RESUMPTION OF VENTILATION AT THE END OF OBSTRUCTIVE SLEEP APNEAS IS NOT DETERMINED BY DIAPHRAGMATIC FATIGUE

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INTRODUCTION

In patients affected by obstructive sleep apnea syndrome (OSAS) a progressive increase of the force developed by the respiratory muscles is usually observed during the occlusive phase before upper airway patency is resumed (Onal and Lopata, 1986).

The inspiratory pressures generated by the action of respiratory muscles increase toward the end of the apnea, reaching values potentially close to those known to determine an impairment of muscular contraction.

However, it has not yet been established whether in these conditions diaphragmatic fatigue occurs. In fact, Guilleminault (1980) first described a significant decrease in the centroid frequency of the spectrum of diaphragmatic electromyogram (EMGdi), compatible with the onset of diaphragmatic fatigue, in a patient with OSAS during an obstructive apnea occurring in non-REM (NREM) sleep; conversely, Martin et al. (1982) did not report any modification suggesting diaphragmatic fatigue, in the same spectrum of the EMGdi analyzed in terms of high/low frequency ratio. Moreover, Vincken et al. (1987) speculated from their results that in OSAS, when the respiratory muscles develop a certain strength close to the fatigue threshold, arousal occurs in order to prevent the onset of diaphragmatic fatigue.

Our study was designed to contribute to the solution of this controversy by evaluating the diaphragmatic contraction during obstructive apneas in NREM sleep both from the spectral and the mechanical point of view.

METHODS

Four men and one woman with OSAS were studied during nocturnal sleep. Sleep state was identified by electroencephalogram (EEG), electro-oculogram (EOG), and submental EMG by the conventional standard criteria.

EMGdi was performed via an esophageal electrode and the frequency power spectrum of the signal was measured in order to detect the development of diaphragmatic fatigue from the changes in the power
Fig. 1. Time course of the H/L ratio variation during obstructive apneas in the investigated sample. On the abscissa, number of breaths from the third preapneic (-3) to the third postapneic (13). On the ordinate, H/L ratio expressed as percentage of the value at the third preapneic breath. Data are expressed as mean ± SE.

contained in the high (150-360 Hz) and low (20-50 Hz) frequency bands (H/L) (Scheitzer et al., 1979).

Transdiaphragmatic pressure (Pdi) was measured by the conventional balloon catheter technique. Each patient performed, during wakefulness, maximal voluntary inspiratory efforts in the supine position in order to obtain the maximal transdiaphragmatic pressure (Pdi max). From the Pdi tracing the tension-time index of the diaphragm (TTdi), i.e. the product of Pdi/Pdimax and T1/Ttot (Bellemare and Grassino, 1982a), was calculated. A TTdi value > 0.18 was assumed as a potentially fatiguing threshold (Bellemare and Grassino, 1982b).

Airflow (V) was also monitored by a Fleisch No. 2 pneumotachograph. All the signals were recorded on a strip-chart recorder (7758B Hewlett Packard) and on magnetic tape (3968A Hewlett Packard) for later playback and analysis.

A breath by breath analysis from the third preapneic to the third postapneic breath was performed in total of 30 obstructive apneas for the five patients.

RESULTS

Fig. 1. illustrates the time course of the H/L ratio values obtained for the five patients during the preapneic, apneic and postapneic