doi.org/10.51891/rease.v9i1.8336

NONINVASIVE MECHANICAL VENTILATION MANAGEMENT AND HACOR SCORE IN ACUTE HYPOXEMIC RESPIRATORY FAILURE INDUCED BY INFLUENZA A (H1N1): A CASE REPORT

MANEJO DA VENTILAÇÃO MECÂNICA NÃO INVASIVA E ESCORE HACOR NA INSUFICIÊNCIA RESPIRATÓRIA HIPOXÊMICA AGUDA INDUZIDA POR INFLUENZA A (H1N1): RELATO DE CASO

Jorge Luís Guerra[1]
Jacqueline Rodrigues de Freitas Vianna[2]
Thais Helena de Paula Michelato[3]
Miléa Mara Lourenço da Silva Simões[4]
Natali Canelli Valim[5]
Maurício Jamami[6]

RESUMO: A gripe é uma infecção viral aguda altamente contagiosa que afeta o sistema respiratório e causa surto global em humanos. Geralmente é autolimitada, pode evoluir para síndrome respiratória aguda grave (SARS) e, eventualmente, leva à insuficiência respiratória hipoxêmica aguda (AHRF). O objetivo principal foi descrever um relato de caso de manejo cuidadoso da VNI na SRAG causada pelo vírus influenza A H1N1, utilizando o escore HACOR. A paciente apresentou melhora clínica, radiológica e laboratorial após 4 dias de tratamento com VNI. Recebeu alta da UTI após 7 dias e do hospital após 10 dias. A VNI na AHRF é viável em pacientes bem selecionados. Atenção especial às configurações do ventilador deve ser dada particularmente ao volume corrente expirado, permitindo menor tempo de internação, complicações da intubação orotraqueal e, portanto, reduzindo os custos hospitalares. Nessas condições, o novo escore HACOR pode ser muito útil para evitar o atraso indevido do tempo de intubação e o aumento da mortalidade.

Palavras-Chave: Ventilação mecânica não invasiva. Vírus influenza A subtipo H1N1. Hipoxemia respiratória aguda.

[1] Master's degree in Cardiovascular Physiotherapy, Respiratory, Exercise Physiology and Functional Performance at the Federal University of São Carlos- UFscar - Rodovia Whashington Luis, Km 235- São Carlos- SP Orcid: https://orcid.org/0000-0002-4102-7141
[2] Post-doctoral student in Cardiovascular Physiotherapy, Respiratory, Exercise Physiology and Functional Performance, Federal University of São Carlos- UFscar Professor at the Claretian University Center of Batatais- SP Physiotherapy Coordinator in the Intensive Care Unit of Batatais-SP Orcid: https://orcird.org/0000-0001-9048-7438.
[3] Graduated in Physiotherapy from the Claretian University Center of Batatais- SP Master's student in Cardiovascular Physiotherapy, Respiratory, Exercise Physiology and Functional Performance at the Federal University of São Carlos-UFscar (Student). Orcid: https://orcid.org/0000-0001-8813-3569.
[4] Professor at the Claretian University Center of Batatais- SP Physiotherapist in the Intensive Care Unit of Batatais-SP Orcid: https://orcid.org/0000-0003-4107-4965
[5] Adult Intensive Care Unit, Santa Casa de Misericórdia Hospital, Batatais, São Paulo, Brazil Medical Clinic, Medical School of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil Orcid: https://orcid.org/0000-0001-5416-0059.
[6] PhD in Physiological Sciences from the Federal University of São Carlos UFSCar Lecturer at the Federal University of São Carlos-SP UFscar - Rodovia Whashington Luis, Km 235- São Carlos- SP BR Orcid: https://orcid.org/0003-3272-521X.

ABSTRACT: Influenza is a highly contagious, acute viral infection that affects the respiratory system, and causes global outbreak in humans. It is usually self-limited, may progress to severe acute respiratory syndrome (SARS), and eventually leads to acute hypoxemic respiratory failure (AHRF). The main objective was to describe a case report of careful management of NIV in SARS caused by influenza A H1N1 virus, using the HACOR score. The patient exhibited clinical, radiological and laboratory improvement after 4 days of NIV treatment. She was discharged from ICU after 7 days and from the hospital after 10 days. NIV in AHRF is feasible in well-selected patients. Special attention to ventilator settings should be taken particularly to the expired tidal volume, allowing less hospitalization time, orotracheal intubation complications, and therefore, reducing hospital costs. Under these conditions, the new HACOR score can be very useful to avoid unduly delay of intubation time and increased mortality.

Keywords: Noninvasive mechanical ventilation. Influenza virus A subtype H1N1. Adult acute hypoxemic respiratory.

RESUMEN: La influenza es una infección viral aguda altamente contagiosa que afecta el sistema respiratorio y causa un brote global en humanos. Por lo general, es autolimitado, puede progresar a síndrome respiratorio agudo severo (SARS) y, finalmente, conduce a insuficiencia respiratoria hipoxémica aguda (AHRF). El objetivo principal fue describir un informe de caso de manejo cuidadoso de la VNI en RSS causado por el virus de la influenza A H1N1, utilizando la puntuación HACOR. El paciente mostró mejoría clínica, radiológica y de laboratorio después de 4 días de tratamiento con VNI. Fue dado de alta de la UCI después de 7 días y del hospital después de 10 días. La VNI en la ARHA es factible en pacientes bien seleccionados. Se debe prestar especial atención a las configuraciones del ventilador especialmente al volumen corriente expirado, lo que permite una estancia hospitalaria más corta, complicaciones de la intubación orotraqueal y, por lo tanto, reduce los costos hospitalarios. En estas condiciones, la nueva puntuación HACOR puede ser muy útil para evitar el retraso indebido del tiempo de intubación y el aumento de la mortalidad.

Palabras clave: Ventilación mecánica no invasiva. Subtipo H1N1 del virus de la influenza A. Hipoxemia respiratoria aguda.

Financial support: The authors have no conflict of interest to disclose.

INTRODUCTION

On April 24, 2009, the World Health Organization (WHO) announced the emergence of a novel virus, influenza A virus subtype H1N1 (A/H1N1). Influenza A H1N1 virus is of swine origin, with alarming initial data on its ability to cause severe acute respiratory syndrome (SARS), preferably in individuals aged between 5 and 59 years. The mortality rate is approximately 6 to 10%, and it may cause the death of 100 to 200 million people worldwide.1 Influenza A H1N1 has been characterized as mild illness with low lethality. In Brazil, the Ministry of Health recognized the occurrence of this new influenza a virus of sustained transmission. SARS infections may be asymptomatic or may cause AHRF, fever above 38ºC, cough and dyspnea, accompanied or not by gastrointestinal manifestations, tachypnea ≥25 breaths per minute, leukocytosis,

leukopenia or neutrophilia, diffuse interstitial infiltrate, or patchy areas of condensation. Infected patients need strict monitoring of their vital signs. Extracorporeal membrane oxygenation (ECMO) should be considered when Fio2＞90% to ensure peripheral oxygen saturation (SpO2).2

Noninvasive ventilation (NIV) is usually recommended as the first therapeutic option. However, its efficacy in AHRF patients is still controversial in the field of medical research, considering that it requires a rigorous indication and efficient and clinically appropriate management decisions to detect its failure. Thus, the aim of this study was to describe a case report of NIV management in patients with SARS caused by influenza virus A H1N1, using the HACOR score.

CASE REPORT

A previously healthy 51-year-old woman, heavy smoker (30 years/pack), was admitted to the Clinical Hospital Santa Casa de Batatais in São Paulo, SP, Brazil, the study involving human participants was approved by the Research Ethics Committee of the Institution (CEP/Plataforma Brasil) and registered under CAAE N. 07351119.2.0000.5381 The patient presented with fever for 3 days, runny nose, odynophagia, dry cough, evolving to a wet, or productive cough, dyspnea, peripheral oxygen saturation (SpO_2) of 82% while breathing room air. Patient had not been immunized in the current year's influenza vaccination campaign. Nasal cannula oxygen therapy was initiated, however, without improvement of respiratory distress. Her condition worsened and she was transferred to the Intensive Care Unit (ICU), Santa Casa de Batatais. On physical examination, the patient exhibited a regular medical condition, was conscious and aware. Her systolic blood pressure (SBP) was 100 mmHg and diastolic blood pressure (DBP), 60 mmHg, requiring a reservoir face mask at 15 L/min to keep SpO_2 above 90%. Chest auscultation revealed reduced ventilation on the lower zones and on the middle third to the right with additional high frequency crackles in the lower zones and wheezing to the left. Due to suspected SARS caused by influenza virus HIN1 and with possible secondary bacterial infection, leukocytosis, neutrophilia, the patient received oral oseltamivir along with an antimicrobial regimen (ceftriaxone, clarithromycin and oxacillin). Chest X-ray showed bilateral reticulonodular infiltrate in middle third to the right and left lower zones with focal areas of consolidation in organization (**Figures 1A and B**).

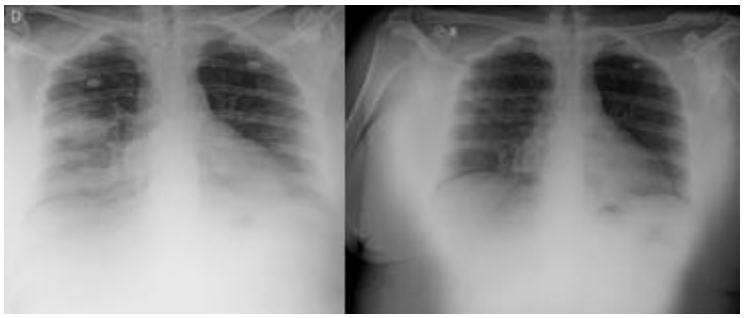

Figure 1 – Chest X- ray; A- Admission; B- Discharge

Arterial blood gas (ABG) analysis revealed AHRF. The patient was allocated to a private room under droplet isolation precautions (TBPs). The case was then reported to the Epidemiological Surveillance System as a probable case of SARS disease. Nasopharyngeal swab collection was performed with real-time reverse transcription–polymerase chain reaction (RT-PCR) assay at the Instituto Adolfo Lutz Laboratory – Ribeirão Preto – SP. The test was positive for influenza A-H1N1.

The patient was connected to a NIV using a portable BiPAP A 30 machine (BiPAP, Murrysville, PA, USA) and received bilevel (S/T mode) pressure support ventilation (PSV) between 8 and 12 cmH_2O_2 with positive end-expiratory pressure (PEEP) of approximately 6 to12 cmH_2O_2 via an oronasal mask, which was later replaced by a nasal mask. The NIV parameters and respiratory and hemodynamic behavior during the 4-day management are detailed in Table 1. NIV proved to be effective in the first two hours.

Table 1. BiPAP settings and respiratory and hemodynamic parameters

Hospitalization period	2 hours	Day 1	Day 2	Day 3	Day 4	Day 5
PIP (cmH_2O)	24	22	20	17	14	—
PSV (cmH_2O)	12	12	12	9	8	—
PEEP (cmH_2O)	12	10	8	8	6	—
SpO_2(%)	90	98	96	96	97	95
RR (rpm)	28	22	20	18	16	12
DAP (mmHg)	100	128	140	143	143	124
SBP (mmHg)	60	86	70	80	86	71
HR (bpm)	88	88	89	79	76	63

\PIP: Peak inspiratory pressure, PSV: Pressure support ventilation; PEEP Positive end-expiratory pressure; SpO2: peripheral oxygen saturation; RR: respiratory rate; DAP: diastolic arterial pressure; SBP: systolic blood pressure; HR: heart rate; BPM: beats per minute

The HACOR score, which includes heart rate, acidosis, consciousness, oxygenation, and respiratory rate, is used as a predictor of NIV failure in hypoxemic patients. During the NIV procedure in this particular case, the HACOR score was ≤ 2, showing a low probability of NIV failure of 8 to 17% and the SpO_2/FIO_2 ratio was > 200. The NIV was applied continuously in the first 48 hours and intermittently in the following 48 hours. The patient was then submitted to physiotherapy for respiratory dysfunction, which included airway secretion clearance, maintenance or improvement of lung volume, until discharge from the ICU on day 7. The clinical, radiological and laboratory findings showed improvement, and the patient was discharged on the 10th day of hospitalization. SpO_2/FIO_2 ratio and the HACOR scores during the NIV management are shown in (**Figure 2**).

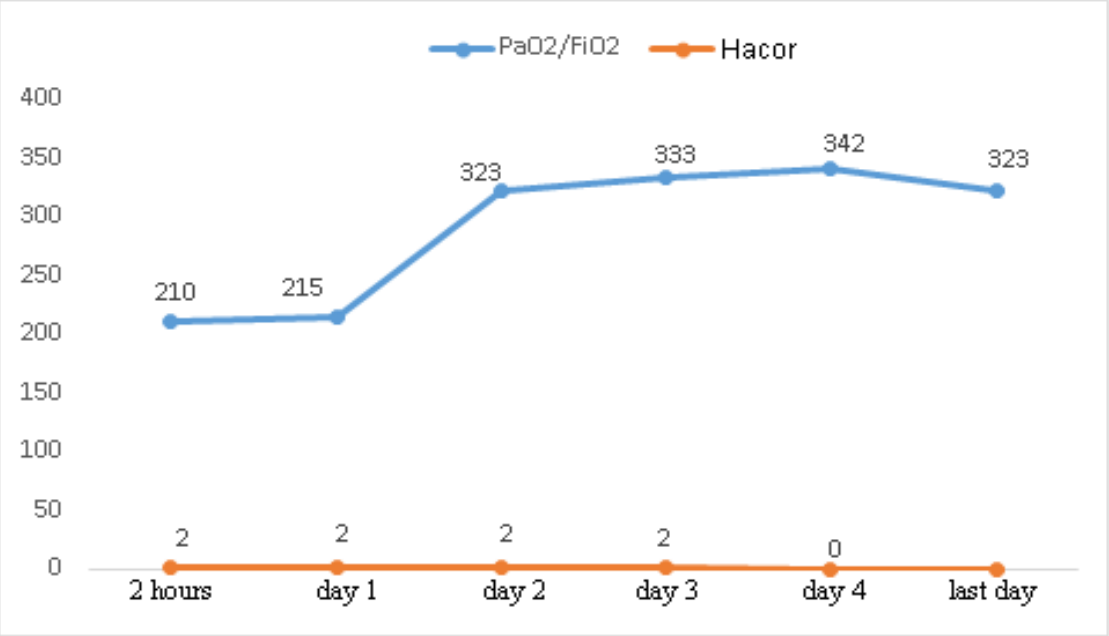

Figure 2 - PaO_2/FiO_2 interface behavior during NIV

DISCUSSION

Non-invasive ventilation with two level pressure has proved to be beneficial in reducing the work of breathing, the carbon dioxide blood pressure ($PaCO_2$), and increasing transpulmonar pressure.[3] The suggested PSV ventilation parameters are enough to generate an approximate tidal volume of 6 to 8 ml/kg and RR < 30 rpm and PEEP of 8 cmH_2O, with recommendations of an initial PEEP around 6 cmH_2O. It is worth noting that the parameters should be adjusted and/or readjusted, according to the patient's needs and health conditions.[4]

A crucial issue for determining the effectiveness of NIV is the choice of the most appropriate interface. Two different mask types are commonly used in acute respiratory failure; oronasal or facial mask and nasal mask; theoretically, both have advantages and disadvantages. Oronasal masks allow mouth breathing and reduce air leaks and are most adequate for patients with acute dyspnea. However, they interfere with speech, feeding and expectoration and can cause more claustrophobic reactions and dead space than nose masks. In contrast, the nasal masks provide greater air leakage through the mouth, limiting the reliability of the pressures delivered to the lungs.[5]

In the present case report, the oronasal mask was indicated for the patient in the first two hours. With the improvement of respiratory distress, the oronasal was replaced by the nasal mask due to the patient's adequate collaboration in maintaining the oral seal. It is known that many patients do not tolerate some interfaces, even when there is clinical indication for NIV, later evolving to IMV. The application of NIV in patients with AHRF - SARS is still controversial, since it does not resolve in 40 to 60% of the cases.[1]

Rello et al.[6] reported that 68.8% of patients with influenza A HIN1 infection needed IMV. Patients who have received NIV showed improvement in ventilation and reduction of respiratory work; however, IMV proved to be necessary.

The 2017 Guidelines of the European Respiratory Society (ERS) and American Thoracic Society (ATS)[7] recommend that NIV for patients with AHRF caused by influenza A H1N1 virus infection should present failure rates ranging from 13% to 77%. The guideline committee members also emphasized the need for randomized clinical trials to evaluate the efficacy of NIV during a pandemic.

Use of NIV should be continuously monitored at bedside by a health care professional within thirty minutes to two hours. For NIV to be considered successful, the following criteria should be met: reduction of the respiratory rate; increase in the tidal volume; reduction or cessation of the use of accessory muscles, increase in the partial pressure of oxygen (PaO_2) and/or the peripheral oxygen saturation (SpO_2), and reduction of $PaCO_2$ without significant abdominal distension. When NIV is unsuccessful, orotracheal intubation (OTI) with invasive ventilation should be performed.[8] Duan et al. [9]developed a scoring system to accurately predict NIV failure in AHRF, using the following variables: heart rate, acidosis (pH), consciousness (GCS), oxygenation, and respiratory rate. The authors identified a HACOR score >5 at one hour of NIV, which revealed a high risk of failure that remained at 12, 24 and 48 hours. Girault et al.[10] have

recognized the HACOR score as a useful tool to pinpoint patients with high risk of failure, however, for patients with AHRF, the HACOR score is not expected to reduce the rate of NIV failure. Both studies demonstrated that the mortality rate may be reduced when patients at high risk of failure undergo immediate intubation.[9,10] Although NIV has been evidenced as a controversial practice for patients under investigation of H1N1, Dutra et al.[11] reported the use of NIV performed with a conventional microprocessor-controlled, using a full-face mask in four female patients diagnosed with SARS, two of them infected with H1N1 virus. Improvement was observed in the respiratory pattern, SpO2, blood gas analysis, and X-ray. Patients stayed for a short period in the ICU, and there was no need for orotracheal intubation. Yokoyama et al.[12] described the case of a 40-yearl-old obese woman admitted to a hospital with AHRF caused by influenza A (H1N1) virus. The patient was submitted to NIV and showed improvement in the Pao_2/Fio_2 ratio of 284 on the 8th day. IMV was not necessary and the patient was discharged on the 11th day. The results obtained in the present case report were similar to those mentioned above, demonstrating that NIV may be effective in SARS caused by influenza A (H1N1) virus.

CONCLUSION

Our findings have shown that NIV is an effective treatment for acute hypercapnic respiratory failure (AHRF). Special attention to ventilator settings should be taken particularly to the expired tidal volume, allowing less hospitalization time, orotracheal intubation complications, and therefore, reducing hospital costs. Under these conditions, the new HACOR score can be very useful to avoid unduly delay of intubation time and to reduce high mortality rates.

ACKNOWLEDGMENTS

The authors acknowledge the entire ICU team of the Santa Casa de Batatais.

REFERENCES

1. World Health Organization. Clinical management of human infection with new influenza A (H1N1) virus: initial guidance; May 2009.

2. Ministério da Saúde (Brasil), Secretaria de Vigilância em Saúde Gabinete Permanente de Emergências de Saúde Pública-Brasília Emergência de Saúde Pública de Importância Internacional. Protocolo de manejo clínico e vigilância epidemiológica da influenza. 5 de agosto de 2009.

3. Ferreira CF, Santos FB. Aspectos gerais da ventilação não invasiva Revisão da literatura Rev Científica do HCE (2008) Ano III Nº2. 4

4. Stocker R, Neff T, Stein S, et al. Prone positioning and low-volume pressure limited ventilation improve survival in patients with severe ARDS. Chest. 1997; 111:1008–17.

5. Kwok H, McCormack J, Cece R, et al. Ensaio controlado de ventilação oronasal versus ventilação por máscara nasal no tratamento da insuficiência respiratória aguda. CriticalCare Medicine. 2003;31(2), 468–473.

6.Rello J, Rodríguez A, Ibañez P, et al. H1N1 SEMICYUC Working Group. Intensive care adult patients with severe respiratory failure caused by Influenza A (H1N1)v in Spain. Crit Care. 2009;13(5):R148. doi: 10.1186/cc8044. Epub 2009 Sep 11. PMID: 19747383; PMCID: PMC2784367

7. Rochwerg B, Brochard L, Elliott MW, et al. Diretrizes oficiais de prática clínica ERS / ATS: ventilação não invasiva para insuficiência respiratória aguda. European Respiratory Journal. 2017;50(2), 1602426.

8. Hess DR. Noninvasive Ventilation for Acute Respiratory Failure. RespirCare 2013;58(6): 950-969.

9. Duan J, Han X, Bai L, et al. Assessment of heart rate, acidosis, consciousness, oxygenation, and respiratory rate to predict noninvasive ventilation failure in hypoxemic patients. IntensiveCare Med. 2017; 43 (2): 192-19.

10. Girault C, Ferrer M, Torres A. Non-invasive ventilation in hypoxemic acute respiratory failure: is it still possible? IntensiveCare Med. 2017; 43 (2): 243-245.

11. Dutra AS, Público SC, Ávila RE, et al. Ventilação mecânica não invasiva em pacientes com síndrome respiratória aguda grave, suspeitos de infecção por influenza A-H1N1: relato de casos. RevMed Minas Gerais 2010; 20 (3 Supl 4): S105-S109.

12. Yokoyama T, Tsushima K, Ushiki A, et al. Acute Lung Injury with Alveolar Hemorrhage due to a Novel Swine-Origin Influenza A (H1N1) Virus. Inter Med 49: 427-430, 2010.