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A Physiologically Informed Modification Of Drug-Induced Sleep Endoscopy

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ABSTRACT

Purpose: Drug-induced sleep endoscopy (DISE) commonly uses target-controlled propofol infusion to identify sites of upper airway collapse in obstructive sleep apnoea (OSA). However, propofol produces an anaesthetic state distinct from physiological sleep, risking artefactual findings. We describe a modification designed to better reproduce natural sleep.

Methods: A single propofol bolus permits brief assessment of static anatomy during light anaesthesia, followed by observation of spontaneous re-emergence of sleep physiology as the drug redistributes. Airway assessment is deferred until cyclical respiration, behavioural

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sleep features, or rapid eye movement (REM) activity appear. Supplemental oxygen is given initially and withdrawn once spontaneous ventilation resumes.

Results: Interpretable sleep is achieved in most patients without repeated dosing. Collapse patterns correlate more closely with natural sleep endoscopy than conventional DISE, with reduced apparent tongue-base collapse and preserved visualisation of REM-associated obstruction.

Conclusions: This modification provides an airway assessment closer to natural sleep and may reduce misclassification. Comparative and validation studies are warranted.

Keywords: Endoscopy; Obstructive sleep apnoea; Sleep; Airway Obstruction; Physiology

INTRODUCTION

Drug-induced sleep endoscopy (DISE) is widely used to evaluate dynamic upper airway obstruction in patients with obstructive sleep apnoea (OSA).[1,2,3] Most contemporary protocols employ target-controlled infusion (TCI) of propofol to achieve a stable sedated state intended to approximate sleep. While this approach offers procedural consistency, propofol produces an anaesthetic state that differs substantially from physiological sleep.[4-7]

Under anaesthesia, respiration is typically regular, with no cyclical changes in depth or rate normally seen in obstructive apnoeic events. Muscle tone reduction is noted and particularly affects the upper airway dilator muscles such as the genioglossus.[5,7] This may lead to an over-representation of tongue-base collapse.[8] In addition, rapid eye movement (REM) sleep, spontaneous positional change, and variation in respiratory drive with sleep stage are absent, limiting the physiological validity of findings.[9,10,11]

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To address these limitations, we developed a modified DISE technique designed to allow recovery from anaesthesia into genuine sleep whilst allowing examination of the upper aero-digestive tract. This physiologically informed modification retains the safety benefits of propofol administration while aiming to enable airway assessment under conditions that more closely resemble natural sleep.

TECHNIQUE DESCRIPTION

Patient selection

Patients are managed within a standard OSA pathway in accordance with NICE guidance, including prior trials of continuous positive airway pressure (CPAP) or mandibular advancement devices where appropriate. DISE is undertaken when additional anatomical clarification is required to guide management.

Anaesthetic strategy

Patients receive no sedative premedication. Standard monitoring is applied. High-flow supplemental oxygen is administered until the end-tidal oxygen concentration reaches at least 80%. Denitrogenation of the lungs provides a modest physiological reserve should a prolonged apnoeic event occur following induction.

In obese patients, oxygenation may be initiated in a semi-upright position to optimise lung recruitment and functional residual capacity.

A single bolus of propofol (approximately 2 mg/kg), administered rapidly over approximately five seconds, is given intravenously. The dose is adjusted according to anxiety, body habitus, OSA severity, and comorbidities. No additional sedative or anaesthetic agents are used, including midazolam, topical local anaesthetic, or nasal decongestants.

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Very rarely, glycopyrrolate (0.1–0.2 mg intravenously) is administered to reduce excessive secretions and facilitate visualisation. Where possible, this is avoided, as anticholinergic agents may alter the physiological environment of the upper aerodigestive tract.

During the initial anaesthetic phase, jaw thrust and 15 litres per minute high-flow oxygen is directed towards the patient's airway via the anaesthetic circuit's catheter mount and angle piece to maintain airway patency and provide additional safety.

Initial inspection

The brief anaesthetic phase is used to assess static anatomical features that are not influenced by sleep state, including septal deviation, turbinate hypertrophy, nasal polyps, adenoid tissue, vocal cord anatomy, and static palatine and lingual tonsil size. The flexible nasendoscope is then positioned in the nasopharynx, immediately posterior to the uvula, allowing unobtrusive visualisation of the oropharynx and larynx.

Washout and environmental control

Ambient stimulation is minimised to facilitate sleep onset. Theatre lights are dimmed, noise is reduced, and operating room access is restricted. Non-invasive blood pressure monitoring is temporarily suspended, and anaesthetic equipment alarms are silenced where safe to do so.

The patient is kept warm and comfortable, and the operator remains completely still. Over the ensuing 10–25 minutes, the clinical effect of propofol diminishes as the drug redistributes from the brain to peripheral tissues, particularly adipose tissue, before hepatic metabolism and renal excretion.[12,13]

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Maintaining the tip of the endoscope just posterior to the uvula, while avoiding rotational torque or unnecessary mucosal contact, has been found to be less stimulating and a reliable position for observing natural and drug-induced sleep.[14]

Physiological sleep emergence

Airway assessment begins only once features of physiological sleep are observed, including:

- Cyclical respiratory variation with progressive hypoventilation, obstruction, arousal, and post-arousal hyperventilation, reflecting intact chemoreceptor-driven respiratory control rather than anaesthetic suppression.
- Features consistent with REM sleep, such as ocular movements visible through the eyelids and subsequent dream recall.
- Behavioural indicators of sleep including yawning, spontaneous repositioning, or startle awakening when addressed.

Supplemental oxygen is withdrawn once stable spontaneous ventilation resumes to avoid suppression of respiratory drive. Oxygen desaturation is tolerated but not beyond the patient's documented baseline from prior sleep studies. Profound hypoxia (<85%) is generally not permitted, as it rarely provides additional diagnostic information, increases the likelihood of spontaneous awakening, and raises ethical concerns regarding non-intervention.

Airway assessment

Collapse patterns are evaluated dynamically using the PTLTbE classification.[14] Alternative classification systems, including VOTE, NOHL, and others, are widely used in clinical practice.[2,3,15]

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Patients are permitted to reposition naturally. Positional effects on airway patency are documented, and the endoscope follows spontaneous movement where feasible. All examinations are video recorded for subsequent review and validation.

Recovery

Patients typically awaken promptly when addressed or upon removal of the endoscope, further indicating recovery from sleep rather than anaesthesia.

Observational findings

Over a decade of experience, interpretable sleep states have been achieved in nearly all patients. Repeat bolus administration is required in approximately one in twenty cases, most commonly due to environmental disturbance or spontaneous arousal in patients with a low arousal threshold.

Collapse patterns observed using this technique appear to align more closely with natural sleep endoscopy, defined as flexible endoscopic assessment performed during unmedicated physiological sleep[1], than with conventional TCI-DISE. Notable advantages include:

- Potential for reduced frequency of tongue-base collapse, suggesting mitigation of anaesthetic artefact.
- Visualisation of REM-associated obstruction, which may represent the dominant pathological state in some patients.
- Real-time assessment of positional improvement, supporting personalised therapeutic selection.

Laryngospasm may occur, as with standard DISE, but has not been perceived to be more frequent with a very low incidence rate. Potential contributing factors include

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laryngopharyngeal reflux and delayed gastric emptying, which may be more prevalent in patients receiving GLP-1 receptor agonists. Judicious propofol dosing, initial upright positioning in obese patients, and pre-procedure screening mitigate risk.

DISCUSSION

This physiologically informed modification of DISE seeks to reconcile the need for procedural safety with the importance of assessing airway behaviour under conditions that reflect genuine sleep physiology. Propofol's pharmacokinetic profile allows a brief period of anaesthesia followed by redistribution and recovery within minutes, creating an opportunity to observe the airway as sleep re-emerges.

Physiological rationale

Traditional TCI-DISE offers procedural stability but removes critical temporal dynamics. Respiratory patterns are regular despite increasing hypoxia in some cases, muscle tone is uniformly suppressed, and REM sleep is absent. Propofol does not reliably reproduce REM sleep or dreaming, which are defining features of physiological sleep.[9,10,11]

By contrast, the modified approach aims to reintroduce cyclical sleep depth, variable tone, and spontaneous positional change. Observation of arousal responses and REM-related obstruction may provide greater diagnostic fidelity when evaluating OSA pathophysiology.

During early development of this technique, a small number of informal observational comparisons were performed between natural sleep endoscopy, TCI-DISE, and the modified approach described here. Although these exploratory observations were not conducted as a formal validation study, they suggested greater tongue-base collapse during conventional

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TCI-DISE than during either natural sleep endoscopy or the modified technique. These early observations informed the development of the approach described here.

Clinical implications

Conventional DISE may overemphasise tongue-base collapse[8], potentially leading to unnecessary or incorrectly targeted surgical intervention. Restoring more natural tone conditions may refine patient selection for palatal, tongue-base, or lateral wall procedures and identify individuals more appropriately managed with positional or neuromodulatory therapy.

Limitations

The technique is time-intensive, offers reduced operator control, and requires patience and close anaesthetic collaboration. Objective sleep-stage monitoring (e.g. bispectral index) was not found to be useful. In our experience, BIS values were often inconsistent with observed clinical sleep features, likely reflecting the fact that BIS was developed to monitor anaesthetic depth rather than physiological sleep.[16,17] This is consistent with recent data demonstrating that BIS cannot differentiate REM sleep from N2 or N3 stages, and that bolus propofol produces a sedation plateau at lighter levels than continuous infusion raising the possibility that this plateau represents early physiological sleep re-emergence driven by drug redistribution rather than a sustained anaesthetic state.[18] This limitation further highlights the distinction between anaesthesia and sleep.

Future work

Formal comparison with polysomnographically confirmed sleep states is warranted. A formal comparative study evaluating examination findings across natural sleep endoscopy, TCI-DISE,

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and our modified technique is warranted and represents an important next step in establishing the validity of this approach. Prospective studies correlating DISE findings with treatment outcomes would further clarify the clinical value of this approach.

CONCLUSION

This physiologically informed modification of drug-induced sleep endoscopy aims to enable assessment of the upper airway under conditions that more closely approximate natural sleep, including REM-related events and spontaneous positional change. Although technically demanding, it may improve diagnostic accuracy and treatment selection in OSA. The technique complements existing DISE protocols and emphasises the importance of aligning investigative states with true sleep physiology.

CONFLICT OF INTEREST

None declared.

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ETHICAL APPROVAL

This description reflects established clinical practice and did not require formal ethical review.

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SUMMARY

- Drug-induced sleep endoscopy (DISE) is commonly performed using target-controlled infusion of propofol to reproduce a sleep-like state and identify the anatomical sites of upper airway collapse in obstructive sleep apnoea.
- A recognised limitation of this approach is that propofol sedation produces an anaesthetic state that differs fundamentally from physiological sleep, potentially leading to artefactual findings and misinformed treatment decisions.
- We describe a physiologically informed modification of DISE designed to better reproduce natural sleep dynamics, aiming to provide an airway assessment that more closely reflects natural sleep.
- Further comparative and validation studies are warranted.

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