



Sleep related hypoventilation (SRH)

This information sheet from Great Ormond Street Hospital (GOSH) explains the causes, symptoms and treatment of sleep related hypoventilation (SRH) and where to get help.

What is sleep related hypoventilation?

Hypoventilation describes the state in which a reduced amount of air enters the alveoli in the lungs, resulting in low blood levels of oxygen (O_2) and increased levels of the body's waste gas, carbon dioxide (CO_2). Hypoventilation can be due to breathing that is too shallow, breathing that is too slow, obstructed airways or restricted or damaged lungs.

When children sleep, the stages of sleep can be divided into either REM (rapid-eye movement sleep or dream sleep) or NREM (non rapid-eye movement sleep). The muscles that help the body to breathe and keep the air passages open work fully in NREM sleep. In REM sleep, however, these muscles relax leading to shallower breathing. For this reason REM sleep is often the period when sleep-related hypoventilation occurs in children and young people with other underlying medical problems. If the underlying disorder deteriorates or worsens, then there may be further respiratory weakness, with hypoventilation developing in all sleep stages and even during the day.

What causes sleep related hypoventilation?

SRH can occur as a part of various conditions:

1. where the main breathing muscles and in particular the diaphragm, are affected (for example Neurological, Neuromuscular or Obesity Hypoventilation syndromes)
2. where narrowed airways are prominent (for example, in Obstructive Sleep Apnoea (OSA))
3. where the lung is damaged
4. where the lung is restricted from moving (for example, with chest wall deformities)
5. where the brain's control of breathing is impaired (for example, in Congenital Central Hypoventilation Syndrome (CCHS))

What are the signs and symptoms of sleep related hypoventilation?

Signs and symptoms of SRH are related to the higher levels of carbon dioxide in the blood and to sleep disturbance. They include: morning headaches, restless sleep, daytime tiredness or sleepiness and difficulty concentrating at school. Recurrent respiratory problems can also be present including chest infections such as bronchitis, and shortness of breath. Although these signs and symptoms are common, they may not be recognised as signs of SRH.



How is sleep related hypoventilation diagnosed?

Several investigations may be needed to diagnose SRH. The daytime diagnostic tests which may be performed include: lung function tests (blowing tests such as spirometry and peak cough flow), assessment of respiratory muscle strength, measurement of daytime oxygen levels (oxygen saturations or SpO₂) and capillary blood gas (a blood test to measure the CO₂ level in the blood). These daytime tests may suggest that your child has SRH and if this is the case, a sleep study will need to be conducted.

A sleep study usually means an overnight stay in a sleep unit, where measurements of the child's breathing during sleep are recorded by technologists/physiologists experienced in working with children. The measurements are recorded using stick-on or wrap-around sensors and include respiratory rate, heart rate, oxygen saturation, chest wall movement, airflow, measurement of CO₂, video and sound recording. The results are then interpreted by a paediatric sleep consultant, who can make a diagnosis of SRH.

How is sleep related hypoventilation treated?

The decision to start treatment is made on a case-by-case basis once SRH has been confirmed and will depend on the underlying reason for SRH.

Positive Airway Pressure therapy (often in the form of BPAP = Bilevel Positive Airway Pressure, also known as non-invasive ventilation or NIV) is the usual treatment for SRH. This involves your child wearing a mask over the nose and/or mouth while a positive pressure is applied from a bedside device called a ventilator. This blows air into the lungs

at pressure to help the respiratory muscles, improve lung inflation and oxygen levels, as well as helping to remove CO₂ during sleep. This treatment is not a cure for SRH as this is often related to an underlying condition.

Scoliosis is often seen in children with neuromuscular and neurological conditions. As the curvature of the spine increases, the inflation of the lungs is restricted and this may increase SRH. This is not easily reversed, despite surgical correction but sometimes there will be a mild improvement of the underlying SRH.

What happens next?

If your child has been diagnosed with SRH and has been treated or if it was decided to wait and follow progress, a follow-up sleep study will be arranged. This enables the medical professionals to assess if the SRH has been successfully managed or if an alternative therapy is required. Treatment of SRH in children and young people has been shown to improve quality of life, daytime function including learning, concentration and attention. There may also be less daytime fatigue, improvement in sleep quality, and fewer chest infections.

Further information and support

The British Lung Foundation offers support and advice to anyone affected by a breathing condition. Call their helpline on 03000 030 555 from Monday to Friday from 9am to 5pm or visit their website at www.blf.org.uk

The Sleep Apnoea Trust website (www.sleep-apnoea-trust.org) contains information about all types of sleep apnoea.