Drug-Induced Sleep Endoscopy - DISE

Craig Miller and Sanjay R. Parikh

Background

Obstructive sleep apnea (OSA) affects 1 to 4% of children, and has been linked to a number of health-related issues, including behavioral problems, growth failure, cor pulmonale, and other morbidities.[1-3] Children with OSA have been found to have decreased health-related quality of life, making OSA an increasingly more recognized public health concern.[4] Adenotonsillectomy is recommended by the American Academy of Pediatrics as first line surgical treatment for children with OSA,[5] and randomized-controlled trials have found that adenotonsillectomy generally improves symptoms and quality of life of children with OSA.[6]

Unfortunately, studies have shown up to 40% of pediatric patients will have residual OSA after adenotonsillectomy.[7,8] Causes for failure are typically related to other sites of obstruction besides the tonsils and adenoids, including lingual tonsillar hypertrophy and sleep dependent laryngomalacia.[9] Imanguli and Ulualp found that children with Grade I tonsils had a median postoperative AHI of 2.2 after adenotonsillectomy, indicating that the majority of this cohort had residual OSA despite surgery.[10]

Laryngomalacia has long been recognized as a risk factor for OSA in infants.[11] Classically, the dynamic collapse of the supraglottic airway in laryngomalacia manifests during the first few weeks of life with stridor that worsens with agitation, feeding, or supine positioning. Over the last two decades, sleep-dependent laryngomalacia has become a recognized entity and understood as a major contributor to multi-site obstruction seen in severe cases of pediatric sleep apnea. Currently, surgical treatment of sleep dependent laryngomalacia is endoscopic supraglottoplasty. Following this procedure, resolution of OSA has been reported in 58-72% of patients.[9] The success rate for this procedure underscores the significance of identifying the site(s) of obstruction in children with OSA.

MRI studies have found that children with sleep apnea have greater volume of deep cervical lymph nodes.[12] This work encouraged a shift to a new paradigm for understanding pediatric OSA. Specifically, that pediatric OSA may not only be associated with isolated adenotonsillar hypertrophy, but with global lymphoid hypertrophy of the head and neck, and thus may require a wider diagnostic arsenal for identifying specific sites of obstruction in this patient cohort.

This need has led to increased interest in the role of drug-induced sleep endoscopy (DISE) in the evaluation of airway obstruction in children with refractory or severe OSA. DISE typically involves a flexible fiberoptic endoscopic evaluation of the upper airway performed while the child is under general anesthesia while maintaining spontaneous ventilation.[13,14] This examination includes

evaluation of the nasal passages, nasopharynx, oropharynx, soft palate, hypopharynx, supraglottis, glottis, as well as the subglottis and tracheal airway. This assessment provides direct visualization of dynamic airway collapse throughout the upper airway during a sleep-like state.

Anesthetic Considerations

While DISE serves as a quality diagnostic tool, its application and clinical feasibility relies heavily on a strong and cooperative operating room team. A competent and reliable anesthesia team is vital to the success of a DISE exam. Children with OSA are particularly sensitive to the respiratory depressant effects of sedative and hypnotic drugs and are more susceptible to the development of upper airway obstructing during anesthesia and sedation.[15] In patients in whom DISE is indicated, obtaining ideal dynamic airway evaluation is challenging, but beneficial for DISE-directed surgery. Ideally during the exam, the anesthetic regimen will work to maintain the patient physiologically in a sleep-like state with spontaneous ventilation demonstrating patterns of obstruction, including apneas, hypopneas, and oxygen desaturations, that mirror that seen during the patient's natural sleep. A recent retrospective review was conducted to examine the preferred anesthetic for DISE in children.[15] This study compared the anesthetic combination of dexmedetomidine and ketamine with propofol, with or without sevoflurane. This group supports the use of dexmedetomidine and ketamine (DK) as the preferred anesthetic agents due to the significant oxygen desaturations seen in the group that was administered propofol. This is in line with the effects of dexmedetomidine in maintaining spontaneous ventilation, airway patency, and tone, which make it an ideal agent for use during a dynamic airway evaluation. There remains considerable inter- and intra-institutional variation in anesthetic technique for DISE. While a variety of anesthetic agents may be suitable and safe for use during DISE, prospective studies are needed to better understand and standardize DISE anesthesia.

DISE Scoring

In addition to anesthetic technique, surgical technique and indication for DISE are controversial and individual practices vary widely between institutions. A recent multi-institutional study sought to assess the current practice patterns of pediatric DISE at tertiary-care pediatric medical centers with pediatric sleep experts.[16] The survey administered asked respondents about practice patterns regarding indications for DISE, anesthetic preference, and endoscopic protocols, including use of a standardized scoring system, as well as post-DISE management. Results of the multi-institutional survey demonstrated a lack of consensus between experts in the field. There was general agreement regarding the utility of polysomnography prior to DISE, as well as the endoscopic procedure itself, but significant disagreement regarding anesthetic protocol and the utility of DISE-directed surgery immediately following endoscopy. Additionally, there was no consensus on the use of a standardized scoring system for DISE.

We have previously described and validated our own systematic approach to scoring the severity of airway obstruction at five different levels during DISE, termed the 'Chan-Parikh' score.[17] This score relies on a 0-3 scale to assess the

adenoids, the velum, the lateral pharyngeal wall/tonsil region, the tongue base, and the supraglottis. **Figure 1** gives a pictorial example of the scoring system and recommended views for assessment during endoscopic evaluation. Evaluation of this scoring system demonstrated substantial inter-rater and intra-rater reliability for all anatomical sites. Further investigation by our team found that the severity of anatomic obstruction in children with OSA correlates positively with AHI, and thus OSA severity.[18] It appears that this scoring system is useful as a standardized approach to upper airway assessment in pediatric OSA.

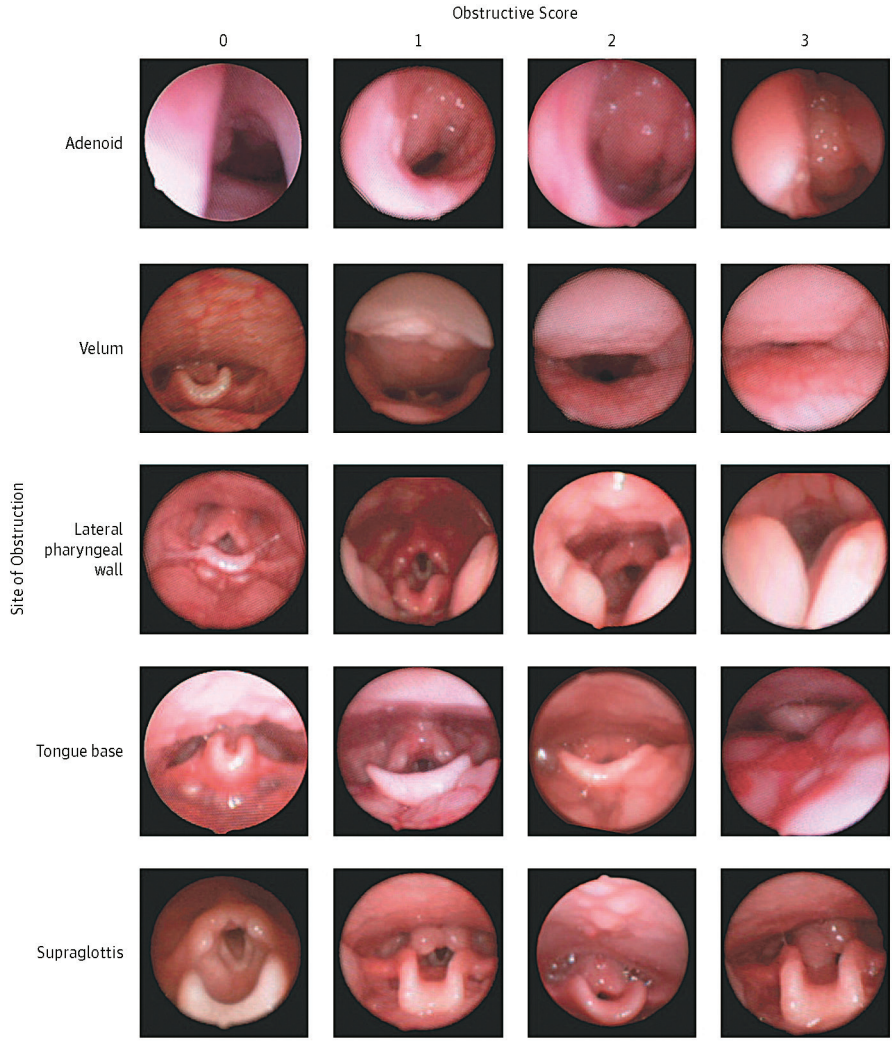

Figure 1. Representative images, suggested viewing regions, and corresponding scores for the Chan-Parikh scoring system.[17]

Recently, there has been a new rating scale developed by Lam *et al*. that assesses six upper airway levels including obstruction at the level of the nasal cavity.[19] This new scale is known as the Sleep Endoscopy Rating Scale (SERS). and evaluates six anatomic sites based on a 0 to 2 scale with 0 representing no obstruction/widely patent and 2 representing complete obstruction. The authors found an association between severity of OSA and multiple levels of obstruction seen on DISE. The authors did not identify a significant association between nasal airway obstruction and OSA severity.

Summary

In summary, drug-induced sleep endoscopy is a safe, well-tolerated procedure that can provide valuable information in patients with severe or refractory OSA following adenotonsillectomy. Although systematic assessment and scoring appears promising, consensus on indications, anesthetic technique, and management of DISE information is lacking and further studies are necessary.

References

1. Lumeng JC, Chervin RD. Epidemiology of pediatric obstructive sleep apnea. Proceedings of the American Thoracic Society 2008; 5:242-252.
2. Greene MG, Carroll JL. Consequences of sleep-disordered breathing in childhood. Current opinion in pulmonary medicine 1997; 3:456-463.
3. Amin R, Somers VK, McConnell Ket al. Activity-adjusted 24-hour ambulatory blood pressure and cardiac remodeling in children with sleep disordered breathing. Hypertension 2008; 51:84-91.
4. Baldassari CM, Mitchell RB, Schubert C, Rudnick EF. Pediatric obstructive sleep apnea and quality of life: a meta-analysis. Otolaryngology--head and neck surgery : official journal of American Academy of Otolaryngology-Head and Neck Surgery 2008; 138:265-273.
5. Chan J, Edman JC, Koltai PJ. Obstructive sleep apnea in children. American family physician 2004; 69:1147-1154.
6. Garetz SL, Mitchell RB, Parker PDet al. Quality of life and obstructive sleep apnea symptoms after pediatric adenotonsillectomy. Pediatrics 2015; 135:e477-486.
7. Ye J, Liu H, Zhang GHet al. Outcome of adenotonsillectomy for obstructive sleep apnea syndrome in children. The Annals of otology, rhinology, and laryngology 2010; 119:506-513.
8. Friedman M, Wilson M, Lin HC, Chang HW. Updated systematic review of tonsillectomy and adenoidectomy for treatment of pediatric obstructive sleep apnea/hypopnea syndrome. Otolaryngology--head and neck surgery : official journal of American Academy of Otolaryngology-Head and Neck Surgery 2009; 140:800-808.
9. Manickam PV, Shott SR, Boss EFet al. Systematic review of site of obstruction identification and non-CPAP treatment options for children with persistent pediatric obstructive sleep apnea. The Laryngoscope 2016; 126:491-500.
10. Imanguli M, Ulualp SO. Risk factors for residual obstructive sleep apnea after adenotonsillectomy in children. The Laryngoscope 2016.
11. Powitzky R, Stoner J, Fisher T, Digoy GP. Changes in sleep apnea after supraglottoplasty in infants with laryngomalacia. International journal of pediatric otorhinolaryngology 2011; 75:1234-1239.
12. Parikh SR, Sadoughi B, Sin S, Willen S, Nandalike K, Arens R. Deep cervical lymph node hypertrophy: a new paradigm in the understanding of pediatric obstructive sleep apnea. The Laryngoscope 2013; 123:2043-2049.

13. Lin AC, Koltai PJ. Sleep endoscopy in the evaluation of pediatric obstructive sleep apnea. International journal of pediatrics 2012; 2012:576719.
14. Truong MT, Woo VG, Koltai PJ. Sleep endoscopy as a diagnostic tool in pediatric obstructive sleep apnea. International journal of pediatric otorhinolaryngology 2012; 76:722-727.
15. Kandil A, Subramanyam R, Hossain MMet al. Comparison of the combination of dexmedetomidine and ketamine to propofol or propofol/sevoflurane for drug-induced sleep endoscopy in children. Paediatric anaesthesia 2016; 26:742-751.
16. Friedman NR, Parikh SR, Ishman SLet al. The current state of pediatric drug-induced sleep endoscopy. The Laryngoscope 2016.
17. Chan DK, Liming BJ, Horn DL, Parikh SR. A new scoring system for upper airway pediatric sleep endoscopy. JAMA otolaryngology-- head & neck surgery 2014; 140:595-602.
18. Dahl JP, Miller C, Purcell PLet al. Airway Obstruction during Drug-Induced Sleep Endoscopy Correlates with Apnea-Hypopnea Index and Oxygen Nadir in Children. Otolaryngology--head and neck surgery : official journal of American Academy of Otolaryngology-Head and Neck Surgery 2016; 155:676-680.
19. Lam DJ, Weaver EM, Macarthur CJet al. Assessment of pediatric obstructive sleep apnea using a drug-induced sleep endoscopy rating scale. The Laryngoscope 2016; 126:1492-1498.