Adaptive pressure support servo-ventilation: a novel treatment for Cheyne-Stokes respiration in heart failure.

Adaptive servo-ventilation (ASV) is a novel method of ventilatory support designed for Cheyne-Stokes respiration (CSR) in heart failure. The aim of our study was to compare the effect of one night of ASV vs. sleep breathing with the effect of other treatments. Fourteen subjects with stable cardiac failure and receiving optimal medical treatment were treated unilaterally and on four treatment nights in random order: nasal oxygen (0.3 L/min), continuous positive airway pressure (CPAP) mean airway pressure 8.5 cm H2O, bilevel CPAP mean airway pressure 7 cm H2O vs. 3 cm H2O during sleep, and ASV. The ASV pressure controller (Respironics) provided a range of inspiratory pressure (PI) derived from a Pi-500 pressure source set to 16.2 cm H2O vs. 6.2 cm H2O. The pressure delivered to the subject was 26.6 cm H2O vs. 5.6 cm H2O. During the one-night treatment period, the central apnea index decreased from 60.1 to 2.84 events/hour (p < 0.001) when ASV was compared to CPAP and 0.7 events/hour (p < 0.001) when ASV was compared to nasal oxygen. There were large increases in slow-wave and rapid eye movement (REM) sleep with ASV but not with oxygen or CPAP. ASV subjects preferred ASV to CPAP. One night ASV suppressed central sleep apnea and/or Cheyne-Stokes respiration (CSR) in heart failure and improved sleep quality better than CPAP or 2 L/min oxygen.

Heart Failure and Central Sleep Apnea/
Cheyne-Stokes Respiration

Heart Failure

Cheyne-Stokes respiration (CSR) has an important influence on prognosis of congestive heart failure (CHF). A number of studies have reported that continuous positive airway pressure (CPAP) is effective in treating CSR. However, the effect of ASV on CSR remains to be determined. The current study was designed to assess the effect of ASV on CSR in patients with CHF. The study was conducted at the Faculty of Medicine, Ruhrlandklinik, Dusseldorf, Germany. The study involved 25 patients (age: 28-80 y, NYHA: II-IV) with stable CHF. The patients were randomised to either CPAP or ASV. At inclusion, both groups were comparable for NYHA class, LVEF, and daytime sleepiness. At 6 months, the improvement in quality of life was higher with ASV and only ASV induced a significant increase in LVEF.

Sleep-disordered breathing (SDB) is known to have serious cardiovascular consequences. Research indicates that up to 70% of patients with heart failure have some form of SDB—either obstructive sleep apnea (OSA) or central sleep apnea (CSA). Furthermore, heart failure patients with CSA also often exhibit a form of periodic breathing, known as Cheyne-Stokes respiration (CSR). These results suggest that patients with CSA-CSR might receive greater benefit from treatment with ASV than with CPAP.

**Conclusion:**
These results suggest that patients with CSA-CSR might receive greater benefit from treatment with ASV than with CPAP.
Prognostic value of nocturnal Cheyne-Stokes respiration in chronic heart failure.

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BACKGROUND: Nocturnal Cheyne-Stokes respiration (CSR) occurs frequently in patients with chronic heart failure (CHF), and it may be associated with sympathoadrenergic activation. The aim of the present study was to evaluate whether CSR could affect prognosis in patients with CHF.

METHODS AND RESULTS: Sixty-two CHF patients with left ventricular ejection fraction ≤35%, in NYHA class II to III, underwent clinical evaluation, Doppler echocardiography, argonplasma, sleep, and respiratory polygraphy. A sleep study to evaluate the occurrence of CSR, expressed as percentage of periodic breathing, and apneas and hypopneas per hour of recording. During a mean follow-up of 24±12 months, 16 patients died of cardiac causes. Nonsurvivors were in a higher NYHA functional class than survivors (P<0.02) and had a more depressed left ventricular ejection fraction (P<0.01), a shorter duration of sleep (P<0.01), and a lower peak VO2 (P<0.01). Nonsurvivors also spent a greater percentage of the night in periodic breathing (P<0.02) with a greater AHI (P<0.01) and showed lower values of arterial baroreflex sensitivity (P<0.05), and of heart rate variability (P<0.02). Multivariate analysis revealed that the AHI correlated with CSR, AHI, arousal index, and the amount of stage 1, 2, and REM sleep and was inversely related to the total sleep time. These data suggest that mortality is higher in CHF patients who develop CSR during sleep than CHF patients without CSR. Although the development of CSR may simply reflect more severe cardiac impairment, we suggest that CSR itself accelerates the deterioration in cardiac function.

CONCLUSIONS: The AHI is a powerful independent predictor of poor prognosis in clinically stable patients with CHF. The presence of an AHI >20/h adds prognostic information compared with other clinical, echocardiographic, and autonomic data and identifies patients at very high risk for subsequent cardiac death.

Increased mortality associated with Cheyne-Stokes respiration in patients with congestive heart failure.

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We hypothesised that mortality is higher in patients with congestive heart failure (CHF) who develop Cheyne-Stokes respiration (CSR) during sleep than CHF patients without CSR. Overnight polysomnography was performed on 16 male patients with chronic, stable CHF (mean age 67±7 years, 10/16 with left heart failure, 14/16 with right). CSR was defined as either an increase in mean arterial pressure of at least 15 mmHg or a decrease in mean arterial pressure of at least 15 mmHg for at least 10 seconds. At baseline, chronic heart failure was associated with higher left ventricular filling pressures, lower peak VO2, lower heart rate variability, and higher sympathetic activity. During the study, 14 patients died. Cumulative survival in the CSR and non-CSR groups, which was significantly lower in the CSR group (P = 0.0419).

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A randomised controlled trial of adaptive ventilation for Cheyne-Stokes breathing in heart failure.

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Heart failure is associated with Cheyne-Stokes breathing, which fragments patients’ sleep. Correction of respiratory disturbance may reduce sleep fragmentation and excessive daytime sleepiness. This randomised, prospective, parallel trial assessed whether noninvasive ventilatory support improves daytime sleepiness compared with the control. A total of 75 subjects (38 males with Cheyne-Stokes breathing and primary apnoea-hypopnoea index 19/h (SD 24) and stable symptomatic chronic heart failure) were randomised to receive ASV or CPAP. Daytime sleepiness (Epworth test) was measured before and after the trial with changes in mean scores from the primary endpoint. Secondary endpoints included brain natriuretic peptide levels and tachycardia reduction. Autonomic treatment reduced excessive daytime sleepiness, the mean Epworth score was 7.9 minutes (SEM 2.6) vs 11.5 minutes (SEM 3.7) with control (p = 0.01). The difference was significant in patients who had good adherence to ASV. We conclude that adaptive ventilatory support produces an improvement in daytime sleepiness in patients with Cheyne-Stokes breathing and chronic heart failure. This study suggests improvements in neurohormonal activation with...