Professor
Department of Anaesthesia, Analgesia and Intensive Care Medicine
Jalalabad Ragib-Rabeya Medical College, Sylhet.
Email: tanveer.pain1@gmail.com

DOI*: https://doi.org/10.3329/jmj.v21i1.78123*

REFERENCES

1. Adi O, Fong CP, Keong YY, Apoo FN, Roslan NL. Helmet CPAP in the emergency department: A narrative review. Am J Emerg Med 2023; 67: 112-9.
2. Patel BK, Wolfe KS, Pohlman AS, Hall JB, Kress JP. Effect of noninvasive ventilation delivered by helmet vs face mask on the rate of endotracheal intubation in patients with acute respiratory distress syndrome: A randomized clinical trial. JAMA 2016; 315 (22): 2435-41.
3. Piastra M, Antonelli M, Chiaretti A, Polidori G, Polidori L, Conti G. Treatment of acute respiratory failure by helmet-delivered non-invasive pressure support ventilation in children with acute leukemia: A pilot study. Intensive Care Med 2004; 30 (3):472-6.
4. Lucchini A, Valsecchi D, Elli S, Doni V, Corsaro P, Tundo P, et al. The comfort of patients ventilated with the Helmet Bundle. Assist Inferm Ric 2010; 29 (4): 174-83.
5. Armirfarzan H, Shanahan JL, Schuman R, Leissner KB. Helmet CPAP: how an unfamiliar respiratory tool is moving into treatment options during COVID-19 in the US. Ther Adv Respir Dis 2020; 14. doi: 10.1177/1753466620951032.
6. Ing RJ, Bills C, Merritt G, Ragusa R, Bremner RM, Bellia F. Role of helmet-delivered noninvasive pressure support ventilation in COVID-19 patients. J Cardiothorac Vasc Anesth 2020; 34 (10): 2575-9.
7. Esquinas Rodriguez AM, Papadakos PJ, Carron M, Cosentini R, Chiumello D. Clinical review: Helmet and non-invasive mechanical ventilation in critically ill patients. Crit Care 2013;17: 223. doi: 10.1186/cc11875.
8. Patroniti N, Foti G, Manfio A, Coppo A, Bellani G, Pesenti A. Head helmet versus face mask for non-invasive continuous positive airway pressure: a physiological study. Intensive Care Med 2003; 29 (10): 1680-7.
9. Racca F, Appendini L, Gregoretti C, Stra E, Patessio A, Donner CF, et al. Effectiveness of mask and helmet interfaces to deliver noninvasive ventilation in a human model of resistive breathing. J Appl Physiol 2005; 99 (4): 1262-71.
10. Ferioli M, Cisternino C, Leo V, Pisani L, Palange P, Nava S. Protecting healthcare workers from SARS-CoV-2 infection: practical indications. Eur Respir Rev 2020; 29 (155). doi: 10.1183/16000617.0068-2020.