CASE REPORT

The Anesthetic Management of a Pediatric Patient for Drug-induced Sleep Endoscopy (DISE): A Case Report

Mary Uy, MD-MBA and Evangeline K. Villa, MD

Department of Anesthesiology, Philippine General Hospital, University of the Philippines Manila

ABSTRACT

Drug-induced sleep endoscopy (DISE) is used for directly visualizing sites of obstruction among patients with obstructive sleep apnea (OSA). Owing to the scarcity of data, there is still no consensus on the anesthetic regimen for conducting pediatric DISE.

This paper presents a 5-year-old patient who underwent DISE using an opioid-sparing regimen with dexmedetomidine and propofol infusion.

Simultaneous dexmedetomidine and propofol infusion is a promising opioid-sparing regimen for pediatric DISE.

Keywords: sleep study, endoscopy, propofol, dexmedetomidine, obstructive sleep apnea, case report

INTRODUCTION

Pediatric obstructive sleep apnea (OSA) is a childhood disorder characterized by an upper airway dysfunction causing complete or partial airway obstruction that disrupts normal ventilation during sleep.[1] This condition may present in any age group, but its incidence is most common among patients aged 2 to 8 years old. When left untreated, an overwhelming number of studies have shown several detrimental long-term effects, including, but not limited to, learning and behavioral problems, cardiovascular complications, and impaired growth.[2]

The pathophysiology of pediatric OSA differs from adults.[3] Adult OSA is more frequently associated with obesity and increase in mechanical load to the airway. On the other hand, pediatric airway is more resistant to collapse from such mechanical forces. Anatomic obstruction plays a bigger role in pediatric OSA, with lymphoid hyperplasia as the leading cause.[1] The increased growth of tonsils and adenoids relative to the size of the upper airway causes narrowing of the airway diameter. Its peak incidence is between ages 2 to 8 years, coinciding with that of pediatric OSA. Other common anatomic etiologies for pediatric OSA includes craniofacial abnormalities such as Crouzon, Pierre-Robin, or Apert syndromes that typically present with micrognathia, micro- or macroglossia, and midface hypoplasia – all of which contribute to a decreased posterior oropharynx space.[1]

The gold standard for diagnosing OSA is nocturnal polysomnography (PSG).[3] PSG assesses the severity of OSA but is incapable of identifying the precise anatomic location of upper airway obstructions. Drug-induced sleep endoscopy (DISE), therefore, was devised to quantify the degree and

Poster presentation – Asian Society of Paediatric Anaesthesiologists 2024, July 11-14, 2024, Kuching, Malaysia.

Corresponding author: Mary Uy, MD-MBA
Department of Anesthesiology
Philippine General Hospital
University of the Philippines Manila
Taft Avenue, Ermita, Manila 1000, Philippines
Email: maryuy.17@gmail.com
ORCiD: https://orcid.org/0009-0001-7010-4986

identify the site of upper airway obstruction as an aid in planning possible surgical interventions.[3,4] The usefulness of DISE and the anesthetic management thereof among the adult population has been well-studied. However, the applicability of these data among the pediatric population is still undetermined owing to anatomic and physiologic differences between adults and children.

CASE PRESENTATION

A 5-year-old Filipino male presented with a five-year history of snoring, observed apnea, and daytime somnolence. Worsening of symptoms prompted consultation with an otorhinolaryngologist. The patient was subsequently scheduled for a drug-induced sleep endoscopy (DISE) with bilateral tonsillectomy.

On preoperative evaluation, the patient was noted to have bronchial asthma, controlled. The rest of ancillary history is non-contributory to the case. The patient weighed 18kg (Z-score 0) and stood at 110cm (Z-score 0). He was seen awake, comfortable, and not in cardiorespiratory distress. Vital signs were normal for age. On assessment of the airway, the patient had no gross orofacial deformities, a Mallampati score of 2, grade 3 bilateral tonsils, adequate mouth opening and thyromental distance, and no loose dentition. The rest of the systemic physical examination findings were unremarkable. Pre-operative workup included CBC, bleeding parameters, serum chemistry, 12-lead ECG, chest X-ray, and 2D echo, all of which had unremarkable findings. A polysomnography test done showed severe obstructive sleep apnea.

On the day of surgery, standard ASA monitors were attached to the patient. A loading dose of dexmedetomidine at 1 mcg/kg was first delivered over 10 minutes, followed by a maintenance infusion of dexmedetomidine 0.5-0.7 mcg/kg/hr. Propofol TCI (Kataria) at a target plasma concentration (Cp) of 2-3 mcg/ml was then initiated. The patient was maintained on deep sedation to general anesthesia throughout the procedure. Due to the unavailability of a processed EEG monitor at our institution, the level of sedation was assessed clinically by observing the parameters monitored in the American Society of Anesthesiologist's continuum of sedation namely responsiveness, airway patency, spontaneous ventilation, and cardiovascular function. Supplemental oxygen was administered via nasal cannula and removed prior to endoscopy. DISE was initiated once snoring was audible (Figure 1). A flexible fiberoptic laryngoscope was then introduced into the patient's left nostril and advanced into the nasopharynx, followed by an inspection of the oropharynx, and the supraglottic area. There were no episodes of desaturation or hemodynamic instability throughout the procedure. Apart from the expected findings of obstruction from the tonsils, a partial obstruction at the nasopharyngeal area was also identified. The surgical plan was then modified to include adenoidectomy.

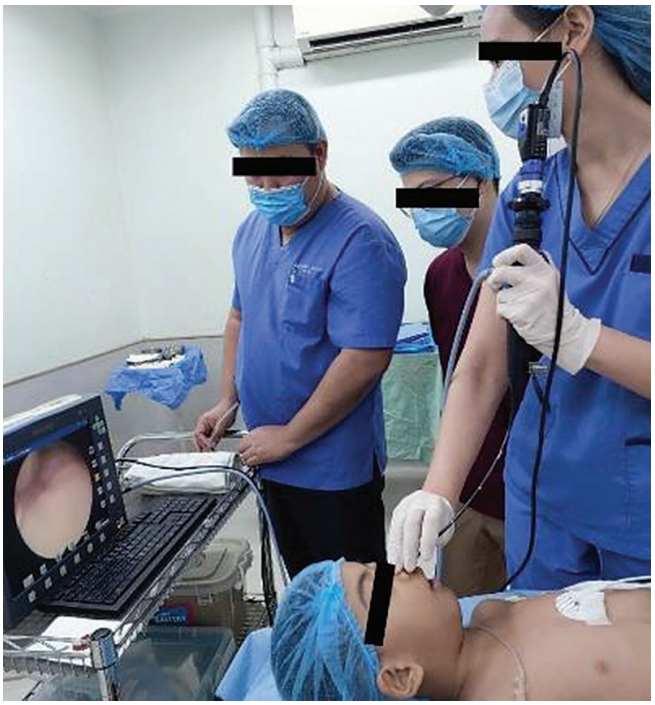

Figure 1. Drug-induced sleep endoscopy (DISE) in a patient with OSA.

After the endoscopy, a bolus dose of fentanyl 1 mcg/kg and atracurium 0.5mg/kg were given. The patient was then intubated using a Macintosh blade size 2 with a cuffed oral RAE endotracheal tube size 5.0. The surgery then commenced. The patient was maintained on dexmedetomidine infusion and propofol TCI (Kataria) for the rest of the procedure. Other medications given intraoperatively included paracetamol, ondansetron, and ketorolac. The total procedural time was two hours. Neuromuscular blockade was reversed with neostigmine and atropine prior to extubation. The patient was transferred to the post-anesthesia care unit fully awake with stable vital signs. At the recovery room, there were no reported episodes of desaturations or post-operative nausea and vomiting. On the first day post-operative day, the mother noted resolution of snoring and apneic episodes. The patient was subsequently discharged two days after. No further follow-up consults were done by the patient.

DISCUSSION

DISE is currently the only available tool used to visualize dynamic airway collapse under conditions that mimic sleep.[3,4] As the patient begins to snore and demonstrate airway collapse post-induction, a nasopharyngoscope is introduced through the nose to visualize all levels of collapse in real-time.[4] Consequently, the main anesthetic goals during DISE are two-fold: first is using a regimen that can quickly and reliably provide a target depth of sedation mimicking natural sleep; and second is ensuring cardiorespiratory stability without the

use of rescue maneuvers (e.g., insertion of nasopharyngeal or oral airway, jaw-thrust and chin-lift maneuvers) or supplemental oxygen.[5] Since upper airway obstruction in the pediatric age group commonly occurs during the rapid eye movement (REM) stage of sleep, ideally, conditions prior to conducting DISE should mimic this state. However, to date, no anesthetic agent has been proven to exactly replicate REM sleep.[5]

A common practice in the field of pediatric anesthesia is the use of inhalational induction to facilitate insertion of intravenous access. However, inhalational agents have been found to exaggerate upper airway collapse and do not replicate natural sleep.[6] Likewise, premedication with benzodiazepines to facilitate induction has questionable effects on the upper airways of pediatric patients. Current data are conflicting ranging from total elimination of REM sleep, to being able to simulate normal sleep, increasing nasal airway resistance, and decreasing cross-sectional area of upper airways to name a few.[7] Most literature, therefore, has recommended avoiding the use of inhalational agents and benzodiazepines for patients undergoing DISE. As the patient was cooperative, an intravenous access was established without any premedication with benzodiazepine or inhalational agent.

Propofol and dexmedetomidine are the most common agents studied for use in DISE. Propofol has a fast onset and time to emergence, making it an appealing choice for the procedure. When compared with dexmedetomidine, a greater degree of obstruction and desaturation were observed among patients given propofol.[8] Conflicting studies argue that the greater degree of desaturation may potentially be more reflective of the upper airway obstruction during REM sleep, while some argue that such findings are indicative of artificial obstruction from over-sedation. On the other hand, dexmedetomidine, despite its slow onset of action, is the preferred pharmacologic agent for most studies due to its overall safer and more stable effects on the cardiopulmonary status while preserving upper airway tone during sleep.[9] MRI sleep studies have found that dexmedetomidine is an ideal agent since it provides sedative effects that parallel natural sleep without significant respiratory depression. Artificial airway placement or positioning aids were also required in a significantly lesser proportion of patients sedated with dexmedetomidine compared to patients sedated with propofol.[10] However, this significant benefit was only demonstrated for patients with severe OSA such as in the case presented.

Few adult studies have cited the use of opioids and ketamine as an adjunct to either propofol or dexmedetomidine. Opioids were found to be effective in ablating cough reflex and reducing time to sedation but are associated with postoperative nausea and vomiting (PONV), respiratory depression, and upper airway obstruction.[11,12] On the other hand, ketamine was promising as an adjunct to either propofol or dexmedetomidine due to its ability to maintain hemodynamic stability and airway reflexes.[5] As the sole agent, disadvantages to the use of ketamine for DISE included long recovery time, increased oral and airway secretions.

In the case presented above, dexmedetomidine and propofol were the agents selected in consideration with the patient's profile and the subsequent procedure after conducting DISE. It is known that patients with OSA have high sensitivity to the respiratory depressant effects of opioids. Selecting an opioid-sparing regimen reduces the chances of inducing artificial obstruction from the anesthetics used. Furthermore, the use of these two anesthetics not only mitigates risk of respiratory depression from opioid use but also reduces the PONV risk for this patient who will subsequently undergo tonsillectomy. Additionally, the simultaneous use of dexmedetomidine with propofol also allows for maintenance of adequate anesthesia while reducing profound adverse effects from each drug such as desaturation, hypotension, and bradycardia compared to when using either agent alone.

Determining adequacy of sedation before initiation of DISE among the pediatric population is still a challenge. Adult studies have used processed EEG monitors like BIS (with target values of 50-70) to standardize the criterion for adequate sedation.[3,10] However, BIS is still not well validated among patients below 12 years old nor does it provide information about the specific sleep stage.[3,5,13] Should BIS be used to monitor the depth of sedation for pediatric patients 4 years and above, the use of a 2-channel adult sensor or a 4-channel pediatric sensor is recommended to ensure adequate contact of the electrodes to the patient's forehead.[13] Alternatively, Narcotrend is another processed EEG monitor that has been validated for use among patients 1 year and older.[13,14] It has incorporated age-related EEG changes in its processing and interpretation algorithm.[15] Studies have found Narcotrend to be just as effective as BIS in accurately determining anesthetic states for neurosurgical procedures and gastrointestinal endoscopy when using propofol infusion.[14] Narcotrend is also capable of displaying the raw EEG signal together with the Narcotrend index. Both of these modalities are unavailable at our institution, hence, were not used. Most studies on pediatric DISE use subjective observations such as lack of patient movement or response to stimuli.[5] These same criteria were applied for the patient presented targeting a state of general anesthesia.

Similarly, even among adult studies, there is also no consensus on the lowest acceptable oxygen saturation before initiating rescue interventions.[5] Preoperative PSG is often used as a guide in most studies.[15] However, it is prudent to keep in mind that in the clinical setting particularly in low-income countries, a preoperative PSG is not always available.

CONCLUSION

Currently, there is no one recommended regimen for sedation in pediatric DISE. The anesthetic regimen during DISE is important to yield accurate and precise clinical

endoscopy findings without compromising patient safety. Simultaneous dexmedetomidine and propofol infusion is a promising opioid-sparing regimen for pediatric DISE. Conducting further studies on monitoring the depth of sedation, as well as setting a threshold for the lowest acceptable oxygen saturation will also be helpful in improving the anesthetic management during DISE.

Declaration of Patient Consent

The authors certified that they have obtained consent for the use of images and clinical information for publication.

Statement of Authorship

Both authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

Both authors declared no conflicts of interest.

Funding Source

None.

REFERENCES

1. Gouthro K, Slowik J. Pediatric obstructive sleep apnea. In: StatPearls. Treasure Island (FL): StatPearls Publishing. 2023 May. PMID: 32491542
2. Schwengel D, Dalesio N, Stierer T. Pediatric obstructive sleep apnea. Anesthesiol Clin. 2014 Mar;32(1):237-261. doi:10.1016/j.anclin.2013.10.012. PMID: 24491659.
3. Oh M, Dedhia R, Current techniques and role of drug-induced sleep endoscopy for obstructive sleep apnea. Curr Sleep Medicine Rep. 2017 Jul; 3, 152–163. doi:10.1007/s40675-017-0082-3.
4. Gillespie M, Reddy R, White D, Discolo CM, Overdyk FJ, Nguyen SA. A trial of drug-induced sleep endoscopy in the surgical management of sleep-disordered breathing. Laryngoscope. 2013 Jan;123(1):277-282. doi:10.1002/lary.23506. PMID: 22952110
5. Liu K, Liu C, Alex G, Szmuk P, Mitchell R. Anesthetic management of children undergoing drug-induced sleep endoscopy: A retrospective review. Int J Pediatr Otorhinolaryngol. 2020 Oct;139:110440. doi:10.1016/j.ijporl.2020.110440. PMID: 33080472
6. Ehsan Z, Mahmoud M, Shott S, Amin R, Ishman S. The effects of anesthesia and opioids on the upper airway: A systematic review. Laryngoscope. 2016 Jan;126(1):270-284. doi:10.1002/lary.25399. PMID: 26198715
7. Genta P, Eckert D, Gregorio M, Danzi N, Moriya H, Malhotra A, et al. Critical closing pressure during midazolam-induced sleep. J Appl Physiol (1985). 2011 Aug;111(5):1315-1322. doi:10.1152/japplphysiol.00508.2011. PMID: 21852408. PMCID: PMC3774482
8. Chang E, Certal V, Song S, Zaghi S, Carrasco-llatas M, Torre C, et al. Dexmedetomidine versus propofol during drug-induced sleep endoscopy and sedation: a systematic review. Sleep Breath. 2017 Jan;21(3):727-735. doi:10.1007/s11325-017-1465-x. PMID: 28130737
9. Carrasco-Llatas M, Matarredona-Quiles S, De Vito A, Chong KB, Vicini C. Drug-induced sleep endoscopy: Technique, indications, tips and pitfalls. Healthcare (Basel). 2019 Jul 24;7(3):93. doi: 10. 3390/healthcare7030093. PMID: 31344900. PMCID: PMC6787696
10. Mahmoud M, Gunter J, Donnelly L, Wang Y, Nick T, Sadhasivam S. A comparison of dexmedetomidine with propofol for magnetic resonance imaging sleep studies in children. Anesth Analg. 2009 Sep;109(3):745-753. doi:10.1213/ane.0b013e3181adc506. PMID: 19690241
11. Sagalow E, Stewart M, Estephan L, Rodin J, Ananth A, Curcio B, et al. Assessing postoperative recovery with volatile gas versus total intravenous anesthesia in patients with and without obstructive sleep apnea. Ann Otol Rhinol Laryngol. 2023 Jun;132(6):667-673. doi:10.1177/00034894221112501. PMID: 35833578
12. Grasso C, Marchesini V, Disma N. Applications and limitations of neuro-monitoring in paediatric anaesthesia and intravenous anaesthesia: A narrative review. J Clin Med. 2021 June;10(12):2639. Published 2021 Jun 15. doi:10.3390/jcm10122639. PMID: 34203942. PMCID: PMC8232784
13. Schmidt G, Bischoff P, Standl T, Lankenau G, Hilbert M, Schulte Am Esch J. Comparative evaluation of Narcotrend, Bispectral Index, and classical electroencephalographic variables during induction, maintenance, and emergence of a propofol/remifentanil anesthesia. Anesth Analg. 2004 May;98(5):1346-53. doi:10.1213/01.ane.0000111209.44119.30. PMID: 15105213.
14. Kreuer S, Wilhelm W. The Narcotrend monitor. Best Pract Res Clin Anaesthesiol. 2006 Mar;20(1):111-119. doi:10.1016/j.bpa.2005.08.010. PMID: 16634418.
15. Adler AC, Musso MF, Mehta DK, Chandrakantan A. Pediatric drug induced sleep endoscopy: A simple sedation recipe. Ann Otol Rhinol Laryngol. 2020 May;129(5):428-433. doi:10.1177/0003489419892292. PMID: 31808353