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REVIEW PAPERS PRACE POGLĄDOWE

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Analysis of the effectiveness of noninvasive ventilation techniques in patients with COVID-19

Analiza skuteczności nieinwazyjnych technik wentylacji u pacjentów z COVID-19

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Summary

Health care system from the end of 2019 faced a huge challenge worldwide which was the emergence of a new species of coronavirus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Wuhan, China. Within a short time, the pathogen revealed a pandemic nature. On January 30, 2019, the World Health Organization (WHO) announced the outbreak of the COVID-19 pandemic. The greatest threat to human health and life is the damage to the lungs that accompanies a virus infection and the development of Acute Respiratory Distress Syndrome (ARDS). As the epidemic proceeded, a significant amount of the hospital bed facilities was occupied by patients requiring passive oxygen therapy and, in large part, respiratory support using high flow oxygen therapy (HFNC) and continuous positive airway pressure (CPAP) devices. A variety of techniques for applying passive oxygen therapy allow the use of different oxygen flows, with a proportional increase in FiO_2 in the breathing mixture.

Streszczenie

System Opieki Zdrowotnej od końca 2019 roku na całym świecie stanął przed ogromnym wyzwaniem, którym było pojawienie się nowego gatunku koronawirusa zwanego koronawirusem drugiego ciężkiego zespołu oddechowego (SARS-CoV-2) w Wuhan (Chiny). W krótkim czasie patogen ujawnił charakter pandemiczny. 30 stycznia 2019 roku Światowa Organizacja Zdrowia (WHO) ogłosiła wybuch pandemii COVID-19. Największym zagrożeniem zdrowia i życia człowieka jest uszkodzenie płuc, które towarzyszy infekcji wywołanej wirusem, oraz rozwinięcie się ostrej niewydolności oddechowej (ARDS). W trakcie rozwoju epidemii znacząca część bazy łóżkowej szpitali została wypełniona pacjentami wymagającymi tlenoterapii biernej, a w dużej części wspomagania oddechu przy pomocy tlenoterapii wysokoprzepływowej (HFNC) oraz urządzeń generujących ciągłe dodanie ciśnienia w drogach oddechowych (CPAP). Rozmaite techniki stosowania tlenoterapii biernej pozwalają na zastosowanie różnych przepływów tlenu, z proporcjonalnym wzrostem FiO_2 w mieszaninie oddechowej.

Conflict of interest
Konflikt interesów

None
Brak konfliktu interesów

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INTRODUCTION

The ongoing pandemic of the new coronavirus disease COVID-19 poses a serious threat to the world's human population, particularly in countries with limited health care system efficacy (1). Severe bilateral pneumonia is the main symptom of COVID-19, so adequate ventilatory support is critical for patient survival. Although knowledge about COVID-19 continues to grow, it is still unclear what type of respiratory failure support is the most beneficial. Hypoxemia is crucial in the course of COVID-19, so improving oxygenation is the first and essential step in the treatment of patients with COVID-19 (2, 3). This becomes particularly important in situations of limited capacity for mechanical ventilation due to lack of equipment or medical staff. Oxygen delivery can be increased using non-invasive techniques which are more advanced than the reservoir face mask, such as non-invasive ventilation (NIV) using CPAP masks or helmets, high flow nasal ventilation (HFNC), and the abdominal position called the prone position (4-6).

The presence of hypoxemia itself should not be an indication for endotracheal intubation and mechanical ventilation, as hypoxemia in COVID-19 is often remarkably well tolerated. Exhaustion due to respiratory failure as well as consciousness disturbances and increasing hypercapnia argue for the implementation of invasive mechanical ventilation.

NON-INVASIVE VENTILATION (NIV) USING HFNC, CPAP MASKS OR HELMETS

Nasal cannulas enable the administration of oxygen at the flow of up to 6 L/min (FiO_2 about 45%), various types of face masks allow the use of oxygen flows of 10-20 L/min (FiO_2 about 61-99%). However, it should be noted that an increase in oxygen flow increases the risk of contamination of personnel and the environment with pathogens (7). Aerosol dispersion during oxygen therapy using a face mask with a reservoir has been shown to range from 11.2 ± 0.7 to 27.2 ± 1.1 cm (8). The use of non invasive ventilation (NIV) methods results in a similar level of aerosol dispersion e.g. for HFNC 6.5 ± 1.5-17.2 ± 3.3 cm for a flow rate of 10-60 l/min respectively, allowing a much higher arterial blood oxygen saturation to be achieved. This enables their large-scale use in departments treating patients for COVID-19.

In hypoxaemic respiratory failure manifesting as decreased saturation, accelerated and shallow breathing, the essential element of therapy is to increase the oxygen concentration in the respiratory mixture of the patient by expanding the inflamed alveoli, improving ventilation and alveolar perfusion, mechanical, continuous positive airway pressure (CPAP) breathing support and ventilator therapy (9, 10). Most patients with COVID-19 should be ventilator-assisted with the lowest possible effective inspired oxygen concentration (FiO_2). The saturation of the patient on ventilatory support should be maintained between 92-96% (11-13).

Non-invasive ventilation allows the patient to be ventilated with positive inspiratory pressure without the need for endotracheal intubation, using face masks, nasal masks, or intranasal cannulas adapted to deliver High Flow Oxygen Therapy (HFOT). When evaluating a patient with a high probability of developing acute respiratory failure, a prompt decision to initiate NIV is crucial. Delaying the decision to use NIV increases the risk of treatment failure (14-16). This method is mainly used by emergency departments and intensive care units. Studies show beneficial effects of this type of ventilation also in internal medicine departments (17). The beneficial effect of non-invasive therapy is possible thanks to the care of the patient by adequately trained medical staff. Analysis of the procedure of NIV use by emergency medical teams in prehospital management indicates a reduction in mortality and a decrease in the risk of patient intubation. A trained member of the emergency medical team, can successfully use CPAP in patients with severe respiratory failure. This is associated with a 30% reduction in intubation rates, and a 21% reduction in mortality in appropriately qualified patients (18-21).

There are some technology solutions available to ensure proper bedside NIV in the emergency department or intensive care setting. CPAP is a therapy that allows the delivery of a breathing mixture under positive pressure that is maintained in the airway throughout the respiratory cycle. The patient independently initiates inspiration through a mask tightly placed on the face, which allows ventilation with oxygen or its mixture with air using positive pressure generated by the device. It leads to the creation of positive pressure in the airways protecting the alveoli from collapsing (22). The ventilator is controlled by setting the end-inspiratory pressure at which the inspiratory phase is terminated. The optimal baseline positive airway pressure (PEEP) should be 5 to 8 cm H_2O and FiO_2 which should be able to maintain saturation > 90%. PEEP can be increased to 20-25 cm H_2O, but special caution must be taken in such cases due to the higher than in other conditions risk of barotrauma.

Another non-invasive respiratory support technique that was widespread during the COVID-19 pandemic is high flow nasal cannula oxygen therapy (HFNC).

It allows oxygen to be administered to the patient through wide cannulas occupying 3/4 of the width of the nostrils. The device allows the administered air/oxygen mixture to be heated to 37 degrees Celsius, which prevents damage to the nasal mucosa. The oxygen minute flow for an adult patient can be set in the range of 40-60 L/min, with an oxygen concentration in the mixture from 21-100%.

Both of these techniques for assisting the patient's breathing can be combined with the prone position, particularly when severe respiratory distress syndrome (ARDS) is present, i.e. a decrease in the PaO_2/FiO_2 ratio < 150. Positioning the patient on the abdomen with support for at least 8-16 hours per day results in increased alveolar recruitment and improved oxygenation (23-25). Clinical observations indicate positive effects of abdominal positioning in conscious patients using passive oxygen therapy and non-invasive ventilation methods (26, 27). The supine position shifts the heart muscle anteriorly, which does not press on the lungs. Additionally, ventilation of the posterior lung regions is improved. The use of the abdominal position is associated with complications, such as skin ischaemia due to continuous compression, displacement of catheters, endotracheal tubes, probes, and cardiac arrhythmias (28). When sudden cardiac arrest (SCA) occurs, implementation of proper resuscitation processes is an issue (29, 30). The American Heart Association guidelines in earlier recommendations emphasized the priority of placing the patient on their back. The 2020 update of the recommendations does not indicate a more favorable solution (31-33).

Suddenly changing the position of the patient during cardiac arrest may exacerbate the patient's hemodynamic instability.

Conducting NIV with an oxygen helmet is a relatively inexpensive procedure. It allows for patient's breathing support with an inspiratory pressure range up to 17-20 cm H_2O, depending on the model, and to maintain positive end-expiratory pressure (PEEP), improving ventilation of compressed alveoli. The introduction of the possibility of CPAP helmet ventilation, has reduced the number of long-term complications that occur after the use of NIV (34). A comparison of mechanically ventilated patients to a control group indicated a significant reduction in mortality in patients who used an oxygen helmet. In addition, a reduction in the need for intubation was demonstrated in patients who received NIV with the use of an oxygen helmet (35, 36). Patient tolerance of the procedure may be an issue.

CONTRAINDICATIONS TO THE USE OF NIV

When deciding whether to implement noninvasive ventilation techniques in a patient with COVID-19, contraindications should be considered. The most important of these are impaired consciousness, as well as lack of patient cooperation due to other reasons. In addition, non-invasive ventilation techniques should not be used in patients with airway obstruction, facial deformities, high risk of regurgitation, and significant amounts of secretions without effective evacuation (37, 38).

MONITORING THE PATIENT DURING NIV

Once the NIV procedure has been implemented, the patient should be carefully observed. In the first few minutes, early problems such as complete mask intolerance, air leaks should be excluded. Once the patient accepts the therapy, the patient's vital signs and blood oxygenation parameters should be closely monitored for the next two hours: saturation, cardiac function, blood pressure measurement and acid-base balance, arterial blood gas meter. After two hours, based on the patient's clinical status, including the degree of cooperation, and arterial blood gasometry results of laboratory tests, a decision can be made to maintain therapy in patients with a positive response. If NIV fails and the patient's condition deteriorates, endotracheal intubation and ventilator ventilation should be considered. Unfortunately, a large percentage of NIV fails in patients with acute respiratory failure (39-42).

Withholding therapy in a patient should be based on observation of the patient's general condition, and resolution of the cause of respiratory failure. There are no universal parameters to determine the patient's readiness to discontinue therapy; optimal parameters may include respiratory rate in the range of 12-22 breaths/min, saturation above 90% with FiO_2 equal to or greater than 60%, hemodynamic stability achieved with no or minimal effect of vasopressors with preserved heart rate in the range of 50-120 beats/min, minimum NIV settings in the range of BIPAP positive olfactory pressure 10 cm H_2O, airway pressure 5 cm H_2O, or CPAP at a maximum of 10 cm H_2O. If the patient's oxygen needs can be met in the FiO_2 range up to 60% with a high-flow nasal cannula or low-flow oxygen, then methods to minimize the patient's exposure to high FiO_2 oxygen therapy should be considered.

COMPLICATIONS

NIV therapy implemented in the proper patient is safe. If administered correctly, it should not cause side effects. However, the most common complications include: skin damage due to mask pressure on tissues, eye irritation, sinus pain, nasal congestion and bleeding due to dry mucous membranes, and mild gastric distension (43). Complications associated with the use of positive airway pressure in the form of barotrauma are rare compared to invasive ventilation methods (44).

PRACTICAL ASPECTS OF CARING FOR A PATIENT UNDERGOING NIV

The patient should be in a sitting or semi-sitting position. It is possible to conduct NIV in the supine or Trendelenburg position.

The patient should undergo sedation and have analgesic drugs administered. Drug doses should be selected individually depending on the patient's condition and tolerance of pharmacotherapy. The potential reducing effect on the respiratory center of sedative and analgesic drugs should be kept in mind (45).

Patients with acute respiratory failure treated with NIV are usually not fed in order to not increase the risk of aspiration of food contents during possible gastric distension and vomiting. Nasogastric tubes may cause leakage of the ventilation mask and leakage of the respiratory mixture thus reducing the effectiveness of the method. If the patient needs to be fed, parenteral nutrition options should be considered. Bronchoscopy is rarely performed during NIV due to possible adverse reaction of the patient and sudden deterioration of his/her breathing, which may require endotracheal intubation and mechanical ventilation. On the other hand, the procedure itself is possible even with a full face mask by using appropriate connectors. Nebulization can be successfully administered during NIV due to the presence of a universal port in the ventilator. It is also possible to suction the patient through special ports with minimal loss of airway pressure.

Non-invasive ventilation can be used successfully in many patients. Patients in whom the incorporation of NIV should be carefully considered include those who require frequent airway suctioning or are at particular risk for oropharyngeal mask vomiting. A trained multidisciplinary team consisting of physicians, physiotherapists, paramedics, and nurses is an essential component of patient care. Infection and pressure sores prevention in the form of rotations, repositioning, and oral toileting should be implemented. Portable NIV equipment also allows for patient diagnosis in other rooms of the therapy center.

CONCLUSIONS

Non-invasive ventilation involves the delivery of a reathing mixture using increased inspiratory pressure by non-invasive methods. A patient with indications to start NIV should receive comprehensive care from a team trained in the use of the therapy. There should be no delay in starting the therapy. NIV can be administered using a ventilator in the intensive care unit or using a dedicated device in other units caring for patients with acute respiratory failure. The selection of appropriate initial settings depends on the mode chosen to provide non-invasive ventilation, the availability of resources, the knowledge of the treatment team, and the patient's tolerance of the method. Once NIV is initiated, the patient should be closely monitored for technical ventilation problems or respiratory deterioration. It is important to remember that during noninvasive ventilation, the patient should be allowed a sitting or semi--sitting position that allows free breathing and comfort. NIV used when contraindications have been ruled out is a safe and effective technique for respiratory support.

BIBLIOGRAPHY

1. CDC. 2019 Novel Coronavirus, Wuhan, China. CDC. Available at https://www.cdc.gov/coronavirus/2019-ncov/about/index.html. January 26, 2020.
2. Wu C, Chen X, Cai Y et al.: Risk factors associated with acute respiratory distress syndrome and death in patient with coronavirus disease 2019 pneumonia in Wuhan, China. JAMA Internal Medicine 2020; 180: 934-943.
3. Zhou F, Yu T, Du R et al.: Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan. China: A retrospective cohort study. Lancet 2020; 395: 1054-1062.
4. Matsue Y, Kinugasa Y, Kitai T et al.: Effect of the COVID-19 Pandemic on Acute Respiratory Care of Hypoxemic Patients With Acute Heart Failure in Japan – A Cross-Sectional Study. Circ Rep 2020; 2: 499-506.
5. Coppo A, Bellani G, Winterton D et al.: Feasibility and physiological effects of prone positioning in non-intubated patients with acute respiratory failure due to COVID-19 (PRON-COVID): a prospective cohort study. Lancet Respir Med 2020; 8: 765-774.
6. Paul V, Patel S, Royse M et al.: Proning in Non-Intubated (PINI) in Times of COVID-19: Case Series and a Review. J Intensive Care Med 2020; 35: 818-824.
7. Eames I, Tang JW, Li Y, Wilson P: Airborne transmission of disease in hospitals. J R Soc Interface 2009; 6: S697-S702.
8. Li J, Fink JB, Ehrmann S: High-flow nasal cannula for COVID-19 patients: low risk of bio-aerosol dispersion. Eur Respir J 2020; 5.
9. CDC. 2019 Novel Coronavirus, Wuhan, China: Prevention & Treatment. CDC. Available at https://www.cdc.gov/coronavirus/2019-ncov/about/prevention-treatment.html. January 27, 2020.
10. Wiersinga WJ, Rhodes A, Cheng AC et al.: Treatment of Coronavirus Disease 2019 (COVID-19): A Review. JAMA 2020; 8: 782-793.
11. Leung CCH, Joynt GM, Gomersall CD et al.: Comparison of high-flow nasal cannula versus oxygen face mask for environmental bacterial contamination in critically ill pneumonia patients: a randomized controlled crossover trial. J Hosp Infect 2019; 101(1): 84-87.
12. Shenoy N, Luchtel R, Gulani P: Considerations for target oxygen saturation in COVID-19 patients: are we under-shooting? BMC Med 2020; 18(1): 260.
13. Nielsen Jeschke K, Bonnesen B, Hansen EF et al.: Guideline for the management of COVID-19 patients during hospital admission in a non-intensive care setting. Eur Clin Respir J 2020; 7(1): 1761677.
14. Nava S, Navalesi P, Conti G: Time of non-invasive ventilation. Intensive Care Med 2006; 32(3): 361-370.
15. Collaborative Research Group of Noninvasive Mechanical Ventilation for Chronic Obstructive Pulmonary Disease: Early use of non-invasive positive pressure ventilation for acute exacerbations of chronic obstructive pulmonary disease: a multicentre randomized controlled trial. Chin Med J (Engl) 2005; 118(24): 2034-2040.
16. Ozsancak Ugurlu A, Sidhom SS, Khodabandeh A et al.: Use and outcomes of noninvasive positive pressure ventilation in acute care hospitals in Massachusetts. Chest 2014; 145(5): 964-971.
17. Cabrini L, Landoni G, Bocchino S et al.: Long-Term Survival Rate in Patients With Acute Respiratory Failure Treated With Noninvasive Ventilation in Ordinary Wards. Crit Care Med 2016; 44(12): 2139-2144.
18. Thompson J, Petrie DA, Ackroyd-Stolarz S, Bardua DJ: Out-of-hospital continuous positive airway pressure ventilation versus usual care in acute respiratory failure: a randomized controlled trial. Ann Emerg Med 2008; 52(3): 232-241.
19. Roessler MS, Schmid DS, Michels P et al.: Early out-of-hospital non-invasive ventilation is superior to standard medical treatment in patients with acute respiratory failure: a pilot study. Emerg Med J 2012; 29(5): 409-414.
20. Mal S, McLeod S, Iansavichene A et al.: Effect of out-of-hospital noninvasive positive-pressure support ventilation in adult patients with severe respiratory distress: a systematic review and meta-analysis. Ann Emerg Med 2014; 63(5): 600-607.
21. Winck JC, Ambrosino N: COVID-19 pandemic and non invasive respiratory management: Every Goliath needs a David. An evidence based evaluation of problems. Pulmonology 2020; 4: 213-220.
22. Sawyer AM, Gooneratne NS, Marcus CL et al.: A systematic review of CPAP adherence across age groups: clinical and empiric insights for developing CPAP adherence interventions. Sleep Med Rev 2011; 15(6): 343-356.

23. Marini JJ: How to recruit the injured lung. Minerva Anestesiol 2003; 69(4): 193-200.
24. Lee HJ, Im JG, Goo JM et al.: Acute lung injury: effects of prone positioning on cephalocaudal distribution of lung inflation – CT assessment in dogs. Radiology 2005; 234(1): 151-161.
25. Keenan JC, Formenti P, Marini JJ: Lung recruitment in acute respiratory distress syndrome: what is the best strategy? Curr Opin Crit Care 2014; 20(1): 63-68.
26. Prone Positioning Might Help More COVID-19 Patients - Medscape - Nov 20, 2020.
27. Mullen L, Byrd D: Using simulation training to improve preoperative patient safety. AORN J 2013; 97: 419-427.
28. Greenland JR, Michelow MD, Wang L, London MJ: COVID-19 infection: implications for perioperative and critical care physicians. Anesthesiology 2020; 132: 1346-1361.
29. Guérin C, Reignier J, Richard JC et al.; PROSEVA Study Group: Prone positioning in severe acute respiratory distress syndrome. N Engl J Med 2013; 368: 2159-2168.
30. Shuster M, Lim SH, Deakin CD et al.; CPR Techniques and Devices Collaborators: Part 7: CPR techniques and devices: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2010; 122: S338-S344.
31. Truhlář A, Deakin CD, Soar J et al.; Cardiac Arrest in Special Circumstances Section Collaborators: European Resuscitation Council Guidelines for Resuscitation 2015: Section 4. Cardiac arrest in special circumstances. Resuscitation 2015; 95: 148-201.
32. Soar J, Maconochie I, Wyckoff MH et al.: 2019 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation 2019; 145: 95-150.
33. Edelson DP, Sasson C, Chan PS et al.; American Heart Association ECC Interim COVID Guidance Authors: Interim guidance for basic and advanced life support in adults, children, and neonates with suspected or confirmed COVID-19: from the emergency cardiovascular care committee and get with the guidelines-resuscitation adult and pediatric task forces of the American Heart Association. Circulation 2020; 141: e933-e943.
34. Patel BK, Wolfe KS, MacKenzie EL et al.: One-Year Outcomes in Patients With Acute Respiratory Distress Syndrome Enrolled in a Randomized Clinical Trial of Helmet Versus Facemask Noninvasive Ventilation. Crit Care Med 2018; 46(7): 1078-1084.
35. Liu Q, Gao Y, Chen R, Cheng Z: Noninvasive ventilation with helmet versus control strategy in patients with acute respiratory failure: a systematic review and meta-analysis of controlled studies. Crit Care 2016; 20: 265.
36. Patel BK, Wolfe KS, Pohlman AS et al.: 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): 2435-2441.
37. Cajander P, Edmark L, Ahlstrand R et al.: Effect of positive end-expiratory pressure on gastric insufflation during induction of anaesthesia when using pressure-controlled ventilation via a face mask: A randomised controlled trial. Eur J Anaesthesiol 2019; 36(9): 625-632.
38. Ali MJ, Psaltis AJ, Murphy J, Wormald PJ: Endoscopic dacryocystorhinostomy and obstructive sleep apnoea: the effects and outcomes of continuous positive airway pressure therapy. Clin Exp Ophthalmol 2015; 43(5): 405-408.
39. Soo Hoo GW, Santiago S, Williams AJ: Nasal mechanical ventilation for hypercapnic respiratory failure in chronic obstructive pulmonary disease: determinants of success and failure. Crit Care Med 1994; 22(8): 1253-1261.
40. Antón A, Güell R, Gómez J et al.: Predicting the result of noninvasive ventilation in severe acute exacerbations of patients with chronic airflow limitation. Chest 2000; 117(3): 828-833.
41. Antonelli M, Conti G, Moro ML et al.: Predictors of failure of noninvasive positive pressure ventilation in patients with acute hypoxemic respiratory failure: a multi-center study. Intensive Care Med 2001; 27(11): 1718-1728.
42. Esteban A, Anzueto A, Frutos F et al.; Mechanical Ventilation International Study Group: Characteristics and outcomes in adult patients receiving mechanical ventilation: a 28-day international study. JAMA 2002; 28(3): 345-355.
43. Cook DT, Dahlhausen CM, Draper KR, Hilton LR: Pneumoperitoneum and PEG Dislodgement Secondary to Noninvasive Ventilation after PEG Tube Placement. Am Surg 2019; 85(11): 1308-1309.
44. Confalonieri M, Gazzaniga P, Gandola L et al.: Haemodynamic response during initiation of non-invasive positive pressure ventilation in COPD patients with acute ventilatory failure. Respir Med 1998; 92(2): 331-337.
45. Muriel A, Peñuelas O, Frutos-Vivar F et al.: Impact of sedation and analgesia during noninvasive positive pressure ventilation on outcome: a marginal structural model causal analysis. Intensive Care Med 2015; 41(9): 1586-1600.

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