COMMENT

Inspiratory flow limitation in obstructive sleep apnoea patients

Ramon FARRÉ
Unitat de Biofísica i Bioenginyeria, Facultat de Medicina, Universitat de Barcelona-IDIBAPS, Barcelona, Spain

ABSTRACT

Patients suffering from the obstructive sleep apnoea syndrome (OSAS) experience nocturnal episodes of upper airway obstruction resulting in recurrent oxygen desaturations and arousals. Methods to quantify the nocturnal obstructive events are of interest for characterizing this prevalent sleep disorder. In a study published in this issue of Clinical Science, Bloch and co-workers propose the computation of a new index for objectively quantifying the degree of flow limitation in patients with OSAS. The results obtained in a bench test and in a pilot study in patients suggest that the flow limitation index proposed may help to better characterize the disturbed breathing events undergone by patients with OSAS.

The obstructive sleep apnoea syndrome (OSAS) is a prevalent disorder [1] mainly characterized by patient somnolence, with reduced quality of life [2,3] and increased risk of traffic accidents [4–6]. Moreover, OSAS is a suspected cause of cardiovascular diseases [7–9]. Despite the fact that the exact pathophysiological mechanisms involved in OSAS are not fully understood, there is ample evidence that total or partial collapse of the upper airway is the immediate cause of the recurrent oxygen desaturations and arousals experienced by patients with OSAS. Consequently, the detection of disturbed breathing events (apnoeas, hypopnoeas, flow limitation and snoring) is one of the main goals of polysomnographic diagnostic studies in OSAS patients. Although apnoeas, hypopnoeas and snoring are events which are well detected by cessation and reduction of airflow and by sound production respectively, inspiratory flow limitation is more difficult to quantify [10]. Flow limitation is a dynamic obstruction event characterized by the fact that inspiratory flow remains constant regardless of the increase in the pressure applied by the patient’s inspiratory muscles [10,11]. Accordingly, accurate detection of flow limitation requires the recording of the two physiological variables involved: airflow and inspiratory pressure. However, quantifying the magnitude of flow limitation is difficult, because the conventional concept of airflow resistance (or its reciprocal conductance) is not directly applicable during flow limitation. Indeed, the effective resistance of a collapsible conduit, such as the upper airway in OSAS patients, does not depend only on the characteristics of the conduit (as occurs in a rigid tube), but also on the magnitude of the inspiratory pressure [12].

The study by Bloch and co-workers [13] in this issue of Clinical Science addresses the difficult question of quantifying flow limitation in patients with OSAS. As these authors mention, there is evidence in the literature that the effective pressure–flow relationship in the upper airway during flow limitation is not linear, given that inspiratory flow does not increase as the inspiratory effort is raised. The novelty of the approach of Bloch and co-workers [13] is to quantify flow limitation by a unit-free index based on the variation of conductance along the inspiration. Specifically, they propose the 90th/50th percentile ratio of the effective conductance computed instantaneously (at 20 ms internals) from the relationship between flow and pressure (oesophageal pressure minus the elastic component of transpulmonary pressure). An advantage of this index is that it is normalized (i.e. it is independent of the magnitude of conductance). The

Key words: airway resistance, continuous positive airway pressure, inspiratory flow limitation, obstructive sleep apnoea.

Correspondence: Professor Ramon Farré (e-mail rfarre@ub.edu).
performance of the proposed flow limitation index was tested in a bench study, using a mechanical analogue of the collapsible upper airway (Starling resistor), and in a pilot study in a limited number of patients with OSAS during continuous positive airway pressure (CPAP) titration. The authors [13] provide data suggesting that the proposed flow limitation index, which is computed from data obtained invasively by means of an oesophageal balloon, is more suitable than a previously defined flow limitation index computed from the non-invasive recording of the flow signal [14]. This result was indeed expected, since the flow signal depends on both the degree of partial airway collapse and on the magnitude of the inspiratory effort. Accordingly, a given flow signal could be the result of different combinations of airway obstruction and inspiratory effort.

The high prevalence of OSAS with the consequent waiting lists for diagnosis at many centres [15] and the complexity of conventional full polysomnography have increased the interest in simple and non-invasive methods to characterize airway obstruction in patients with OSAS. In one of these methods, the mechanics of the collapsible upper airway is characterized by the relationship between inspiratory flow and the applied CPAP [12]. This method, which can be applied routinely during CPAP titration [16], allows the characterization of the static and the dynamic obstructions of the upper airway by means of the critical pressure and the resistance of the upper airway segment [17]. Another widely employed approach only requires the recording of airflow either by a pneumotachograph or by nasal prongs. This is based on assessing the degree of airway obstruction by the contour of the inspiratory flow waveform [14,18,19]. A third non-invasive approach for assessing the degree of airway obstruction is based on the measurement of airway resistance by means of the forced oscillation technique [20,21]. In contrast with these non-invasive methods to assess airway obstruction in patients with OSAS, the flow limitation index proposed by Bloch and co-workers [13] is of limited application in the routine clinical setting, because of the need of an oesophageal balloon. However, this index can be employed to provide a detailed characterization of airway obstruction in the pathophysiology sleep laboratory [22]. Moreover, the index can be used as a tool to assess the sensitivity and specificity of the estimators of flow limitation most commonly used in routine sleep studies.

REFERENCES
