Surgical management of sleep disordered breathing

BY JONATHAN C HOBSON

Snoring and sleep-disordered breathing are often described as multi-level problems, and different surgical procedures are required to treat the various sites of airway narrowing and/or collapse. **Jonathan Hobson** gives us an eloquent run-through the various options available to the ENT surgeon.

Sleep-disordered breathing (SDB) is manifest by pharyngeal collapse during sleep as a consequence of abnormal structural anatomy and loss of muscle tone during sleep. Snoring is the cardinal sign of SDB and represents flutter in a Starling resistor when collapsing pressures exceed dilatational forces. (A Starling resistor is one in which flow is related not just to the pressure differential across the tube but to the inflow pressure minus the extraluminal pressure.) SDB can be further subdivided into simple snoring, upper airway resistance syndrome and obstructive sleep apnoea (OSA) – the latter of which affects up to 4% of adults. OSA is characterised by repetitive partial or complete collapse of the upper airway during sleep, resulting in disruption of normal sleep architecture and usually associated with arterial desaturations which can be quantified by assessment of the apnoea-hypopnoea index (AHI) by means of an overnight domiciliary sleep study or a formal sleep laboratory polysomnograph. The symptoms of OSA can be divided into daytime and nighttime symptoms. Daytime symptoms include excessive daytime somnolence, morning headaches, neurocognitive impairment (loss of concentration and memory impairment) mood changes, depression and irritability. Nocturnal symptoms include snoring, apnoeas, bruxism, nocturia, drooling and loss of libido. These symptoms are often of prime importance to patients but OSA is a gradually progressive disease and as it worsens in severity it is associated with the development of significant medical comorbidities, which may go unrecognised by the patient. OSA is more importantly associated with an increased risk of myocardial infarction, hypertension, cerebrovascular accident and a decrease in psychomotor efficiency associated with five additional years of age. The aims of treatment therefore in OSA are twofold: 1) control of symptoms; and 2) minimisation of mortality risk.

The mechanisms by which these aims are achieved are varied but the underpinning principle is to overcome the tendency of the upper airway to collapse. Whereas tracheostomy was once considered the 'gold standard' means of achieving this by bypassing the collapsible part of the upper airways, continuous positive airway pressure (CPAP) is the gold standard treatment of OSA in the 21st century. Meta-analyses have shown that CPAP reduces the AHI by 7.97 events per hour and reduces the Epworth sleepiness score (ESS) by 2.9 points more than placebo [1]. The side-effects of CPAP (air leaks, oral and nasal dryness, nasal congestion, epistaxis, pressure intolerance, aerophagia, claustrophobia) tend not to cause significant morbidity or mortality but they may be sufficient, if left untreated, to preclude the patient from continuing CPAP use. It is known that CPAP adherence varies widely among patients, indeed Weaver in a study of 32 patients using CPAP reported that half were consistent users, applying CPAP on more than 90% of nights for an average of 6.2 hours per night, whereas the other half were intermittent users who had a wide range of daily use, averaging 3.5 hours per night [2]. In spite of measures such as bilevel pressure, autotitration or pressure relief whereby pressure is reduced during expiration, some patients cannot or will not (for aesthetic or psychological reasons) tolerate CPAP devices. Oral appliances are designed to enlarge the upper airway and decrease upper airway collapsibility by retraining the tongue to be held anteriorly or by repositioning the mandible. They are beneficial in patients who do not tolerate CPAP [3]. Surgery can therefore be considered as a second line treatment for OSA when the outcome of CPAP is inadequate or CPAP is not tolerated by the patient. Surgery can also be of benefit as an adjunct when obstructive anatomy or functional deficiencies compromise other therapies [4].

Nasal surgery

Nasal obstruction has several effects on sleep disordered breathing:

- Increases resistance in the collapsible tube of the airway which promotes upper airway collapse
- Causes mouth breathing which displaces the tongue posteriorly thereby narrowing the oropharynx and increasing retrolingual collapsibility as well as decreasing the length and tension of the muscles surrounding the airway, increasing the compliance of the pharyngeal musculature
- Reduces the ventilatory stimulus of nasal airflow (the so-called nasobronchial reflex).

It stands to reason, therefore, that surgery to correct nasal obstruction can reverse these effects. This surgery may be directed to the septum, turbinates and/or nasal valves and is covered in standard rhinological textbooks. It is rare for nasal surgery alone to cure SDB but it will often ameliorate it and it can also decrease the amount of CPAP pressure required, which tends to increase compliance [5].

Soft-tissue surgery

This encompasses all surgery that does

not involve the facial skeleton and aims to address obstruction that is either retrolingual or retropalatal. Pharyngeal airway reconstruction should be performed in a step-wise fashion to minimise morbidity and improve surgical outcomes. Patients with mild OSA can undergo uvulopalatoplasty (U3P) and radio-frequency channelling of the tongue to increase the space behind the palate and reduce tongue bulk. The U3P techniques performed in the past often removed large amounts of mucosa that led to scarring of the soft palate, velopharyngeal reflux and symptoms of globus and post-nasal drip as the 'drip-spout' function of the uvula was destroyed. Modern surgical technique favours mucosal-sparing surgery with lateral suture advancement of the posterior pillar into the supratonsillar region [6]. Patients in whom the initial surgery is unsuccessful can proceed to palatal advancement, geniotubercle advancement or submucosal linguaplasty in a step-wise manner [7].

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Orthognathic surgery

Maxillo-mandibular advancement (MMA) involves a Le Fort I osteotomy of the maxilla and a sagittal split osteotomy of the mandible. Anterior distraction of the maxilla and mandible is followed by rigid fixation. The advantage of MMA is that it offers simultaneous expansion of the naso-, oro- and hypo-pharynx but it is technically demanding with a higher risk of complications than soft tissue surgery. It is often reversed for patients with specific anatomical deformities such as retrognathia.

Obesity management

Patients with SDB with a body mass index of > 40 kg/m² tend not to have favourable outcomes from pharyngeal surgery. Bariatric surgery should be offered to this cohort of patients. This encompasses a variety of procedures including Roux-en-Y gastric bypass, laparoscopic sleeve gastrectomy and biliopancreatic diversion. 75% of obese patients will see an improvement in their AHI following bariatric surgery.

Snoring surgery

Snoring represents the noise made by palatal or lingual flutter without the degree of airway collapsibility that causes OSA. The mainstay of surgical treatments for snoring has been procedures designed to stiffen the palate and reduce the amount of flutter. Commonly performed procedures include radio-frequency ablation of the soft palate and soft palatal implants. The National Institute for Health and Care Excellence (NICE) state that there are no safety concerns with either of these procedures but that long-term evidence of their efficacy is lacking.

Outcome measures of surgery

Surgery rarely cures OSA, but the lack of cure should not be judged as failure. New higher-level evidence shows excellent clinical outcomes with surgery, in long-term health, short-term symptoms and quality of life, even when complete cure is not achieved. It is unrealistic and inappropriate to expect that surgery must result in a cure to be considered worthwhile. Evaluating surgical treatments is complicated because placebo control is usually not feasible with invasive therapies, randomisation to or away from invasive therapy may limit patient enrolment and generalisability, and surgery is a heterogeneous array of procedures and combinations of procedures. Despite these testing challenges, well-controlled studies are showing important benefits of surgery and, moreover, of combinations of surgical procedures [8].

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Declaration of competing interests
None declared