Irregular Respiration as a Marker of Wakefulness During Titration of CPAP


TAKE-HOME POINTS:

• It is possible to manually identify the transition from sleep to wake from the flow signal alone.
• It is possible to automatically identify the transition from sleep to wake from the flow signal alone.
• This study describes the development of SensAwake™, which automatically senses the transition from sleep to wake and promptly reduces the delivered pressure to facilitate the return to sleep.

AIM:

• To examine the ability to detect transitions from sleep to wake using the continuous positive airway pressure (CPAP) flow signal alone and to automate this process.

METHODS:

PHASE 1 — Evaluation of the relationship between the visual onset of irregularity and EEG:
• 20 obstructive sleep apnea (OSA) patients (Respiratory Disturbance Index [RDI] 13-119 events/hour) underwent full nocturnal polysomnography (PSG).
• Periods of irregular respiration were manually identified from the flow signal alone while the scorers were blinded to sleep staging.
• Sleep and arousals (as defined by the American Association of Sleep Medicine [AASM]) were manually scored using traditional PSG measures (EEG, EOG and EMG).
• Results from manually marked periods of irregular respiration were compared to scored sleep.

PHASE 2 — Automated detection of irregular respiration:
• 50 PSG studies were scored manually for periods of irregular respiration from the flow signal alone, and were used to train an artificial neural network (ANN).
• The trained ANN was then tested for accuracy using the flow signals from 24 different PSG studies.
• Results from the ANN were compared to EEG defined wake and arousals (as defined by the AASM).

RESULTS:

• Phase 1 — The positive predictive value of manually scored irregular respiration to detect the transition from sleep to wake was 0.89 and 0.98 for wake and arousal combined.
• Phase 2 — The positive predictive value of irregular respiration identified by the ANN was 0.86 for wake and arousal combined.

CONCLUSIONS:

• The presence of an irregular respiratory pattern was highly predictive of the transition from sleep to wake.
• Detection of irregular respiration can be automated with an ANN.