Disordered breathing during sleep is recognised as a frequent and serious health problem. Three conditions are associated with sleep disruption:

- Upper airway narrowing and collapsibility is the cause of **obstructive** sleep apnea with sleep disruption and daytime somnolence. For symptomatic patients, treatment with continuous positive airway pressure (CPAP) is very effective.

- Neuromuscular weakness (and, possibly, morbid obesity) leads to nocturnal hypoventilation with hypercapnia and hypoxaemia. Non-invasive ventilation (NIV) [Chapter 11] at night is the treatment of choice.

- **Unobstructed** apneas occur with poor left ventricular function in chronic heart failure, related to nocturnal hyperventilation lowering \( \text{PaCO}_2 \) below the apneic threshold. CPAP treatment removes the apneas and improves nocturnal oxygenation, but does not improve long–term survival (Bradley et al, 2005a).
Flow limitation: apnea. As the pharynx becomes more collapsible, inspiratory flow limitation increases until closure occurs. If closure has occurred at a PaCO₂ below the apneic threshold, a central apnea will occur, lasting until the rhythm re-initiation threshold has been exceeded, followed by an obstructive apnea (Figure 10.5). This is called a mixed apnea.

![AIRFLOW AND THORACOABDOMINAL MOTION IN APNEAS](image)

Figure 10.5 Schematic diagram of airflow (from facemask) and anteroposterior movement of the thoracic and abdominal wall [from magnetometers]. Central apneas have no airflow or thoracoabdominal movement. Obstructive apneas have out of phase (see arrows) motion of the thorax and abdomen, but no airflow at the mouth. Oesophageal pressure trace is shown for the mixed apnea in B; note larger ΔPoes during obstructed efforts. Modified and redrawn from Gibson, 2009, p. 112.
10.4 Learning Points

- Sleep has “quiet” NREM (80% of sleep time) and “active” REM phases; in REM, most muscles (except the diaphragm) are silent
- Obstructive sleep apnea (OSA) is caused by a narrow pharynx with increased collapsibility and a negative pharyngeal transmural pressure
- Frequent arousals from apneas (when inspiratory effort or hypoxaemia exceeds “threshold”) disrupts sleep and causes daytime somnolence
- Obstructive apneas have thoracoabdominal movements (out of phase), falling $\text{Sa}_O^2$ and zero airflow at the mouth and/or nose
- Hypopneas have reduced $\dot{V}_I$, flow limitation on inspiration (a flow “plateau”) and increased respiratory effort ($\uparrow \Delta P_{oes}$)
- Central apneas have no airflow and no respiratory movement
- OSA occurs typically in obese middle-aged men
- Nasal CPAP is an effective treatment for OSA
- Hypercapnic central apneas respond to nocturnal NIV
- Hypocapnic central apneas with periodic breathing occur in CHF when $\text{PaCO}_2$ is < apneic threshold

Further Reading

General


Historical