

Upper airway stimulation for obstructive sleep apnoea in Asians: A Singapore sleep centre experience

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Dear Editor,

Obstructive sleep apnoea (OSA) is the most prevalent sleep-related breathing disorder, affecting approximately 15% of the global population.¹ In Singapore, 30.5% of the population has moderate-to-severe OSA.² The gold standard treatment, continuous positive airway pressure (CPAP) therapy, often has poor adherence, with only 13.8% of Singaporeans diagnosed with OSA adhering to CPAP therapy after 1 year.³

Upper airway stimulation (UAS), a novel treatment for patients with moderate-to-severe OSA who are intolerant of CPAP therapy, has shown promising results in Europe and America over the last 10 years.⁴⁻⁸ Various studies have shown that UAS, specifically hypoglossal nerve stimulation (HGNS) has high surgical success rates,⁴⁻⁶ compliance rates^{4,5} and patient satisfaction.⁷ HGNS is as effective as CPAP in reducing the apnoea-hypopnoea index (AHI), and may even be more effective in reducing daytime sleepiness.⁸

However, current HGNS registries primarily reflect results from Caucasian patients.⁹ Data from Asian populations are lacking. Asians frequently have distinct craniofacial characteristics (e.g. smaller upper airways and greater neck adiposity), which may affect HGNS efficacy. Therefore, understanding HGNS performance in Asians is essential for delivering equitable care across patient groups.

In Asia, HGNS was first introduced in 2022. Here, we report the clinical characteristics and outcomes of HGNS in Asian patients at a single tertiary Singaporean sleep centre. This study was approved by the SingHealth Centralised Institutional Review Board (IRB 2019–2011). We retrospectively reviewed charts of Asian patients who had undergone UAS

with a unilateral hypoglossal nerve implant (Inspire Medical Systems, Maple Grove, MN, US) and had completed a post-implantation fine-tune sleep study between May 2022 and October 2023.

All patients were diagnosed with OSA based on a preoperative polysomnographic sleep study, conducted as a level 1 in-laboratory attended study (scored according to American Association of Sleep Medicine 2012 guidelines),¹⁰ or a level 3 unattended peripheral arterial tonometry home sleep apnoea test (HSAT; WatchPAT, ZOLL-Iltamar, Caesarea, Israel). Preoperative drug-induced sleep endoscopy (DISE) was routine, and lateral cephalometry done in selected patients.

Patients who met the following criteria were offered UAS: moderate-to-severe OSA (AHI ≥ 15), age ≥ 21 years, body mass index (BMI) < 32 kg/m², intolerant of CPAP therapy, and absence of complete concentric palatal collapse on DISE. Patients underwent unilateral hypoglossal nerve implant via a dual incision approach (neck and chest). The cuff electrode, pressure-sensing lead and implantable pulse generator were placed on the right hypoglossal nerve, the second or third right intercostal space and a right chest subcutaneous pocket, respectively. UAS delivers phasic stimulation to the protruder branches of the hypoglossal nerve, resulting in tongue stiffening via intrinsic transverse/vertical tongue muscle activation and tongue protrusion via genioglossus/hyoglossus activation. This increases retroglossal airway diameter prior to inspiration, thus preventing upper airway collapse in OSA. Patients were observed for 1 night and discharged the next day. The implant was switched on 1 month postoperatively and titration polysomnography (PSG) was performed at 6 months postoperatively.

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Data collected included demographics, BMI, neck circumference, surgical history, Epworth Sleepiness Scale (ESS), Functional Outcomes of Sleep Questionnaire (FOSQ), PSG parameters, cephalometry and complications. Post-implantation AHI was derived from the in-laboratory titration PSG segment with the fewest respiratory events and tolerable stimulation amplitude. Sleep time for this segment averaged 118.3 ± 77.4 minutes (range 39.4–351.1 min).

Pre- and post-implantation AHI, ESS and FOSQ were compared using paired t-tests. Sleep parameters between patients with skeletal class II (patients with retrognathism) and patients with skeletal class I+III (no retrognathism) were compared using the Mann-Whitney U test. A significance level of $P < 0.05$ was considered statistically significant. Analyses were performed using R version 4.0.1 (R Foundation for Statistical Computing, Vienna, Austria).

Fifteen Asian patients were included (Table 1), comprising 13 males (88.7%) and 2 females (13.3%), mostly of Chinese ethnicity (80%). The mean age was 53.7 ± 10.0 years (range 34–67 years). The mean BMI was 25.2 ± 2.5 kg/m² (range 21.7–30.2 kg/m²). The mean neck circumference was 38.7 ± 2.6 cm (range 33.9–42.0 cm). Seven and 8 patients underwent preoperative in-laboratory PSG and HSAT, respectively.

At baseline, the mean AHI was 33.6 ± 13.2 events per hour (range 17.0–60.6 events per hour). There were 7 and 8 patients with moderate and severe OSA, respectively. The mean AHI significantly decreased from 33.6 ± 13.2 events per hour pre-implantation to 7.1 ± 5.6 events per hour post-implantation ($P < 0.001$). All 15 patients (100%)

achieved surgical success, defined as $\geq 50\%$ AHI reduction from baseline and a postoperative AHI of < 20 events per hour.¹¹ However, there were no significant changes in the ESS score (from 7.5 ± 4.5 to 7.5 ± 4.8 ; $P = 0.535$) or the FOSQ score (29.6 ± 6.6 to 27.93 ± 9.0 ; $P = 0.309$) post-implantation.

Implant surgeries were uneventful in 87% of cases (13/15). One patient had transient hypoglossal neuropraxia; another had transient marginal mandibular neuropraxia. set as new paragraph were available for 11 patients, of whom 36.4% ($n = 4$) were classified as skeletal class I, 36.4% ($n = 4$) as skeletal class II and 27.3% ($n = 3$) as skeletal class III. A comparative analysis between patients in class II versus those in class I and III revealed no significant differences in all sleep parameters and outcomes.

This study represents the first report of the outcomes of HGNS in an Asian population. For the same severity of OSA, Caucasian patients are known to have higher BMIs and less skeletal restriction than Asians.¹² Our cohort displayed these characteristic differences, with a lower mean BMI and higher mean AHI compared to Caucasian-predominant registries.⁹ Our hypothesis was that skeletal restriction may limit room for tongue protrusion, which could conceivably limit the effectiveness of HGNS. As our initial case series was small, the sample size was likely insufficiently powered to compare AHI reductions between skeletal classes. One key study limitation was the use of postoperative titration PSGs to derive the post-operative AHI, which may not be fully reflective of the whole night's AHI. With a larger sample size and longer-term PSG and patient-reported outcome

Table 1. Characteristics among study participants ($n = 15$).

Characteristics	Mean $\pm$ SD			P value
	Preoperative	Postoperative	Difference	
Age, years		53.7 ± 10.0		NA
Sex, male, no. (%)		13 (88.7%)		NA
Ethnicity		12 Chinese, 1 Malay, 1 Indian, 1 Burmese		NA
BMI, kg/m ²		25.2 ± 2.5		NA
Neck circumference, cm		38.7 ± 2.6		NA
ESS	7.5 ± 4.5	7.5 ± 4.8	-0.46 ± 2.6	0.535
FOSQ	29.6 ± 6.6	27.93 ± 9.0	1.31 ± 4.4	0.309
AHI	33.6 ± 13.2	7.1 ± 5.6	-27.3 ± 11.2	< 0.001

AHI: apnoea-hypopnoea index; BMI: body mass index; ESS: Epworth Sleepiness Scale; FOSQ: Functional Outcomes of Sleep Questionnaire; NA: not applicable; SD: standard deviation

in future, we aimed to determine if factors such as baseline PSG characteristics, OSA phenotype, and clinical or anatomical differences may impact HGNS success.

In conclusion, our early experience suggests that HGNS is safe and effective in Asian patients with OSA who meet implantation criteria. As HGNS becomes more widely adopted in Asian sleep centres where skeletal restriction is prevalent, future research should focus on whether these anatomical differences warrant adjustments to treatment protocols or eligibility criteria. Addressing these gaps is critical to delivering equitable care and optimising outcomes across ethnicities. We aim to update our analysis with a larger sample size soon.

Ethics statement

Ethics approval was granted by the SingHealth Centralised Institutional Review Board (IRB 2019-2011).

Declaration

The authors declare they have no affiliations or financial involvement with any commercial organisation with a direct financial interest in the subject or materials discussed in the manuscript. This study did not receive any specific funding.

Availability of data

Additional data may reasonably be requested from the corresponding author.

Keywords: *apnoea-hypopnea index, hypoglossal nerve implant, otorhinolaryngology, respiratory medicine, short-term outcomes, sleep apnoea, sleep surgery*

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