

# In patients with heart failure the burden of central sleep apnea increases in the late sleep hours

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*Sleep*, Volume 42, Issue 1, January 2019, zsy195, <https://doi.org/10.1093/sleep/zsy195>

**Published:** 16 October 2018 **Article history** ▼

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## Abstract

### Study Objectives

Periodic breathing with central sleep apnea (CSA) is common in patients with left ventricular systolic dysfunction. Based on the pathophysiological mechanisms underlying CSA, we hypothesized that the frequency of CSA episodes would increase in the late hours of non-rapid eye movement (NREM) of sleep.

### Methods

Forty-one patients with left ventricular ejection fraction <40% underwent full-night-attended polysomnography scored by a central core lab. Because central apneas occur primarily in NREM sleep, total NREM sleep time for each patient was divided into 8 equal duration segments. Segment event counts were normalized to an events/hour index based on sleep segment duration.

### Results

Central apnea index (CAI) varied among sleep segments ( $p = 0.001$ ). As expected CAI was higher in segment 1 compared to segments 2 and 3, increasing during later segments. The minimum CAI occurred in segment 2 with mean  $\pm$  SD of  $21 \pm 3$  events/hour and maximum CAI was in segment 8 with  $37 \pm 4$  events/hour. We also determined central apnea duration which varied among segments ( $p = 0.005$ ), with longer durations later in the night (segment 1:  $22 \pm 1$  seconds; segment 8:  $26 \pm 1$  seconds,  $p < 0.001$ ). Data were also analyzed including rapid eye movement (REM) sleep, with similar results. Further, comparison of CAI between the first and second half of the night showed a significant increase in the index. Circulation time did not change across the segments ( $p = 0.073$ ).

### Conclusions

In patients with left ventricular dysfunction and CSA, central apnea burden (number and duration) increases during later hours of sleep. These findings have pathophysiological and therapeutic implications.

### Clinical Trial Registration

NCT01124370.

central sleep apnea, heart failure, apnea burden, lung

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Online ISSN 1550-9109

Print ISSN 0161-8105

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