

Hypoglossal nerve stimulation for moderate to severe obstructive sleep apnoea

Interventional procedures guidance

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1 Recommendations

- 1.1 Current evidence on the safety and efficacy of hypoglossal nerve stimulation for moderate to severe obstructive sleep apnoea is limited in quantity and quality. Therefore, this procedure should only be used with special arrangements for clinical governance, consent and audit or research.
- 1.2 Clinicians wishing to do hypoglossal nerve stimulation for moderate to severe obstructive sleep apnoea should:
 - Inform the clinical governance leads in their NHS trusts.

- Ensure that patients understand the uncertainty about the procedure's safety and efficacy and provide them with clear written information to support shared decision-making. In addition, the use of NICE's information for the public is recommended.
 - Audit and review clinical outcomes of all patients having hypoglossal nerve stimulation for moderate to severe obstructive sleep apnoea using NICE's interventional procedure outcomes audit tool.
- 1.3 Patient selection and the procedure should be done by clinicians with special expertise in the management of obstructive sleep apnoea.
- 1.4 Further research including the use of observational data from registries should provide information on patient selection, safety outcomes, quality of life, long-term outcomes and the position of the procedure in the treatment pathway. NICE may update the guidance on publication of further evidence.

2 Indications and current treatments

- 2.1 Obstructive sleep apnoea (OSA) is characterised by repeated episodes of apnoea and hypopnoea during sleep, loud snoring and excessive daytime sleepiness. The main cause is collapse of the upper airway during sleep. OSA has a big impact on quality of life and increases the risk of having a stroke and developing conditions such as hypertension and atrial fibrillation.
- 2.2 OSA may be improved by lifestyle changes such as weight loss, avoiding alcohol or sedative medication, and change of sleeping position. The most common treatment for severe OSA is continuous positive airway pressure, applied through a face mask during sleep. Surgical interventions include tonsillectomy, adenoidectomy, uvulopalatopharyngoplasty and, rarely, tracheostomy and bariatric surgery.

3 The procedure

- 3.1 Hypoglossal nerve stimulation aims to treat obstructive sleep apnoea by

preventing the tongue prolapsing backwards and causing upper airway obstruction during sleep. It works by delivering an electrical current to the hypoglossal nerve. This contracts the genioglossus muscle, the major muscle responsible for tongue protrusion, and all other intrinsic muscles of the tongue. Using general anaesthesia, a neurostimulator is implanted in an infraclavicular subcutaneous pocket and a stimulating lead is placed on the main trunk of the hypoglossal nerve. The neurostimulator delivers electrical pulses to the hypoglossal nerve. With some devices, stimulation can be synchronised with respiration using sensing leads that measure changes in breathing. The respiratory-sensing leads are positioned between the external and internal intercostal muscle. The stimulator is programmed and controlled wirelessly to adapt to specific patient needs.

4 Efficacy

This section describes efficacy outcomes from the published literature that the committee considered as part of the evidence about this procedure. For more detailed information on the evidence, see [NICE's interventional procedure overview](#).

In a systematic review and meta-analysis of 200 patients, there was a statistically significant decrease in the apnoea–hypopnoea index (AHI; a normal AHI is less than 5 events per hour). At 3-, 6-, and 12-month follow-up the mean differences from baseline were -23.94 (95% confidence interval [CI] -31.45 to -16.43, 34 patients), -25.60 (95% CI -31.18 to -20.01, 60 patients) and -17.51 (95% CI -20.69 to -14.34, 170 patients) respectively ($p < 0.001$ for all time points).

- 4.1 In a randomised controlled therapy-withdrawal trial of 46 'responders' from a prospective case series of 126 patients (23 therapy-maintenance responders compared with 23 therapy-withdrawal responders), there was a statistically significant increase in the mean AHI from 7.6 at 1-year follow-up (before randomisation into the trial) to 25.8 at 1 week after randomisation, in the group in which the device was turned off for 1 week ($p < 0.001$). There was no statistical difference in mean AHI within the therapy-maintenance group, who continued to use the device (7.2 compared with 8.9). At 18-month follow-up, the mean AHI scores were 9.6 in the therapy-maintenance group and 10.7 in the group who had the device turned off for 1 week ($p < 0.05$ for the differences

- compared with baseline within groups). There was a statistically significant difference between the therapy-withdrawal group and the therapy-maintenance group for change in mean AHI, from assessment at 1 year to assessment at the end of the therapy-withdrawal study ($p < 0.001$).
- 4.2 In the systematic review and meta-analysis of 200 patients, there was a statistically significant decrease in the oxygen desaturation index (defined as the number of times per hour of sleep that the blood oxygen level drops by 4 or more percentage points from baseline). At 3-, 6-, and 12-month follow-up the mean differences from baseline were -10.04 (CI -16.31 to -3.78, 34 patients), -11.68 (95% CI -17.16 to -6.19, 60 patients) and -13.73 (95% CI -16.87 to -10.58, 170 patients) respectively ($p < 0.01$ at 3 months and $p < 0.001$ at 6 and 12 months).
- 4.3 In the systematic review and meta-analysis of 200 patients, there was a statistically significant decrease in the Epworth sleepiness scale (scores range from 0 to 24 with higher scores indicating more daytime sleepiness). At 3-, 6-, and 12-month follow-up the mean differences from baseline were -4.17 (CI -6.45 to -1.90, 34 patients), -3.82 (95% CI -5.37 to -2.27, 60 patients) and -4.42 (95% CI -5.39 to -3.44, 170 patients) respectively ($p < 0.001$ for all time points).
- 4.4 In a follow-up study of 95 patients from the prospective case series of 126 patients, there was a statistically significant increase in the mean functional outcomes of sleep questionnaire score (FOSQ, ranging from 5 to 20 with higher scores indicating better subjective sleep quality) from 14.6 ± 3.0 at baseline to 17.5 ± 2.9 at 4-year follow-up ($p < 0.05$).
- 4.5 In the follow-up study of 95 patients from the prospective case series of 126 patients, the rates of bed-partner reported 'no snoring' or 'soft snoring' were 17% (18/108) at baseline and 85% at 4-year follow-up.
- 4.6 In a prospective case series of 46 patients, there was a statistically significant improvement in the mean sleep apnoea quality of life index from 4.3 ± 1.0 at baseline to 4.7 ± 1.2 at 6-month follow-up ($p = 0.019$).
- 4.7 The specialist advisers listed the key efficacy outcomes as: reduction in

severity of obstructive sleep apnoea, improved sleep and reduced daytime sleepiness.

5 Safety

This section describes safety outcomes from the published literature that the committee considered as part of the evidence about this procedure. For more detailed information on the evidence, see [NICE's interventional procedure overview](#).

- 5.1 Transient ipsilateral hemi-tongue paresis was reported in 15% (2/13) of patients in a prospective case series of 13 patients from a systematic review and meta-analysis of 200 patients.
- 5.2 Tongue abrasion was reported in 26% (33/126) of patients in a follow-up study of 95 patients from a prospective case series of 126 patients within 4 years of the procedure.
- 5.3 Bleeding was reported in 1 patient within 30 days of implantation in a prospective case series of 46 patients. This was caused by a hypertensive crisis and surgical intervention was needed; hypertension was treated with medication. In the same study, haematoma was reported in 7% (3/46) of patients. One of the 2 cases classified as non-serious occurred within 30 days of implantation and the other occurred more than 30 days after implantation. The third case was classified as a serious event and occurred within 30 days of implantation.
- 5.4 Rupture of a vein was reported in 6% (2/31) of patients during cervical tunnelling in a prospective case series of 31 patients; 1 of the patients needed 1 further cervical incision.
- 5.5 Seroma at an incision site was reported in 10% (2/20) of patients after the procedure in a retrospective case series of 20 patients. One seroma occurred at the sensing-lead incision 1 week after surgery and the other occurred at the implantable pulse-generator incision 4 weeks after surgery. Both resolved uneventfully with percutaneous needle drainage.
- 5.6 Headache was reported in 6% (8/126) of patients in the prospective case series of 126 patients within 1 year of the procedure.

- 5.7 Infection was reported in 1 patient in a prospective case series of 22 patients from the systematic review and meta-analysis of 200 patients; the device was removed.
- 5.8 Dry mouth was reported in 13% (16/126) of patients in the prospective case series of 126 patients within 3 years of the procedure.
- 5.9 Discomfort due to electrical stimulation was reported in 58% (73/126) of patients in the prospective case series of 126 patients within 4 years of the procedure. In the same study, discomfort related to incisions was reported in 29% (37/126) of patients and discomfort not related to incisions was reported in 27% (34/126) of patients within 4 years of the procedure.
- 5.10 Paraesthesia was reported in 13% (6/46) of patients (within 30 days of implantation in 5 patients, and more than 30 days after implantation in 1 patient) in the prospective case series of 46 patients.
- 5.11 Device migration more than 30 days after implantation was reported in 1 patient in the prospective case series of 46 patients. Cuff dislodgement was reported in 2 patients in a prospective case series of 31 patients, and in 1 patient in a prospective case series of 21 patients, from the systematic review and meta-analysis of 200 patients; all 3 patients needed a new procedure to replace it.
- 5.12 Device removal was reported in 4 patients in the prospective case series of 31 patients, and in 2 patients in the prospective case series of 21 patients, from the systematic review and meta-analysis of 200 patients. Device removal was also reported in 3 patients, 1 to 4 years after the procedure, in the prospective case series of 126 patients. The reasons for removal were insomnia, septic sternoclavicular joint adjacent to the device and non-response to therapy. Device removal for cosmetic reasons was reported in 1 patient in a case series of 60 patients.
- 5.13 Leads breaking was reported in 15% (2/13) of patients in the prospective case series of 13 patients from the systematic review and meta-analysis of 200 patients.

- 5.14 Defective implanted pulse-generator connector was reported in 1 patient in the prospective case series of 13 patients from the systematic review and meta-analysis of 200 patients.
- 5.15 Other complications reported in the systematic review and meta-analysis of 200 patients included postoperative pain and stiffness, sore throat, stitch abscess, local swelling, fever and lack of tongue response to stimulation.
- 5.16 In addition to safety outcomes reported in the literature, specialist advisers are asked about anecdotal adverse events (events which they have heard about) and about theoretical adverse events (events which they think might possibly occur, even if they have never done so). For this procedure, the specialist advisers did not list any anecdotal adverse events. They considered that the following were theoretical adverse events: fatigue of the upper airway dilator muscles leading to worsening sleep apnoea, and hypoglossal nerve damage.

6 Committee comments

- 6.1 There is more than 1 device available for this procedure.
- 6.2 Drug-induced sedated endoscopy was used for patient screening in the studies, but this assessment technique is not commonly used in the UK.
- 6.3 A transcutaneous approach can be used for hypoglossal nerve stimulation but this is not covered by this guidance.
- 6.4 In the studies reviewed, the procedure was used in patients who could not tolerate continuous positive airway pressure.

7 Further information

- 7.1 For related NICE guidance, see the [NICE website](#).
- 7.2 No patient commentary was sought because the procedure is not currently done in the UK. The Sleep Apnoea Trust Association provided

feedback on this procedure.

- 7.3 This guidance requires that clinicians doing the procedure make special arrangements for audit. NICE has identified relevant audit criteria and has developed [NICE's interventional procedure outcomes audit tool](#) (which is for use at local discretion).

Information for patients

NICE has produced [information on this procedure for patients and carers](#). It explains the nature of the procedure and the guidance issued by NICE, and has been written with patient consent in mind.

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Endorsing organisation

This guidance has been endorsed by [Healthcare Improvement Scotland](#).

Accreditation

