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Title: The double loop gain in obstructive sleep apnea syndrome

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Body: Obstructive sleep apneas usually occur in a periodic breathing pattern. This is probably due to instability of the respiratory control system. Using a simple model of the chemoreflex feedback loop, the tendency to develop periodic breathing can be described by the 'double loop gain' (1). In mathematical terms, the double loop gain equals the squared coherence between an input and an output variable of the respiratory control system (a frequency-dependent correlation coefficient, ranging from 0 to 1). The hypothesis was tested that the double loop gain is increased (> 0.7) during obstructive apneas. In 20 patients with obstructive sleep apnea syndrome, the double loop gain was derived using a wavelet analysis of O₂ saturation and ventilation derived from nasal pressure. The resulting gain is a function of time and frequency for different time scales. In all patients, a significantly increased double loop gain was found during obstructive apneas and hypopneas. The gain was > 0.7 in $63.4 \pm 13.9\%$ (SD) of the time and was associated with periodic breathing (period of 68.2 ± 22.5 sec). On average, $84.6 \pm 13.7\%$ of the apneas occurred in episodes in which the double loop gain was significantly increased. Conclusion: it is possible to derive the double loop gain from O₂ saturation and nasal pressure during obstructive apneas. An increased gain was associated with the occurrence of obstructive sleep apnea, in keeping with the idea that the periodic breathing results from chemoreflex activity. Assessment of the double loop gain makes it possible to characterize sleep apnea patients according to their tendency to develop periodic breathing. (1) Van den Aardweg, J.G., and Karemaker, J.M. AJRCCM 2002; 165: 1041-1047.