REVIEW

The importance of high flow nasal cannula (HFNC) oxygen therapy

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Abstract

High flow nasal cannula (HFNC) oxygen therapy devices are used on a daily-basis in many intensive care units and postoperative wards. Such a device deliver a mixture of air and oxygen, warmed, humidified, with gas flow between 20-60 L/min, and inspired oxygen fraction between 0.21-1. Therefore, it improves oxygenation, decreases dead space, washes out the carbon dioxide (CO2) from patients' airways, improves thoraco-abdominal synchrony and decreases the work of breathing. Studies have shown efficacy of HFNC oxygen therapy use for acute hypoxemic respiratory failure, for patients with exacerbations of chronic pulmonary diseases, after extubation in order reduce the need for mechanical ventilation, in perioperative period to prevent atelectasis and in palliative care, in order to reduce breathlessness. It isn`t feasible for patients with severe altered neurological status, facial trauma, basal skull fracture, complete airway obstruction or epistaxis. There are no standardized recommendation for the use or contraindication of HFCN oxygen therapy. The weaning is realised according with patients' tolerance, oxygen saturation, respiratory and heart rates.

Keywords: high flow nasal cannula, oxygen therapy, hypoxemia, anesthesia, comfort.

Rezumat

Aparatele de oxigenoterapie cu flux crescut pe canula nazală sunt folosite în mod curent în secțiile de terapie intensivă și în saloanele de îngrijire postoperatorie. Aceste aparate asigură o mixtură de aer și oxigen, încălzită, umidificată, cu fluxuri între 20-60 L/min și o fracție inspiratorie a oxigenului cuprinsă între 0,21-1. Astfel, îmbunătățesc oxigenerarea, scad spațiul mort, spală dioxidul de carbon din căile respiratorii, îmbunătățesc sincronismul torace-

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abdomen și scad travaliul respirator. Studiile arată eficacitatea oxigenoterapiei cu flux crescut în cazurile de insuficiență respiratorie acută hipoxemică, pentru pacienți cu exacerbări al patologiilor pulmonare cronice, după extubare pentru a reduce necesitatea ventilației mecanice, în perioada perioperatorie pentru a preveni atelectazia pulmonară și în medicina paleativă, pentru a ameliora senzația de sufocare. Nu este fezabilă pentru pacienții cu status neurologic sever afectat, traumă facială, fractură de bază de craniu, obstrucție completă de căi aeriene sau epistaxis. Nu există recomandări standardizate pentru folosirea sau contraindicarea oxigenoterapiei cu flux crescut. Sevrarea se realizează în funcție de toleranța pacientului, saturația oxigenului, precum și frecvențele respiratorie și cardiacă.

Cuvinte cheie: flux crescut pe canula nazală, oxigenoterapie, hioxemie, anestezie, confort.

INTRODUCTION

The high flow nasal cannulas were firstly used at the beginnings of 2000 for the treatment of chronic obstructive pulmonary disease (COPD)[1] and afterwards for cases with respiratory failure, postextubation and after various surgeries[2,3]. After that, HFNC started to be used in children with all types of respiratory failure and premature neonates[4]. These devices remove all the complications related with non-invasive mechanical ventilation, like air leakage, nasal trauma, skin lesions, pressure ulcers and low patients tolerability rate[3].

Hypoxemia is one of the most encountered situation in hospitalised patients and the need for supplemental oxygen therapy is very common. It can be delivered in the form of low flow nasal cannula (LFNC) oxygen therapy or high flow nasal cannula (HFNC) oxygen therapy[5]. All the HFNC devices permit the handling of two delivered parameters: the gas flow rate and the oxygen percentage. The oxygen is mixed with air, the inspired oxygen fraction being comprised between 0.21 and 1, and the gas flow ranges between 20 and 60 litres per minute. The main advantages are the capacity of heat up until normal body temperature and 100% humidification (to prevent airway mucosa irritation and dryness) along with comfortable access and grate tolerance[5].

The device for HFNC oxygen therapy is made of a flowmeter, an oxygen-air blender, an active humidifier, a heated inspiratory circuit and a nasal cannula. They are independents devices, with friendly interfaces, without strident alarms, which don`t interfere with patients monitoring systems[6].

There are non-standardized recommendations about weaning from HFNC oxygen therapy. Some clinicians prefer to decrease both the gas flow and oxygen concentration in the same time; others decrease first the flow, and then the oxygen concentration or vice-versa. It should be titrated accordingly to patient's tolerance, monitoring respiratory and hart rates, arterial oxygen saturation and blood pressure.

BENEFITS

Many studies have shown that the main beneficial effect of HFNC oxygen therapy is the capacity of improving oxygenation[7,8]. It has shown improvement in clinical status and laboratory tests for patients with various degrees of acute respiratory failure due to pneumonia, acute heart failure, pulmonary embolism, after endotracheal tube removal, chronic pulmonary diseases, neoplasia, impaired neurological status, traumas and burns[7-11].

These devices have the capacity of increasing the airway pressure due to high flows and decreasing dead space with secondary improvement of alveolar ventilation. Therefore, HFNC devices decrease the rate of tracheal intubation and mechanical ventilation[6]. Pham et al. have shown the improvement of thoraco-abdominal synchrony with consecutive decrease in work of breathing and the reduction of breathing frequencies when HFNC devices are used[12]. The use of high flows washes out the carbon dioxide (CO2) from patients' airways and enriches the gas with oxygen[5].

The use of warm, humidified gases primarily increases patient tolerability by reducing airway construction and work of breathing, improves mucociliary function and secretions clearance along with reducing the risk of atelectasis[13]. Corley et al. have shown that HFNC oxygen therapy can be use in perioperative period to reduce the risk of atelectasis in obese patients and to improve oxygenation[14]. Due to the fact that the gas delivered by HFNC devices is warmed and humidified, patients organism are using less energy for conditioning the inspired air[5]. In addition, the patients' respiratory clearance is more efficient because they are able to expel secretions because the cannula only occupies the nose[13].

Regarding postoperative period, Vargas et al. demonstrated the ability of HFNC devices to improve patients` comfort, to ameliorate oxygenation and to decrease length of stay, after major surgery and in burn patients[15-16]. Various studies showed several physiological effects of HFNC oxygen therapy in postoperative period, like reducing the inspiratory effort with subsequent improvement in lung volume and compliance[7].

Studies have highlighted the fact that HFNC oxygen therapy can be used as a method for delivering oxygen during tracheal intubation. Badiger et al. demonstrated reducing the occurrence of severe desaturation before intubation[17]. Jones and Zappetti showed that HFNC oxygen therapy is beneficial in post-extubation period, by reducing the re-intubation rate and the development of respiratory failure after extubation[18].

HFNC oxygen therapy may be beneficial in the emergency room, for patients with dyspnea and hypoxemia. Rittayamai et al. have conducted a study on 40 patients who presented with hypoxia and dyspnea. They observed reduction of dyspnea, respiratory and heart rates, improvement of blood pressure and a higher level of satisfaction for patients with HFNC oxygen therapy. HFNC oxygen therapy was an important tool to prevent respiratory failure aggravation or intubation[19]. Hughes et al. published a retrospective study showing that, in the Emergency Department, HFNC oxygen therapy successfully reduced arterials levels of CO2 in hypercapnic patients without reducing the arterial oxygen levels[20].

In the last few years, HFNC oxygen therapy has been used for procedural sedation, especially bronchoscopy, to prevent hypoxemia appearance[6,11].

HFNC oxygen therapy is used in end-of-life care, as palliative therapy, regarding ethical and economic considerations. It is prescribed for patients with terminal neoplasia in order to ameliorate the respiratory status and relieve the suffering[21,22].

Perioperative period comprises many difficulties. It can be related with patients' previous comorbidities, the impact of actual disease over the organism, anaesthesia, surgical interventions and multiple complications that can result from the therapeutic act[6,23,24]. Kotwinski et al. published some indications for HFNC oxygen therapy use in anesthesia, like pre – oxygenation before intubation, management of difficult airways or awake fibreoptic intubation, rapid sequence induction and support for extubation and postoperative periods. They recommended the use of HFNC devices for surgical interventions on the airways and for paediatric and obstetric anesthesia[25].

POSSIBLE NEGATIVE EFFECTS AND LIMITATIONS

The HFNC devices are not portable and it can interfere with patient mobility[6].

HFNC oxygen therapy cannot be use for patients with Glasgow Coma Scale <8 points with no upper airway reflexes and should be avoided in patients with epistaxis[6,14].

Some clinicians have concerns regarding the possible negative effects of using HFNC oxygen therapy in terms of intubations delay and increased mortality rate[17]. However, according with various clinical studies, there are some predictors of HFNC oxygen therapy failure, like persistent poor oxygen saturation, thoraco-abdominal asynchrony and failure of decreasing the respiratory rate[5,6,13]. Apparently, the first hour after initiating HFNC oxygen therapy is essential for monitoring the improvement in patients` clinical status[13].

There are no absolute contraindications regarding HFNC devices use. Special attention should be paid to patients who have contraindications for non-invasive mechanical ventilation[13].

In the study published at the end of 2018, Kotwinski et al. have established some relative contraindications for HFNC use in anesthesia, like non-consenting patients, uncooperative patient, patients with high risk of aspiration, complete airway obstruction, patients with facial trauma or basal skull fracture[25].

CONCLUSION

High flow nasal cannula (HFNC) oxygen therapy remove the complications related with non-invasive mechanical ventilation, like air leakage, nasal trauma, skin lesions, pressure ulcers and low patients tolerability rate. It improves oxygenation, increases the airway pressure due to high flows and decreases dead space with secondary improvement of alveolar ventilation, washes out the carbon dioxide from patients' airways and enriches the gas with oxygen, improves thoraco-abdominal synchrony, decreases the work of breathing and reduces breathing frequencies. In addition, the mucociliary function and secretions clearance are improved, along with patients tolerance and comfort. HFNC oxygen therapy can be used for patients with acute hypoxemic respiratory failure, exacerbations of chronic pulmonary diseases, after extubation in order reduce the need for mechanical ventilation, in perioperative period to prevent atelectasis and in palliative care, in order to reduce

breathlessness. There are only few possible contraindications for this therapy.

Compliance with ethics requirements:
The authors declare no conflict of interest regarding this article.

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