Hypoventilation improvement in an adult non-invasively ventilated patient with Rapid-onset Obesity with Hypothalamic Dysfunction Hypoventilation and Autonomic Dysregulation (ROHHAD)

Ameliorarea hipoventilației prin ventilație non-invazivă la un adult cu obezitate acută și sindrom de disfuncție hipotalamică cu hipoventilație și dereglare de sistem nervos autonom (ROHHAD)

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Abstract

Rapid-onset Obesity with Hypothalamic Dysfunction, Hypoventilation, and Autonomic Dysregulation (ROHHAD) is a rare disease of unknown etiology, characterised by rapid-onset obesity in young children, hypoventilation, hypothalamic and autonomic dysfunction. Patients between the ages of 2 and 4 present with hyperphagia and weight gain, followed by neuro-hormonal dysfunction and central hypoventilation months or years later. Cardiac arrest may represent the fatal complication of alveolar hypoventilation and early mechanical ventilation is essential for the patient's life. In this paper, we describe a 22-year-old patient with ROHHAD syndrome who had an acute respiratory failure during nocturnal non-invasive ventilation (NIV).

Keywords: ***rapid-onset obesity with hypothalamic dysfunction, hypoventilation, and autonomic dysregulation (ROHHAD), non-invasive ventilation, respiratory failure***

Rezumat

Sindromul caracterizat de obezitate acută cu disfuncție hipotalamică, hipoventilație și dereglare de sistem nervos vegetativ (ROHHAD) este o entitate rară, de etiologie neprecizată, caracterizată prin obezitate instalată în timp scurt la copii, hipoventilație, disfuncție hipotalamică și autonomă. Pacienții cu vârste între 2 și 4 ani se prezintă cu hiperfagie și câștig ponderal marcant, urmate la câteva luni sau ani de disfuncție neurohormonală și hipoventilație centrală. Stopul cardiac poate reprezenta o complicație fatală a hipoventilației alveolare; ventilația mecanică precoce este esențială ca suport vital. Lucrarea descrie cazul unui pacient de 22 de ani cu sindrom ROHHAD și insuficiență respiratorie acută în timpul ventilației non-invazive nocturne.

Cuvinte-cheie: ***obezitate acută și sindrom de disfuncție hipotalamică cu hipoventilație și dereglare de sistem nervos autonom (ROHHAD), ventilație non-invaziva, insuficiență respiratorie***

Introduction

Rapid-onset Obesity with Hypothalamic Dysfunction, Hypoventilation, and Autonomic Dysregulation (ROHHAD) is a rare syndrome that affects the autonomic nervous and the endocrine system. The most characteristic features include, in an otherwise healthy child, a dramatic weight gain over a six- to twelve-month period in the first 10 years of life, followed by hypothalamic dysfunction, dysregulation of the autonomic nervous system, and alveolar hypoventilation[1-2]. Due to the variable timing and onset of other features, a diagnosis is often delayed or missed, potentially leading to fatal central hypoventilation, cardiorespiratory arrest and impaired neurocognitive development[3].

The exact underlying cause of ROHHAD is currently unknown, but a genetic basis has been hypothesised[4]. Tumours of neural crest origin, such as ganglioneuroblastoma and ganglioneuroma, are reported in about 40% of the patients and may be found in the chest or abdomen[5]. In this paper, we describe a young man with a ROHHAD syndrome who had an acute respiratory failure with epilepsy during nocturnal non-invasive ventilation (NIV).

Case report

A 22-year-old patient with ROHHAD was admitted to our institution after experiencing an acute episode of respiratory failure and generalised seizures during a nocturnal NIV. At the age of three, he had the first manifestation of the disease with rapid weight gain. Successively, he presented with a progressive respiratory failure due to a central hypoventilation which led to a tracheotomy and mechanical ventilation. At the age of four, the tracheostomy was removed and the patient received a nocturnal NIV by facial mask (Ultramirage Resmed). In subsequent years, he developed a hypothalamic dysfunction in the forms of central hypothyroidism, delayed puberty, adrenocorticotropic hormone (ACTH) deficiency and diabetes insipidus.

He regularly took hormonal therapy (hydrocortisone, L-thyroxine, desmopressin, testosterone) and NIV each night. The ventilator parameters were periodically adapted to the patient's characteristics and the last pneumological visit was done eight months before the admission when the ventilator setting (BiPap Syncrony Respironic) was adjusted as follows: IPAP 18 cmH_2O, EPAP 4 cmH_2O, Respiratory Rate 16/minute, Inspiratory time: 1 second. One month before admission, the patient underwent an orthopaedic operation on the left foot that reduced the ability to walk and caused an increase in body weight (Body Mass Index of 32). In terms of the patient's thrombocytopenia, he discontinued the prophylactic treatment with low molecular weight heparin and took acetylsalicylic acid, which increased the risk of deep vein thrombosis and pulmonary embolism.

In the last weeks, the patient's father reported a sustained nocturnal drop of oxygen saturation of arterial blood (SaO_2), and that during the day the patient tended to fall asleep and had a reduced ability to concentrate. The patient was admitted to our hospital after a nocturnal acute respiratory failure followed by generalised seizures during NIV. The patient's father, awakened by the monitoring system alarm, called the Emergency Team (ET), removed the ventilator and started manual ventilation. At the arrival of the ET the patient was drowsy but haemodynamically stable, and able to breath spontaneously. He received oxygen by face mask and was transported to our Emergency Department (ED). Upon arrival, the patient was alert and underwent a mental status exam. The examination of the vital signs showed the following parameters: Temperature - 36.7°C, Blood Pressure (BP) - 125/70 mmHg, Heart Rate (HR) - 70/min, Respiratory Rate (RR) - 18/min, SaO_2 - 98% on room air. The following laboratory results were recorded: white blood cell (WBC) count - 14.7 K/mm^3, haemoglobin (Hb) - 9.9 g/dl, Sodium (Na) - 122 mMol/l, Potassium (K) - 4.1 mMol/l, Calcium (Ca) 9.2 mg/dl; normal liver function tests and cardiac enzymes. Computed tomography (CT) scan did not reveal signs of pulmonary embolism or parenchymal lesions. He was transferred to the Intensive Care Unit where he was non-invasively ventilated by helmet.

The day after he was transferred to our Sub-Intensive Respiratory Care Unit. During the night, when he was ventilated with his home ventilator, we recorded frequent episodes of arterial desaturation with a nadir of 67%, due to obstruction of the upper airways which was corrected by manual chin lift. Initially, we changed the ventilator setting, increasing the inspiratory pressure to overcome the airways resistance.

Despite this change, the patient continued to have arterial desaturation due to obstructive hypoventilation. A second step was to replace the facial mask with another kind of mask: nasal or full-face. Unfortunately, the patient was unable to ventilate with the nasal mask and the full face mask did not fit tightly to the face. Morning Arterial Blood Gas analysis (ABG) on room air still demonstrated a pH of 7.35, PCO_2 - 49 mmHg, PO_2 - 84 mmHg, HCO_3 - 30 mmHg. On the following night, during NIV, we applied a soft collar to lift the chin (Figure 1). This significantly improved the ventilation, eliminating the functional upper respiratory obstruction and increasing the SaO_2 value that was constantly above 95%. Morning ABG displayed: pH - 7.40, PCO_2 - 42 mmHg, PO_2 - 86 mmHg, HCO_3 - 28 mmHg. Noteworthy, the improvement of the patient's ventilation determined the disappearance of the morning headache and the daytime somnolence related to the poor quality of sleep and finally the spontaneous serum Na normalisation.

In the course of the hospitalisation, during NIV with collar, the patient underwent nocturnal polysomnography that was unremarkable. Since the hospital discharge, the patient is on NIV with soft collar and has a good quality of sleep. He has resumed his physical activity with progressive weight reduction. We have since started more investigations to evaluate the use of other devices in combination with NIV.

Discussion

ROHHAD is a rare disease of unknown aetiology, characterised by rapid-onset obesity in young children, hypoventilation, hypothalamic and autonomic dysfunction. It has been increasingly reported in literature over the past decades and recently has been distinguished from Congenital Central Hypoventilation Syndrome (CCHS)[6]. Patients with ROHHAD have an absent or attenuated response to hypercarbia and/or hypoxemia; central hypoventilation with cardiac arrest represent the potential cause of death[7]. The prognosis has improved with earlier treatment by mechanical ventilation and about half of patients with ROHHAD required tracheostomy for positive pressure ventilation[8].

In this paper, we described a patient with ROHHAD syndrome who, after a brief period of invasive ventilation, received a nocturnal NIV by facial mask. Before the admission to our hospital, he had a worsening of the night ventilation with prolonged nocturnal periods of arterial desaturation as showed by home monitoring. During the hospitalisation, we demonstrated that this effect was due to a condition of upper airways obstruction. In order to improve the effectiveness of the ventilation, we firstly changed the ventilation mode and then the mask. It is known that the facial mask can determine a posterior displacement of the mandible with a subsequent reduction of the retropharyngeal space[9]. For this reason, we used other type of masks (nasal, full face), but unfortunately, these were not well tolerated by the patient. In order to pull forward the mandible reducing the upper airways resistance, we used a soft collar during the nocturnal NIV. This procedure significantly improved the ventilation, sleep and consequently reduced the morning symptoms.

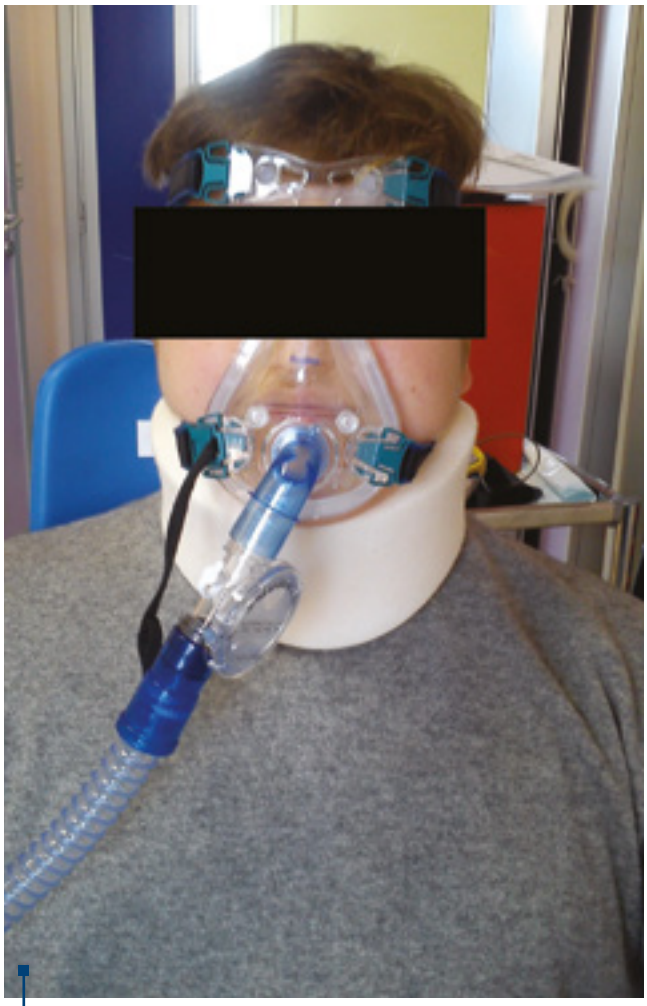

Figure 1. *Patient with soft collar during non-invasive ventilation*

Conclusions

In conclusion, patients with ROHHAD syndrome can also have obstructive hypoventilation, probably caused by obesity. A continuous assessment of respiratory conditions allows the identification of this condition in order to change the respiratory care, including the use of devices in combination with NIV. ■

Conflict of interests: The authors have no conflict of interests.

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