Sleep Medicine 62 (2019) 77–79

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Images in Sleep Medicine

Contribution of transcutaneous capnography to the interpretation of abnormal respiratory events during noninvasive ventilation☆

Grazia Crescimanno [a, b, *], Francesca Greco [c], Maria Canino [b], Manuela Bertini [b], Oreste Marrone [a]

[a] National Research Council, Institute of Biomedicine and Molecular Immunology, Palermo, Italy
[b] Centre for Respiratory Complicances of Neuromuscular Rare Disease, Villa Sofia-Cervello Hospital, Palermo, Italy
[c] Italian Union Against Muscular Dystrophy, Section of Palermo, Italy

ARTICLE INFO

Article history:
Received 2 May 2019
Received in revised form
12 June 2019
Accepted 21 June 2019
Available online 2 July 2019

1. Introduction to the cases

Non-invasive ventilation (NIV) is an effective treatment in chronic hypercapnic respiratory failure. The SomnoNIV group classified abnormal respiratory events (AREs) that can occur under NIV [1]. Among them, they described events characterised by reduction in flow signal and decrease in thoracic and abdominal movements without phase opposition. These events were interpreted as a consequence of a reduced ventilatory drive following hyperventilation and decrease in $PaCO_2$, particularly during unstable sleep. The fall in $PaCO_2$ can induce glottis closure or temporarily reduce, or abolish, ventilation, due to unmasking of a hypocapneic/apneic threshold. However, events with similar polygraphic characteristics can also reflect hypoventilation due to poor effectiveness of NIV, more commonly during REM sleep.

Transcutaneous PCO_2 ($PtcCO_2$) may help to identify the pathophysiology of each event and may address to the appropriate therapy.

2. Image analysis

The images were obtained from polysomnographic recordings during NIV application in two patients with amyotrophic lateral sclerosis. The first three traces of both figures are relevant to the whole night and represent, from top to bottom: (1) hypnogram, (2) $PtcCO_2$, and (3) oxygen saturation (SpO_2). The lower traces show a detail of the recordings and represent: (1) flow at the mask, (2) thoracic movements, (3) abdominal movements, (4) SpO_2, and (5) ventilator pressure. The lower part of both figures represents AREs with marked decrease in flow and in thoracic and abdominal movements without phase opposition.

In the case of Fig. 1, assisted pressure controlled NIV was applied. AREs occurred during unstable NREM sleep. After a decrease in $PtcCO_2$, a prolonged apnea with a rapid fall of SpO_2 occurred. Subsequently, a sequence of short central hypopneas and ventilatory intervals appeared, until baseline SpO_2 and $PtcCO_2$ were resumed.

In Fig. 2, a subject was ventilated in pressure support mode. An apnea occurred during REM sleep and was preceded by normal $PtcCO_2$. During the event, $PtcCO_2$ showed a rapid increase that matched a decrease in SpO_2. The ARE was resolved by sudden hyperventilation.

3. Discussion

In the case of Fig. 1, the first apnea was secondary to ventilatory overassistance that reduced $PaCO_2$ below apnea threshold. Then, stable ventilation was not readily established as the apnea/hypopnea threshold was repeatedly overcome. The latter, however, changed continuously, due to interactions among sleep instability, hypoxic and hypercapnic ventilatory control. Eventually, normal

☆ Written permission was obtained from the next of kin of each patient.

* Corresponding author. Istituto di Biomedicina e Immunologia Molecolare del C.N.R., Via Ugo La Malfa, 153, 90146 Palermo, Italy. Fax: +39 0916890856.
E-mail address: grazia.crescimanno@ibim.cnr.it (G. Crescimanno).

https://doi.org/10.1016/j.sleep.2019.06.011

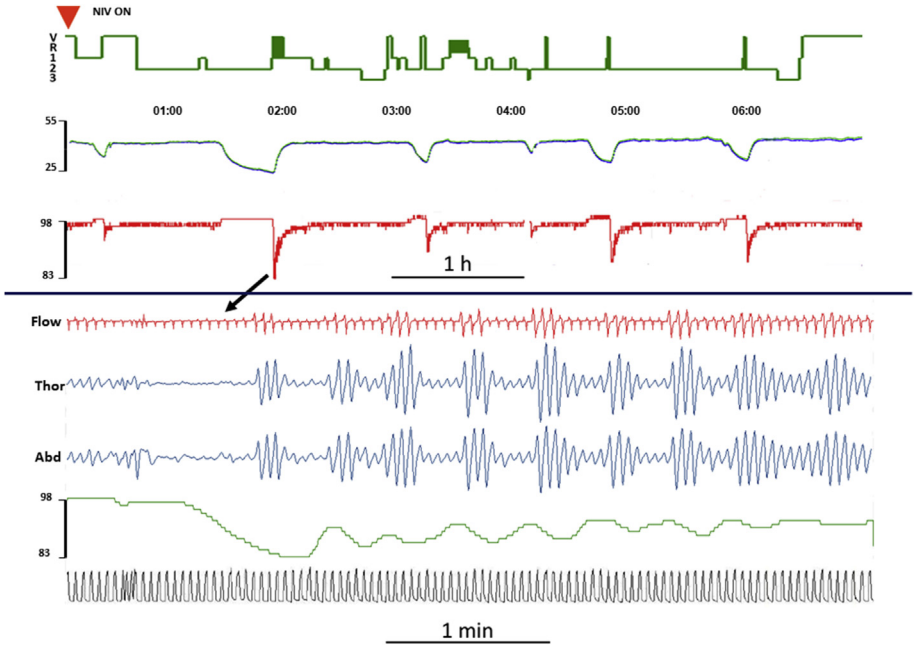

Fig. 1. Abnormal respiratory events arising during unstable NREM sleep after hypocapnia caused by non-invasive ventilation overassistance. See text for traces explanation.

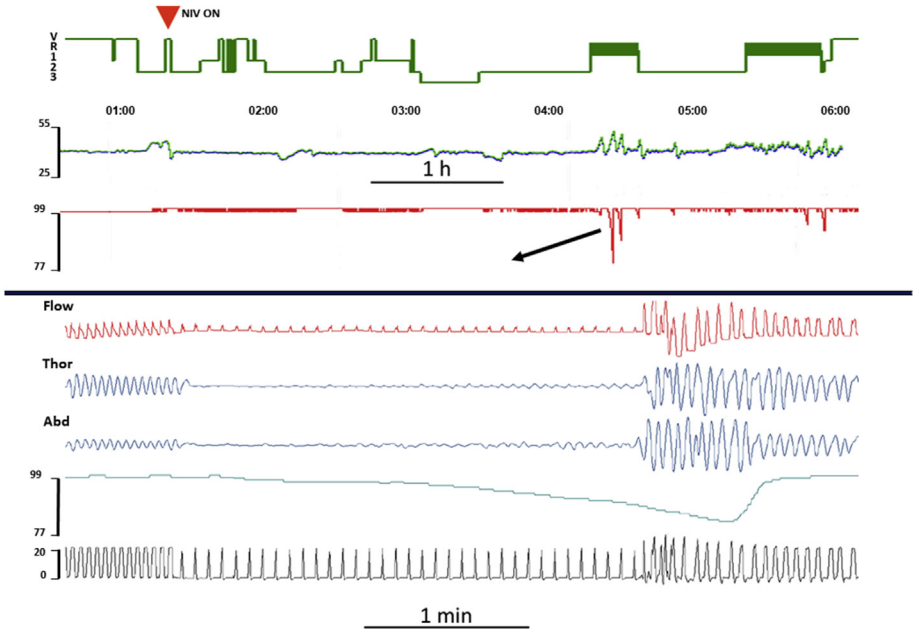

Fig. 2. Abnormal respiratory event causing hypercapnia due to underassistance by non-invasive ventilation during REM sleep. See text for traces explanation.

blood gas tensions, regular ventilation and stable sleep were restored.

The event of Fig. 2, despite a similar polygraphic pattern as in Fig. 1, was an effect of ventilatory underassistance.

Addition of capnography to polygraphic monitoring can facilitate AREs interpretation. Of note, the therapeutic approach to the events we describe is different. In the first case, inspiratory pressure must be decreased, while in the second case inspiratory pressure or back-up frequency should be increased. $PtcCO_2$ has been proposed as an acceptable surrogate of PCO_2 during sleep monitoring [2], although its reliability is better warranted by an experienced team [3]. Thus, implementing $PtcCO_2$ monitoring in clinical practise during NIV can help to understand the significance of AREs of uncertain classification.

Funding

This study was not supported by any external or internal grant.

Acknowledgment

The authors thank Mr Corrado D'Urso for his technical help.

Conflict of interest

None.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2019.06.011.

References

[1] Gonzalez-Bermejo J, Perrin C, Janssens JP, et al. Proposal for asystematic analysis of polygraphy or polysomnography for identifying and scoring abnormal events occurring during non-invasive ventilation. Rev Mal Respir 2014;31(4):312–22.

[2] Berry RB, Budhiraja R, Gottlieb DJ, et al. American academy of sleep medicine. Rules for scoring respiratory events in sleep: update of the 2007 AASM manual for the scoring of sleep and associated events. Deliberations of the sleep apnea definitions task force of the American academy of sleep medicine. J Clin Sleep Med 2012 15;8(5):597–619.

[3] Aarrestad S, Qvarfort M, Kleiven AL, et al. Diagnostic accuracy of simple tools in monitoring patients with chronic hypoventilation treated with non-invasive ventilation; a prospective cross-sectional study. Respir Med 2018;144:30–5.