

# Practice Guidelines for the Perioperative Management of Patients with Obstructive Sleep Apnea: An Updated Report

*American Society of Anesthesiologists*

## Bibliography by Section

### *I. Preoperative Evaluation*

**Medical records review (including patient characteristics likely found in medical records).**

#### *Obesity:*

##### *Nonrandomized comparative studies: OSA versus non-OSA patients*

1. Ahmad S, Nagle A, McCarthy RJ, Fitzgerald PC, Sullivan JT, Prystowsky J: Postoperative hypoxemia in morbidly obese patients with and without obstructive sleep apnea undergoing laparoscopic bariatric surgery. *Anesth Analg* 2008; 107:138-143
2. Carrera M, Barbe F, Sauleda J, Tomas M, Gomez C, Agusti AG: Patients with obstructive sleep apnea exhibit genioglossus dysfunction that is normalized after treatment with continuous positive airway pressure. *Am J Respir Crit Care Med* 1999; 159:1960-1966
3. Gentil B, de Larminat JM, Boucherez C, Lienhart A: Difficult intubation and obstructive sleep apnoea syndrome. *Br J Anaesth* 1994; 72:368
4. Horner RL, Mohiaddin RH, Lowell DG, Shea SA, Burman ED, Longmore DB, Guz A: Sites and sizes of fat deposits around the pharynx in obese patients with obstructive sleep apnoea and weight matched controls. *Eur Respir J* 1989; 2:613-622
5. Koziej M, Cieslicki JK, Gorzelak K, Sliwinski P, Zielinski J: Hand-scoring of MESAM 4 recordings is more accurate than automatic analysis in screening for obstructive sleep apnoes. *Eur Respir J* 1994; 7:1771-1775
6. Kaw R, Pasupuleti V, Walker E, Ramaswamy A, Foldvary-Schafer N: Postoperative complications in patients with obstructive sleep apnea. *Chest* 2012; 141:436-441
7. Kushida CA, Efron B, Guilleminault C: A predictive morphometric model for the obstructive sleep apnea syndrome. *Ann Int Med* 1997; 127:581-587
8. Lavie P, Herrer P, Hoffstein V: Obstructive sleep apnea syndrome as a risk factor for hypertension: population study. *BMJ* 2000; 320:479-482
9. Liao P, Yegneswaran B, Vairavanathan S, Zilberman P, Chung F: Postoperative complications in patients with obstructive sleep apnea: a retrospective matched cohort study. *Can J Anaesth* 2009; 56:819-828
10. Pradhan PS, Gliklich RE, Winkelman J: Screening for obstructive sleep apnea in patients presenting for snoring surgery. *Laryngoscope* 1997; 106:1393-1397 Erratum in: *Laryngoscope* 1997; 107:149
11. Rivlin J, Hoffstein V, Kalbfleish J, McNicholas W, Zamel N, Bryan AC: Upper airway morphology in patients with idiopathic obstructive sleep apnea. *Am Rev Respir Dis* 1984; 129:355-360
12. Schwab RJ, Gupta KB, Geftter WB, Metzger LJ, Hoffman EA, Pack AI: Upper airway and soft tissue anatomy in normal subjects and patients with sleep-disordered breathing. Significance of the lateral pharyngeal walls. *Am J Respir Crit Care Med* 1995; 152:1673-1689

13. Stepanski E, Zayyad A, Nigro C, Lopata M, Basner R: Sleep-disordered breathing in a predominantly African-American pediatric population. *J Sleep Res* 1999; 8:65-70
14. Unal M, Ozturk L, Kanik A: The role of oxygen saturation measurement and body mass index in distinguishing between non-apnoeic snorers and patients with obstructive sleep apnoea syndrome. *Clin Otolaryngol* 2002; 27:344-346
15. Viner S, Szalai JP, Hoffstein V: Are history and physical examination a good screening test for sleep apnea? *Ann Intern Med* 1991; 115:356-359

*Nonrandomized comparative studies: obese versus non-obese patients*

16. Berend KR, Ajluni AF, Núñez-García LA, Lombardi AV, Adams JB: Prevalence and management of obstructive sleep apnea in patients undergoing total joint arthroplasty. *J Arthroplasty* 2010; 25:54-57
17. Coté CJ, Posner KL, Domino KB: Death or neurologic injury after tonsillectomy in children with a focus on Obstructive Sleep Apnea: Houston, We Have a Problem! *Anesth Analg* 2013; Jul 10. [Epub ahead of print]
18. Ezri T, Medalion B, Weisenberg M, Szmuk P, Warters RD, Charuzi I: Increased body mass index per se is not a predictor of difficult laryngoscopy. *Can J Anaesth* 2003; 50:179-183
19. Paoli JR, Lauwers F, Lacassagne L, Tiberge M, Dodart L, Boutault F: Craniofacial differences according to the body mass index of patients with obstructive sleep apnoea syndrome: cephalometric study in 85 patients. *Br J Oral Maxillofac Surg* 2001; 39:40-45
20. Tangugsorn V, Krogstad O, Espeland L, Lyberg T: Obstructive sleep apnoea: multiple comparisons of cephalometric variables of obese and non-obese patients. *J Craniomaxillofac Surg* 2000; 28:204-212
21. Vgontzas AN, Tan TL, Bixler EO, Martin LF, Shubert C, Kales A: Sleep apnea and sleep disruption in obese patients. *Arch Intern Med* 1994; 154:1705-1711
22. Voyagis G, Kyriakis K, Dimitriou V, Vrettou I: Value of oropharyngeal Mallampati classification in predicting difficult laryngoscopy among obese patients. *Eur J Anaesth* 1998; 15:330-334
23. Yu X, Fujimoto K, Urushibata K, Matsuzawa Y, Kubo K: Cephalometric analysis in obese and nonobese patients with obstructive sleep apnea syndrome. *Chest* 2003; 124:212-218

*Observational studies, case reports, or non-pertinent comparison groups*

1. Davies RJO, Ali NJ, Stradling JR: Neck circumference and other clinical features in the diagnosis of the obstructive sleep apnoea syndrome. *Thorax* 1992; 47:101-105
2. Deegan PC, McNicolas WT: Predictive value of clinical features for the obstructive sleep apnoea syndrome. *Eur Respir J* 1996; 9:117-124
3. Dempsey JA, Skatrud JB, Jacques AJ, Ewanowski SJ, Woodson BT, Hanson PR, Goodman B: Anatomic determinants of sleep-disordered breathing across the spectrum of clinical and nonclinical male subjects. *Chest* 2002; 122:840-851
4. Dixon JB, Schachter LM, O'Brien PE: Predicting sleep apnea and excessive day sleepiness in the severely obese: indicators for polysomnography. *Chest* 2003; 123:1134-1141
5. Dominguez-Cherit G, Gonzalez R, Borunda D, Pedroza J, Gonzalez-Barranco J, Herrera MF: Anesthesia for morbidly obese patients. *World J Surg* 1998; 22:969-973
6. Fogel RB, Malhotra A, Dalagiorgou G, Robinson MK, Jakab M, Kikinis R, Pittman SD, White DP: Anatomic and physiologic predictors of apnea severity in morbidly obese subjects. *Sleep* 2003; 26:150-155

7. Frey WC, Pilcher J: Obstructive sleep-related breathing disorders in patients evaluated for bariatric surgery. *Obes Surg* 2003; 13:676-683
8. Friedman M, Tanyeri H, La Rosa M, Landsberg R, Vaidyanathan K, Pieri S, Caldarelli D: Clinical predictors of obstructive sleep apnea. *Laryngoscope* 1999; 109:1901-1907
9. Grunstein R, Wilcox I, Yang TS, Gould Y, Hedner J: Snoring and sleep apnoea in men: association with central obesity and hypertension. *Int J Obes Relat Metab Disord* 1993; 17:533-540
10. Hierl T, Humpfner-Hierl H, Frerich B, Heisgen U, Bosse-Henck A, Hemprich A: Obstructive sleep apnea syndrome: results and conclusions of a principal component analysis. *J Craniomaxillofac Surg* 1997; 25:181-185
11. Hoffstein V, Mateika S: Differences in abdominal and neck circumferences in patients with and without sleep apnoea. *Eur Resp J* 1992; 5:377-381
12. Katz I, Stradling J, Slutsky AS, Zamel N, Hoffstein V: Do patients with obstructive sleep apnea have thick necks? *Am Rev Respir Dis* 1990; 141:1228-1231
13. Kurrek MM, Cobourn C, Wojtasik Z, Kiss A, Dain SL: Morbidity in patients with or at high risk for obstructive sleep apnea after ambulatory laparoscopic gastric banding. *Obes Surg* 2011; 21:1494-1498
14. Laaban JP, Cassuto D, Orvoen-Frija E, Iliou M-C, Mundler O, Leger D, Oppert J-M: Cardiorespiratory consequences of sleep apnea syndrome in patients with massive obesity. *Eur Respir J* 1998; 11:20-27
15. Lopez PP, Stefan B, Schulman CI, Byers PM: Prevalence of sleep apnea in morbidly obese patients who present for weight loss surgery evaluation: more evidence for routine screening for obstructive sleep apnea before weight loss surgery. *Am Surg* 2008; 74:834-838
16. Lorch DG, Sahn SA: Post-extubation pulmonary edema following anesthesia induced by upper airway obstruction. Are certain patients at increased risk? *Chest* 1986; 90:802-805
17. Marcus CL, Ward SLD, Mallory GB, Rosen CL, Beckerman RC, Weese-Mayer DE, Brouillette RT, Trant HT. Use of nasal continuous positive airway pressure as treatment of childhood obstructive sleep apnea. *J Pediatr* 1995; 127:88-94
18. Rajala R, Partinent M, Sane T, Palkonen R, Huikuri K, Seppalainen AM: Obstructive sleep apnoea syndrome in morbidly obese patients. *J Intern Med* 1991; 230:125-129
19. Ramachandran SK, Kheterpal S, Consens F, Shanks A, Doherty TM, Morris M, Tremper KK: Derivation and validation of a simple perioperative sleep apnea prediction score. *Anesth Analg* 2010; 110:1007-1015
20. Randazzo DN, Winters SL, Schweitzer P: Obstructive sleep apnea-induced supraventricular tachycardia. *J Electrocardiol* 1996; 29:65-67
21. Redline S, Tishler PV, Schluchter M, Aylor J, Clark K, Graham G: Risk factors for sleep-disordered breathing in children. Associations with obesity, race, and respiratory problems. *Am J Respir Crit Care Med* 1999; 159:1527-1532
22. Resta O, Foschino-Barbaro MP, Legari G, Talamo S, Bonfitto P, Palumbo A, Minenna A, Giorgino R, De Pergola G: Sleep-related breathing disorders, loud snoring and excessive daytime sleepiness in obese subjects. *Int J Obes Relat Metab Disord* 2001; 25:669-675
23. Schafer H, Pauleit D, Sudhop T, Gouni-Berthold I, Ewig S, Berthold HK: Body fat distribution, serum leptin, and cardiovascular risk factors in men with obstructive sleep apnea. *Chest* 2002; 122:829-839
24. Spector A, Scheid S, Hassink S, Deutsch ES, Reilly JS, Cook SP: Adenotonsillectomy in the morbidly obese child. *Int J Pediatr Otorhinolaryngol* 2003; 67:359-364

25. Spurr K, Morrison DL, Graven MA, Webber A, Gilbert RW: Analysis of hospital discharge data to characterize obstructive sleep apnea and its management in adult patients hospitalized in Canada: 2006 to 2007. *Can Respir J* 2010; 17:213-218
26. Sugerma HJ, Baron PL, Fairman RP, Evans CR, Vetrovec GW: Hemodynamic dysfunction in obesity hypoventilation syndrome and the effects of treatment with surgically induced weight loss. *Ann Surg* 1988; 207:604-613
27. Tami TA, Duncan HJ, Pflieger M: Identification of obstructive sleep apnea in patients who snore. *Laryngoscope* 1998; 108:508-513
28. van Kralingen KW, de Kanter W, de Groot GH, Venmans BJ, van Boxem T, van Keimpema AR, Postmus PE: Assessment of sleep complaints and sleep-disordered breathing in a consecutive series of obese patients. *Respiration* 1999; 66:312-316
29. Wehner RJ, Pierson DJ: The Pickwickian syndrome: a special challenge for the anesthetist. *AANA J* 1977; 45:57-61
30. Woodson BT, Naganuma H: Comparison of methods of airway evaluation in obstructive sleep apnea syndrome. *Otolaryngol Head Neck Surg* 1999; 120:460-463
31. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S: The occurrence of sleep-disordered breathing among middle-aged adults. *N Engl J Med* 1993; 328:1230-1235
32. Zonato AI, Bittencourt LR, Martinho FL, Junior JF, Gregorio LC, Tufik S: Association of systematic head and neck physical examination with severity of obstructive sleep apnea-hypopnea syndrome. *Laryngoscope* 2003; 113:973-980

***Patient history of cardiac arrhythmia, hypertension or stroke:***

*Nonrandomized comparative studies: OSA versus non-OSA patients*

1. Alchanatis M, Tourkohoriti G, Kakouros S, Kosmas E, Podaras S, Jordanoglou JB: Daytime pulmonary hypertension in patients with obstructive sleep apnea: the effect of continuous positive airway pressure on pulmonary hemodynamics. *Respiration* 2001; 68:566-572
2. Davies CW, Crosby JH, Mullins RL, Barbour C, Davies RJ, Stradling JR: Case-control study of 24 hour ambulatory blood pressure in patients with obstructive sleep apnoea and normal matched control subjects. *Thorax* 2000; 55:736-740
3. Davies RJ, Vardi-Visy K, Clarke M, Stradling JR: Identification of sleep disruption and sleep disordered breathing from the systolic blood pressure profile. *Thorax* 1993; 48:1242-1247
4. Grunstein R, Stenlof K, Hedner J, Sjostrom L: Impact of obstructive sleep apnea and sleepiness on metabolic and cardiovascular risk factors in the Swedish Obese Subjects (SOS) Study. *Int J Obes Relat Metab Disord* 1995; 19:410-418
5. Gupta RM, Parvizi J, Hanssen AD, Gay PC: Postoperative complications in patients with obstructive sleep apnea syndrome undergoing hip or knee replacement: a case-control study. *Mayo Clin Proc* 2001; 76:897-905
6. Hla KM, Young TB, Bidwell T, Palta M, Skatrud JB, Dempsey J: Sleep apnea and hypertension. A population-based study. *Ann Intern Med* 1994; 120:382-388
7. Hoffstein V, Mateika S: Cardiac arrhythmias, snoring, and sleep apnea. *Chest* 1994; 106:466-471
8. Kaw R, Pasupuleti V, Walker E, Ramaswamy A, Foldvary-Schafer N: Postoperative complications in patients with obstructive sleep apnea. *Chest* 2012; 141:436-441
9. Koehler U, Schafer H: Is obstructive sleep apnea a risk factor for myocardial infarction and cardiac arrhythmias in patients with coronary heart disease? *Sleep* 1996; 19:283-286

10. Lavie P, Herrer P, Hoffstein V: Obstructive sleep apnea syndrome as a risk factor for hypertension: population study. *BMJ* 2000; 320:479-482
11. Sanner BM, Tepel M, Markmann A, Zidek W: Effect of continuous positive airway pressure therapy on 24-hour blood pressure in patients with obstructive sleep apnea syndrome. *Am J Hypertens* 2002; 15:251-257
12. Shahar E, Whitney CW, Redline S, Lee ET, Newman AB, Nieto FJ, O'Connor GT, Boland LL, Schwartz JE, Samet JM: Sleep-disordered breathing and cardiovascular disease: cross-sectional results of the Sleep Heart Health Study. *Am J Respir Crit Care Med* 2001; 163:19-25
13. Sorajja D, Gami AS, Somers VK, Behrenbeck TR, Garcia-Touchard A, Lopez-Jimenez F: Independent association between obstructive sleep apnea and subclinical coronary artery disease. *Chest* 2008; 133:927-933

*Nonrandomized comparative studies: patient history of cardiac arrhythmia, hypertension or stroke versus no history of cardiac arrhythmia, hypertension or stroke*

14. Dyken ME, Somers VK, Yamada T, Ren ZY, Zimmerman MB: Investigating the relationship between stroke and obstructive sleep apnea. *Stroke* 1996; 27:401-407
15. Fletcher EC, De Behnke RD, Lovoi MS, Gorin AB: Undiagnosed sleep apnea in patients with essential hypertension. *Ann Intern Med* 1985; 103:190-195
16. Hung J, Whitford EG, Parsons RW, Hillman DR: Association of sleep apnoea with myocardial infarction in men. *Lancet* 1990; 336:261-264
17. Katsumata K, Okada T, Miyao M, Katsumata Y: High incidence of sleep apnea syndrome in a male diabetic population. *Diabetes Res Clin Pract* 1991; 13:45-51
18. Sanner BM, Doberauer C, Konermann M, Sturn A, Zidek W: Pulmonary hypertension in patients with obstructive sleep apnea syndrome. *Arch Intern Med* 1997; 157:2483-2487

*Observational studies, case reports, or non-pertinent comparison groups*

1. Bartall HZ, Tye KH, Roper P, Desser KB, Benchimol A: Atrial flutter associated with obstructive sleep apnea syndrome: a case report. *Arch Intern Med* 1980; 140:121-122
2. Becker HF, Koehler U, Stammnitz A, Peter JH: Heart block in patients with sleep apnoea. *Thorax* 1998; 53:S29-S32
3. Gonçalves SC, Martinez D, Gus M, de Abreu-Silva EO, Bertoluci C, Dutra I, Branchi T, Moreira LB, Fuchs SC, de Oliveira AC, Fuchs FD: Obstructive sleep apnea and resistant hypertension: A case controlled study. *Chest* 2007; 132:1858-1862
4. Guilleminault C, Connolly S, Winkle R: Cardiac arrhythmia and conduction disturbances during sleep in 400 patients with sleep apnea syndrome. *Am J Cardiol* 1983; 52:490-494
5. Harbison J, O'Reilly P, McNicholas WT: Cardiac rhythm disturbances in the obstructive sleep apnea syndrome: effects of nasal continuous positive airway pressure therapy. *Chest* 2000; 118:591-595
6. James AL, Runciman M, Burton MJ, Freeland AP: Investigation of cardiac function in children with suspected obstructive sleep apnea. *J Otolaryngol* 2003; 32:151-154
7. Kraiczki H, Peker Y, Caidahl K, Samuelsson A, Hedner J: Blood pressure, cardiac structure and severity of obstructive sleep apnea in a sleep clinic population. *J Hypertens* 2001; 19:2071-2078
8. Krieger J, Sforza E, Apprill M, Lampert E, Weitzenblum E, Ratomaharo J: Pulmonary hypertension, hypoxemia and hypercapnea in obstructive sleep apnea patients. *Chest* 1989; 96:729-737

9. Laks L, Lehrhaft B, Grunstein RR, Sullivan CE: Pulmonary hypertension in obstructive sleep apnoea. *Eur Respir J* 1995; 8:537-541
10. Liston R, Deegan P, McCreery C, McNicholas WT: Role of respiratory sleep disorders in the pathogenesis of nocturnal angina and arrhythmias. *Postgrad Med J* 1994; 70:275-280
11. Logan AG, Perlikowski SM, Mente A, Tisler A, Niroumand M, Leung RS, Bradley TD: High prevalence of unrecognized sleep apnea in drug-resistant hypertension. *J Hypertens* 2001; 19:2271-2277
12. Miller WP: Cardiac arrhythmias and conduction disturbances in the sleep apnea syndrome: prevalence and significance. *Am J Med* 1982; 73:317-321
13. Nieminen P, Tolonen U, Lopponen H: Snoring and obstructive sleep apnea in children: a 6-month follow-up study. *Arch Otolaryngol Head Neck Surg* 2000; 126:481-486
14. Nieto FJ, Young TB, Lind SK, Shahar E, Samet JM, Redline S, D'Agostino RB, Newman AB, Lebowitz M, Pickering TG: Association of sleep-disordered breathing, sleep apnea, and hypertension in a large community-based study. Sleep Heart Health Study. *JAMA* 2000; 283:1829-1836
15. Peiser J, Ovnat A, Uwyed K, Lavie P, Charuzi I: Cardiac arrhythmias during sleep in morbidly obese sleep-apneic patients before and after gastric bypass surgery. *Clin Cardiol* 1985; 8:519-521
16. Peppard PE, Young TB, Palta M, Skatrud J: Prospective study of the association between sleep-disordered breathing and hypertension. *N Engl J Med* 2000; 342:1378-1384
17. Rama PR, Sharma SC: Sleep apnea and complete heart block. *Clin Cardiol* 1994; 17:675-677
18. Ramachandran SK, Kheterpal S, Consens F, Shanks A, Doherty TM, Morris M, Tremper KK: Derivation and validation of a simple perioperative sleep apnea prediction score. *Anesth Analg* 2010; 110:1007-1015
19. Sajkov D, Cowie RJ, Thornton AT, Espinoza HA, McEvoy RD: Pulmonary hypertension in hypoxemia in obstructive sleep apnea syndrome. *Am J Respir Crit Care Med* 1994; 149:416-422
20. Spurr K, Morrison DL, Graven MA, Webber A, Gilbert RW: Analysis of hospital discharge data to characterize obstructive sleep apnea and its management in adult patients hospitalized in Canada: 2006 to 2007. *Can Respir J* 2010; 17:213-218
21. Young T, Peppard P, Palta M, Hla KM, Finn L, Morgan B, Skatrud J: Population-based study of sleep-disordered breathing as a risk factor for hypertension. *Arch Intern Med* 1997; 157:1746-1752

***Other patient conditions:***

*Nonrandomized comparative studies:*

1. Fogel RB, Malhotra A, Pillar G, Pittman SD, Dunaif A, White DP: Increased prevalence of obstructive sleep apnea syndrome in obese women with polycystic ovary syndrome. *J Clin Endocrinology Metabolism* 2001; 86:1175-1180
2. Gentil B, Lienhart A, Fleury B: Enhancement of postoperative desaturation in heavy snorers. *Anesth Analg* 1995; 81:389-392
3. Katsumata K, Okada T, Miyao M, Katsumata Y: High incidence of sleep apnea syndrome in a male diabetic population. *Diabetes Res Clin Pract* 1991; 13:45-51
4. Kramer MF, de la Chaux R, Fintelmann R, Rasp G: NARES: a risk factor for obstructive sleep apnea? *Am J Otolaryngol* 2004; 25:173-177

5. Vgontzas AN, Legro RS, Bixler EO, Grayev A, Kales A, Chrousos GP: Polycystic ovary syndrome is associated with obstructive sleep apnea and daytime sleepiness: role of insulin resistance. *J Clin Endocrinology Metabolism* 2001; 86:517-520

*Observational studies, case reports, or non-pertinent comparison groups*

1. Chung F, Yegneswaran B, Herrera F, Shenderey A, Shapiro CM: Patients with difficult intubation may need referral to sleep clinics. *Anesth Analg* 2008; 107:915-920
2. Dhonneur G, Combes X, Leroux B, Duvaldestin P: Postoperative obstructive apnea. *Anesth Analg* 1999; 89:762-767
3. Dyken ME, Lin-Dyken DC, Poulton S, Zimmerman MB, Sedars E: Prospective polysomnographic analysis of obstructive sleep apnea in down syndrome. *Arch Pediatr Adolesc Med* 2003; 157:655-560
4. Hattori H, Hattori C, Yonekura A, Nishimura T: Two cases of sleep apnea syndrome caused by primary hypothyroidism. *Acta Otolaryngol Suppl* 2003; 550:59-64
5. Levine OR, Simpser M. Alveolar hypoventilation and cor pulmonale associated with chronic airway obstruction in infants with Down syndrome. *Clin Pediatr* 1982; 21:25-29
6. Marcus CL, Ward SLD, Mallory GB, Rosen CL, Beckerman RC, Weese-Mayer DE, Brouillette RT, Trant HT. Use of nasal continuous positive airway pressure as treatment of childhood obstructive sleep apnea. *J Pediatr* 1995; 127:88-94
7. Marcus CL, Keens TG, Bautista DB, von Pechmann WS, Ward Davidson SL: Obstructive sleep apnea in children with Down syndrome. *Pediatrics* 1991; 88:132-139
8. Nakazawa K, Ikeda D, Ishikawa S, Makita K: A case of difficult airway due to lingual tonsillar hypertrophy in a patient with Down's syndrome. *Anesth Analg* 2003; 97:704-705
9. Piper JG, Dirks BA, Traynelis VC, VanGilder JC: Perioperative management and surgical outcome of the acromegalic patient with sleep apnea. *Neurosurgery* 1995; 36:70-74
10. Price SD, Hawkins DB, Kahlstrom EJ: Tonsil and adenoid surgery for airway obstruction: perioperative respiratory morbidity. *Ear Nose Throat J* 1993; 72:526-531
11. Sie KC, Perkins JA, Clarke WR: Acute right heart failure due to adenotonsillar hypertrophy. *Int J Pediatr Otorhinolaryngol* 1997; 41:53-58
12. Spurr K, Morrison DL, Graven MA, Webber A, Gilbert RW: Analysis of hospital discharge data to characterize obstructive sleep apnea and its management in adult patients hospitalized in Canada: 2006 to 2007. *Can Respir J* 2010; 17:213-218
13. Wilson K, Lakheeram I, Morielli A, Brouillette R, Brown K: Can assessment for obstructive sleep apnea help predict postadenotonsillectomy respiratory complications? *Anesthesiology* 2002; 96:313-322

***Cephalometric measurement:***

*Nonrandomized comparative studies:*

1. Andersson L, Brattstrom V: Cephalometric analysis of permanently snoring patients with and without obstructive sleep apnoea syndrome. *Int J Oral Maxillofac Surg* 1991; 20:159-162
2. Arens R, McDonough JM, Corbin AM, Rubin NK, Carroll ME, Pack AI, Liu J, Udupa JK: Upper airway size analysis by magnetic resonance imaging of children with obstructive sleep apnea syndrome. *Am J Respir Crit Care Med* 2003; 167:65-70

3. Arens R, McDonough JM, Costarino AT, Mahboubi S, Tayag-Kier CE, Maislin G, Schwab RJ, Pack AI: Magnetic resonance imaging of the upper airway structure of children with obstructive sleep apnea syndrome. *Am J Respir Crit Care Med* 2001; 164:698-703
4. Bacon WH, Krieger J, Turlot JC, Stierle JL: Craniofacial characteristics in patients with obstructive sleep apneas syndrome. *Cleft Pal J* 1988; 25:374-378
5. Bacon WH, Turlot JC, Krieger J, Stierle J-L: Cephalometric evaluation of pharyngeal obstructive factors in patients with sleep apnoeas syndrome. *Angle Orthod* 1990; 60:115-122
6. Baik UB, Suzuki M, Ikeda K, Sugawara J, Mitani H: Relationship between cephalometric characteristics and obstructive sites in obstructive sleep apnea syndrome. *Angle Orthod* 2002; 72:124-134
7. Battagel JM, L'Estrange PR: The cephalometric morphology of patients with obstructive sleep apnoea (OSA). *Eur J Orthod* 1996; 18:557-569
8. Biddle C: Comparative aspects of the airway during general anesthesia in obese sufferers of sleep apnea and matched normals. *Adv Pract Nurs Q* 1996; 2:14-19
9. Biddle C: Orocephalometry and airway control in obese sleep-disordered breathers, obese normals, and matched controls undergoing general anesthesia. *CRNA* 1994; 5:97-103
10. DeBerry-Borowiecki BD, Kukwa K, Blanks RHI: Cephalometric analysis for diagnosis and treatment of obstructive sleep apnea. *Laryngoscope* 1988; 98:226-234
11. Guilleminault C, Li K, Chen NH, Poyares D: Two-point palatal discrimination in patients with upper airway resistance syndrome, obstructive sleep apnea syndrome, and normal control subjects. *Chest* 2002; 122:866-870
12. Hochban W, Brandenburg U: Morphology of the viscerocranium in obstructive sleep apnoea syndrome - cephalometric evaluation of 400 patients. *J Craniomaxillofac Surg* 1994; 22:205-213
13. Jamieson A, Guilleminault C, Partinin M, Quera-Salva MA: Obstructive sleep apneic patients have craniomandibular abnormalities. *Sleep* 1986; 9:469-477
14. Kushida CA, Efron B, Guilleminault C: A predictive morphometric model for the obstructive sleep apnea syndrome. *Ann Int Med* 1997; 127:581-587
15. Lyberg T, Krogstad O, Djupesland G: Cephalometric analysis in patients with obstructive sleep apnoea syndrome: I. Skeletal morphology. *J Laryngol Otol* 1989; 103:287-292
16. Lyberg T, Krogstad O, Djupesland G: Cephalometric analysis in patients with obstructive sleep apnoea syndrome: II. Soft tissue morphology. *J Laryngol Otol* 1989; 103:293-297
17. Mayer P, Pepin JL, Bettega G, Veale D, Ferretti G, Deschaux C, Levy P: Relationship between body mass index, age and upper airway measurements in snorers and sleep apnoea patients. *Eur Respir J* 1996; 9:1801-1809
18. Prachartam N, Hans MG, Strohl KP, Redline S: Upright and supine cephalometric evaluation of obstructive sleep apnea syndrome and snoring subjects. *Angle Orthod* 1994; 64:63-73
19. Riley RW, Guilleminault C, Herran J, Powell N: Cephalometric analysis and flow-volume loops in obstructive sleep apnea. *Sleep* 1983; 6:303-311
20. Rivlin J, Hoffstein V, Kalbfleish J, McNicholas W, Zamel N, Bryan AC: Upper airway morphology in patients with idiopathic obstructive sleep apnea. *Am Rev Respir Dis* 1984; 129:355-360
21. Sakakibara H, Tong M, Matsushita K, Girata M, Konishi Y, Suetsugu S: Cephalometric abnormalities in non-obese and obese patients with obstructive sleep apnea. *Eur Respir J* 1999; 13:403-410



22. Steinberg B, Fraser B: The cranial base in obstructive sleep apnea. *J Oral Maxillofac Surg* 1995; 53:1150-1154
23. Tangugsorn V, Skatvedt O, Krogstad O, Lyberg T: Obstructive sleep apnoea: a cephalometric study. Part I. Cervico-craniofacial morphology. *Eur J Orthod* 1995; 17:45-56
24. Tangugsorn V, Skatvedt O, Krogstad O, Lyberg T: Obstructive sleep apnoea: a cephalometric study. Part II. Uvulo-glossopharyngeal morphology. *Eur J Orthod* 1995; 17:57-67
25. Yu X, Fujimoto K, Urushibata K, Matsuzawa Y, Kubo K: Cephalometric analysis in obese and nonobese patients with obstructive sleep apnea syndrome. *Chest* 2003; 124:212-218
26. Zucconi M, Ferini SL, Palazzi S, Orena C, Zonta S, Smirne S: Habitual snoring with and without obstructive sleep apnoea; the importance of cephalometric variables. *Thorax* 1992; 47:157-161
27. Zucconi M, Ferini-Strambi L, Palazzi S, Curci C, Cucchi E, Smirne S: Craniofacial cephalometric evaluation in habitual snorers with and without obstructive sleep apnoea. *Otolaryngol Head Neck Surg* 1993; 109:1007-1013

*Observational studies, case reports, or non-pertinent comparison groups*

1. Colmenero C, Esteban R, Albarino AR, Colmenero B: Sleep apnoea syndrome associated with maxillofacial abnormalities. *J Laryngol Otol* 1991; 105:94-100
2. Dempsey JA, Skatrud JB, Jacques AJ, Ewanowski SJ, Woodson BT, Hanson PR, Goodman B: Anatomic determinants of sleep-disordered breathing across the spectrum of clinical and nonclinical male subjects. *Chest* 2002; 122:840-851
3. Fregosi RF, Quan SF, Karmingk KL, Morgan WJ, Goodwin JL, Caberera R, Gmitro A: Sleep-disordered breathing, pharyngeal size and soft tissue anatomy in children. *J Appl Physiol* 2003; 95:2030-2038
4. Hierl T, Humpfner-Hierl H, Frerich B, Heisgen U, Bosse-Henck A, Hemprich A: Obstructive sleep apnea syndrome: results and conclusions of a principal component analysis. *J Craniomaxillofac Surg* 1997; 25:181-185
5. Lowe AA, Santamaria JD, Fleetham JA, Price C: Facial morphology and obstructive sleep apnoea. *Am J Orthod Dentofac Orthop* 1986; 90:484-491
6. Marcus CL, Ward SLD, Mallory GB, Rosen CL, Beckerman RC, Weese-Mayer DE, Brouillette RT, Trant HT. Use of nasal continuous positive airway pressure as treatment of childhood obstructive sleep apnea. *J Pediatr* 1995; 127:88-94
7. Naganuma H, Okamoto M, Woodson BT, Hirose H: Cephalometric and fiberoptic evaluation as a case-selection technique for obstructive sleep apnea syndrome (OSAS). *Acta Otolaryngol* 2002 (Suppl); 547:57-63
8. Pae EK, Lowe AA, Fleetham JA: Shape of the face and tongue in obstructive sleep apnoea patients - Statistical analysis of coordinate data. *Clin Orthod Res* 1999; 2:10-18
9. Partinen M, Guilleminault C, Salva Ma Quera, Jamieson A: Obstructive sleep apnea and cephalometric roentgenograms. The role of anatomic upper airway abnormalities in the definition of abnormal breathing during sleep. *Chest* 1998; 93:1199-1205
10. Sforza E, Bacon W, Weiss T, Thibault A, Petiau C, Krieger J: Upper airway collapsibility and cephalometric variables in patients with obstructive sleep apnea. *Am J Respir Crit Care Med* 2000; 161:347-352

***Sleep studies:***

*Observational studies, case reports, or non-pertinent comparison groups:*

1. Biavati MJ, Manning SC, Phillips DL: Predictive factors for respiratory complications after tonsillectomy and adenoidectomy in children. Arch Otolaryngol Head Neck Surg 1997; 123:517-521
2. Kim JA, Lee JJ, Jung HH: Predictive factors of immediate postoperative complications after uvulopalatopharyngoplasty. Laryngoscope 2005; 115:1837-1840
3. Reisch S, Daniuk J, Steltner H, Ruhle KH, Timmer J, Guttman J: Detection of sleep apnea with the forced oscillation technique compared to three standard polysomnographic signals. Respiration 2000; 67:518-525
4. Rowley JA, Aboussouan LS, Badr MS: The use of clinical prediction formulas in the evaluation of obstructive sleep apnea. Sleep 2000; 23:929-938
5. Suen JS, Arnold JE, Brooks LJ: Adenotonsillectomy for treatment of obstructive sleep apnea in children. Arch Otolaryngol Head Neck Surg 1995 May; 121:525-530
6. Viner S, Szalai JP, Hoffstein V: Are history and physical examination a good screening test for sleep apnea? Ann Intern Med 1991; 115:356-359

**Patient/family interview and screening protocol.**

***Patient interview:***

*Observational studies, case reports, or comparisons without pertinent control groups*

1. Duran J, Esnaola S, Rubio R, Iztueta A: Obstructive sleep apnea-hypopnea and related clinical features in a population-based sample of subjects aged 30 to 70 yr. Am J Respir Crit Care Med 2001; 163:685-689

***Family interview:***

*Observational studies, case reports, or non-pertinent comparison groups*

1. Sinha R, Bose S, Thangaswamy CR: Unrecognized obstructive sleep apnea in children: caught on the wrong foot and lessons learnt!!! Paediatr Anaesth 2008; 18:984-986

***Screening questionnaire or protocol:***

*Nonrandomized comparative studies:*

1. Lakdawala L: Creating a safer perioperative environment with an obstructive sleep apnea screening tool. J Perianesth Nurs 2011; 26:15-24

*Observational studies, case reports, or comparisons without pertinent control groups*

1. Ahmadi N, Chung SA, Gibbs A, Shapiro CM: The Berlin questionnaire for sleep apnea in a sleep clinic population: relationship to polysomnographic measurement of respiratory disturbance. Sleep Breath 2008; 12:39-45
2. Carroll JL, McCollley SA, Marcus CL, Curtis S, Loughlin GM: Inability of clinical history to distinguish primary snoring from obstructive sleep apnea syndrome in children. Chest 1995; 108:610-618
3. Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun Y: High STOP-Bang score indicates a high probability of obstructive sleep apnoea. Br J Anaesth 2012; 108:768-775

4. Chung F, Ward B, Ho J, Yuan H, Kayumov L, Shapiro C: Preoperative identification of sleep apnea risk in elective surgical patients using the Berlin questionnaire. *J Clin Anesth* 2007; 19:130-134
5. Chung F, Yegneswaran B, Liao P, Chung SA, Vairavanathan S, Islam S, Khajehdehi A, Shapiro CM: STOP questionnaire: a tool to screen patients for obstructive sleep apnea. *Anesthesiology* 2008; 108:812-821
6. Chung F, Yegneswaran B, Liao P, Chung SA, Vairavanathan S, Islam S, Khajehdehi A, Shapiro CM: Validation of the Berlin questionnaire and American Society of Anesthesiologists checklist as screening tools for obstructive sleep apnea in surgical patients. *Anesthesiology* 2008; 108:822-830
7. Deegan PC, McNicolas WT: Predictive value of clinical features for the obstructive sleep apnoea syndrome. *Eur Respir J* 1996; 9:117-124
8. Gali B, Whalen FX, Schroeder DR, Gay PC, Plevak DJ: Identification of patients at risk for postoperative respiratory complications using a preoperative obstructive sleep apnea screening tool and postanesthesia care assessment. *Anesthesiology* 2009; 110:869-877
9. Gali B, Whalen FX Jr, Gay PC, Olson EJ, Schroeder DR, Plevak DJ, Morgenthaler TI: Management plan to reduce risks in perioperative care of patients with presumed obstructive sleep apnea syndrome. *J Clin Sleep Med* 2007; 3:582-588
10. Goldstein NA, Sculerati N, Walsleben JA, Bhatia N, Friedman DM, Rapoport DM: Clinical diagnosis of pediatric obstructive sleep apnea validated by polysomnography. *Otolaryngol Head Neck Surg* 1994; 111:611-617
11. Gurubhagavatula I, Maislin G, Pack AI: An algorithm to stratify sleep apnea risk in a sleep disorders clinic population. *Am J Respir Crit Care Med* 2001; 164:1904-1909
12. Haraldsson PO, Carefelt C, Knutsson E, Persson HE, Rinder J: Preliminary report: validity of symptom analysis and daytime polysomnography in diagnosis of sleep apnea. *Sleep* 1992; 15:261-263
13. Ishii L, Godoy A, Ishman SL, Gourin CG, Ishii M: The nasal obstruction symptom evaluation survey as a screening tool for obstructive sleep apnea, *Arch Otolaryngol Head Neck Surg* 2011; 137:119-123
14. Kapuniaie LE, Andrew DJ, Crowell DH, Pearce JW: Identifying sleep apnea from self-reports. *Sleep* 1988; 11:430-436
15. Kump K, Whalen C, Tishler PV, Browner I, Ferrette V, Strohl KP, Rosenberg C, Redline S: Assessment of the validity and the utility of a sleep-symptom questionnaire. *Am J Respir Crit Care Med* 1994; 150:735-741
16. Netzer NC, Stoohs RA, Netzer CM, Clark K, Strohl KP: Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. *Ann Intern Med* 1999; 131:485-491
17. Rosenthal L, Dolan D: The Epworth Sleepiness Scale in the identification of obstructive sleep apnea. *J Nerv Ment Dis* 2008; 196:429-431
18. Rowley JA, Aboussouan LS, Badr MS: The use of clinical prediction formulas in the evaluation of obstructive sleep apnea. *Sleep* 2000; 23:929-938
19. Serafini FM, MacDowell Anderson W, Rosemurgy AS, Strait T, Murr MM: Clinical predictors of sleep apnea in patients undergoing bariatric surgery. *Obes Surg* 2001; 11:28-31
20. Sharma SK, Vasudev C, Sinha S, Banga A, Pandey RM, Handa KK: Validation of the modified Berlin questionnaire to identify patients at risk for the obstructive sleep apnoea syndrome. *Indian J Med Res* 2006; 124:281-290

21. Vasu TS, Doghramji K, Cavallazzi R, Grewal R, Hirani A, Leiby B, Markov D, Reiter D, Kraft WK, Witkowski T: Obstructive sleep-apnea syndrome and postoperative complications: clinical use of the STOP-BANG questionnaire are more likely to have multiple postoperative complications. *Arch Otolaryngol Head Neck Surg* 2010; 136:1020-1024
22. Weatherwax KJ, Lin X, Marzec ML, Malow BA: Obstructive sleep apnea in epilepsy patients: the Sleep Apnea scale of the Sleep Disorders Questionnaire (SA-SDQ) is a useful screening instrument for obstructive sleep apnea in a disease-specific population. *Sleep Med* 2003; 4:517-521
23. Yegneswaran B, Chung F: The importance of screening for obstructive sleep apnea before surgery. *Sleep Med* 2009; 10:270-271

### **Focused physical examination.**

#### *Physical characteristics of patient (neck circumference, tonsil size, tongue volume):*

##### Nonrandomized comparative studies

1. Kushida CA, Efron B, Guilleminault C: A predictive morphometric model for the obstructive sleep apnea syndrome. *Ann Int Med* 1997; 127:581-587
2. Mortimore IL, Marshall I, Wraith PK, Sellar RJ, Douglas NJ: Neck and total body fat deposition in nonobese and obese patients with sleep apnea compared with that in control subjects. *Am J Resp Crit Care Med* 1998; 157:280-283
3. Schellenberg JB, Maislin G, Schwab RJ: Physical findings and the risk for obstructive sleep apnea: The importance of oropharyngeal structures. *Am J Respir Crit Care Med* 2000; 16:740-748
4. Schwab RJ, Gupta KB, Geffer WB, Metzger LJ, Hoffman EA, Pack AI: Upper airway and soft tissue anatomy in normal subjects and patients with sleep-disordered breathing. Significance of the lateral pharyngeal walls. *Am J Respir Crit Care Med* 1995; 152:1673-1689

##### Observational studies, case reports, or non-pertinent comparison groups

1. Brodsky JB, Lemmens HJ, Brock-Utne JG, Vierra M, Saidman LJ: Morbid obesity and tracheal intubation. *Anesth Analg* 2002; 95:732-736
2. Croft CB, Brockbank MJ, Wright A, Swanston AR: Obstructive sleep apnoea in children undergoing routine tonsillectomy and adenoidectomy. *Clin Otolaryngol* 1990; 15:307-314
3. Dahlqvist J, Dahlqvist A, Marklund M, Berggren D, Stenlund H, Franklin KA: Physical findings in the upper airways related to obstructive sleep apnea in men and women. *Acta Otolaryngol* 2007; 127:623-630
4. Davies RJO, Ali NJ, Stradling JR: Neck circumference and other clinical features in the diagnosis of the obstructive sleep apnoea syndrome. *Thorax* 1992; 47:101-105
5. Davies RJO, Stradling JR: The relationship between neck circumference, radiographic pharyngeal anatomy, and obstructive sleep apnoea syndrome. *Eur Respir J* 1990; 3:509-514
6. Deegan PC, McNicolas WT: Predictive value of clinical features for the obstructive sleep apnoea syndrome. *Eur Respir J* 1996; 9:117-124
7. Dixon JB, Schachter LM, O'Brien PE: Predicting sleep apnea and excessive day sleepiness in the severely obese: indicators for polysomnography. *Chest* 2003; 123:1134-1141

8. Do KL, Ferreyra H, Healy JF, Davidson TM: Does tongue size differ between patients with and without sleep-disordered breathing? *Laryngoscope* 2000; 110:1552-1555
9. Erdamar B, Suoglu Y, Cuhadaroglu C, Katircioglu S, Guven M: Evaluation of clinical parameters in patients with obstructive sleep apnea and possible correlation with the severity of the disease. *Eur Arch Otorhinolaryngol* 2001; 258:492-495
10. Ferguson KA, Ono T, Lowe AA, Ryan F, Fleetham JA: The relationship between obesity and craniofacial structure in obstructive sleep apnoea. *Chest* 1995; 108:375-381
11. Friedman M, Tanyeri H, La Rosa M, Landsberg R, Vaidyanathan K, Pieri S, Caldarelli D: Clinical predictors of obstructive sleep apnea. *Laryngoscope* 1999; 109:1901-1907
12. Grunstein R, Wilcox I, Yang TS, Gould Y, Hedner J: Snoring and sleep apnoea in men: association with central obesity and hypertension. *Int J Obes Relat Metab Disord* 1993; 17:533-540
13. Hoffstein V, Mateika S: Differences in abdominal and neck circumferences in patients with and without sleep apnoea. *Eur Resp J* 1992; 5:377-381
14. Katz I, Stradling J, Slutsky AS, Zamel N, Hoffstein V: Do patients with obstructive sleep apnea have thick necks? *Am Rev Respir Dis* 1990; 141:1228-1231
15. Ramachandran SK, Kheterpal S, Consens F, Shanks A, Doherty TM, Morris M, Tremper KK: Derivation and validation of a simple perioperative sleep apnea prediction score. *Anesth Analg* 2010; 110:1007-1015
16. Stradling JR, Crosby JH: Predictors and prevalence of obstructive sleep apnea and snoring in 1001 middle aged men. *Thorax* 1991; 46:85-90
17. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S: The occurrence of sleep-disordered breathing among middle-aged adults. *N Engl J Med* 1993; 328:1230-1235

### ***Characteristics of the airway:***

#### ***Nonrandomized comparative studies***

1. Biddle C: Comparative aspects of the airway during general anesthesia in obese sufferers of sleep apnea and matched normals. *Adv Pract Nurs Q* 1996; 2:14-19
2. Biddle C: Orocephalometry and airway control in obese sleep-disordered breathers, obese normals, and matched controls undergoing general anesthesia. *CRNA* 1994; 5:97-103
3. Galvin JR, Rooholamini SA, Stanford W: Obstructive sleep apnea: diagnosis with ultrafast CT. *Radiology* 1989; 171:775-778
4. Isono S, Shimada A, Utsugi M, Konno A, Nishino T: Comparison of static mechanical properties of the passive pharynx between normal children and children with sleep-disordered breathing. *Am J Respir Crit Care Med* 1998; 157:1204-1212
5. Lofaso F, Coste A, d'Ortho MP, Zerah-Lancner F, Delclaux C, Goldenberg F, Harf A: Nasal obstruction as a risk factor for sleep apnoea syndrome. *Eur Respir J* 2000; 16:639-643
6. Schellenberg JB, Maislin G, Schwab RJ: Physical findings and the risk for obstructive sleep apnea. The importance of oropharyngeal structures. *Am J Respir Crit Care Med* 2000; 162:740-748
7. Schwab RJ, Gupta KB, Geftter WB, Metzger LJ, Hoffman EA, Pack AI: Upper airway and soft tissue anatomy in normal subjects and patients with sleep-disordered breathing. Significance of the lateral pharyngeal walls. *Am J Respir Crit Care Med* 1995; 152:1673-1689

Observational studies, case reports, or comparisons without pertinent control groups

1. Bradley TD, Brown IG, Grossman RF, Zamel N, Martinez D, Phillipson EA, Hoffstein V: Pharyngeal size in snorers, nonsnorers, and patients with obstructive sleep apnea. *N Engl J Med* 1986; 315:1327-1331
2. Brodsky JB, Lemmens HJ, Brock-Utne JG, Vierra M, Saidman LJ: Morbid obesity and tracheal intubation. *Anesth Analg* 2002; 95:732-736
3. Friedman M, Tanyeri H, La Rosa M, Landsberg R, Vaidyanathan K, Pieri S, Caldarelli D: Clinical predictors of obstructive sleep apnea. *Laryngoscope* 1999; 109:1901-1907
4. Hoffstein V, Szalai JP: Predictive value of clinical features in diagnosing obstructive sleep apnea. *Sleep* 1993; 16:118-122
5. Liistro G, Rombaux P, Belge C, Dury M, Aubert G, Rodenstein DO: High Mallampati score and nasal obstruction are associated risk factors for obstructive sleep apnoea. *Eur Respir J* 2003; 21:248-252
6. Oliven A, Aspandiarov E, Gankin I, Gaitini L, Tov N: Collapsibility of the relaxed pharynx and risk of sleep apnoea. *Eur Respir J* 2008; 32:1309-1315
7. Ramachandran SK, Kheterpal S, Consens F, Shanks A, Doherty TM, Morris M, Tremper KK: Derivation and validation of a simple perioperative sleep apnea prediction score. *Anesth Analg* 2010; 110:1007-1015
8. Zonato AI, Bittencourt LR, Martinho FL, Junior JF, Gregorio LC, Tufik S: Association of systematic head and neck physical examination with severity of obstructive sleep apnea-hypopnea syndrome. *Laryngoscope* 2003; 113:973-980

***Laryngoscopic assessment:***

Nonrandomized comparative studies

1. Isono S, Remmers JE, Tanaka A, Sho Y, Sato J, Nishino T: Anatomy of pharynx in patients with obstructive sleep apnea and in normal subjects. *J Appl Physiol* 1997; 82:1319-1326
2. Woodson BT, Naganuma H: Comparison of methods of airway evaluation in obstructive sleep apnea syndrome. *Otolaryngol Head Neck Surg* 1999; 120:460-463
3. Zonato AI, Bittencourt LR, Martinho FL, Junior JF, Gregorio LC, Tufik S: Association of systematic head and neck physical examination with severity of obstructive sleep apnea-hypopnea syndrome. *Laryngoscope* 2003; 113:973-980

Observational studies, case reports, or comparisons without pertinent control groups

1. Boroweicki B, Pollak CP, Weitzman ED, Rakoff S, Imperato J: Fibro-optic study of pharyngeal airway during sleep in patients with hypersomnia obstructive sleep syndrome. *Laryngoscope* 1978; 88:1310-1313

**II. Preoperative Preparation**

**Preoperative treatment/optimization for OSA (e.g., CPAP, BIPAP, mandibular appliances, medical treatment).**

***Preoperative CPAP vs no CPAP:***

Nonrandomized comparative studies

1. Gupta RM, Parvizi J, Hanssen AD, Gay PC: Postoperative complications in patients with obstructive sleep apnea syndrome undergoing hip or knee replacement: a case-control study. *Mayo Clin Proc* 2001; 76:897-905

Observational studies, case reports, or non-pertinent comparison groups

1. Arisaka H, Sakuraba S, Kobayashi R, Kitahama H, Nishida N, Furuya M, Yoshida K: Perioperative management of obstructive sleep apnea with nasal continuous positive airway pressure. *Anesth Prog* 2008; 55:121-123
2. Rennotte MT, Baele P, Aubert G, Rodenstein DO: Nasal continuous positive airway pressure in the perioperative management of patients with obstructive sleep apnea submitted to surgery. *Chest* 1995; 107:367-374
3. Waters KA, Everett FM, Bruderer JW, Sullivan CE: Obstructive sleep apnea: the use of nasal CPAP in 80 children. *Am J Respir Crit Care Med* 1995; 152:780-785

**CPAP vs no CPAP (non- perioperative studies):**

Randomized controlled trials

1. Ballester E, Badia JR, Hernandez L, Carrasco E, de Pablo J, Fornas C, Rodriguez-Roisin R, Montserrat JM: Evidence of the effectiveness of continuous positive airway pressure in the treatment of sleep apnea/hypopnea syndrome. *Am J Respir Crit Care Med* 1999; 159:495-501
2. Engleman HM, Martin SE, Deary IJ, Douglas NJ: Effect of continuous positive airway pressure treatment on daytime function in sleep apnoea/hypopnoea syndrome. *Lancet* 1994; 343:572-575
3. Engleman HM, Martin SE, Deary IJ, Douglas NJ: Effect of CPAP therapy on daytime function in patients with mild sleep apnoea/hypopnoea syndrome. *Thorax* 1997; 52:114-119
4. Engleman HM, Martin SE, Kingshott RN, Mackay TW, Deary IJ, Douglas NJ: Randomised placebo controlled trial of daytime function after continuous positive airway pressure (CPAP) therapy for the sleep apnoea/hypopnoea syndrome. *Thorax* 1998; 53:341-345
5. Faccenda JF, Mackay TW, Boon NA, Douglas NJ: Randomized placebo-controlled trial of continuous positive airway pressure on blood pressure in the sleep apnea-hypopnea syndrome. *Am J Respir Crit Care Med* 2001; 163:344-348
6. Jenkinson C, Davies RJO, Mullins R, Stradling JR: Comparison of therapeutic and subtherapeutic nasal continuous positive airway pressure for obstructive sleep apnoea: a randomised prospective parallel trial. *Lancet* 1999; 353:2100-2105
7. Loreda JS, Ancoli-Israel S, Dimsdale JE: Effect of continuous positive airway pressure vs placebo continuous positive airway pressure on sleep quality in obstructive sleep apnea. *Chest* 1999; 116:1545-1549
8. Montserrat JM, Ferrer M, Hernandez L, Farre R, Vilagut G, Navajas D, Badia JR, Carrasco E, De Pablo J, Ballester E: Effectiveness of CPAP treatment in daytime function in sleep apnea syndrome: a randomized controlled study with an optimized placebo. *Am J Respir Crit Care Med* 2001; 164:608-613
9. Tan YK, L'Estrange PR, Luo YM, Smith C, Grant HR, Simonds AK, Spiro SG, Battagel JM: Mandibular advancement splints and continuous positive airway pressure in patients with obstructive sleep apnoea: a randomized cross-over trial. *Eur J Orthod* 2002; 24:239-249

Observational studies, case reports, or non-pertinent comparison groups

1. Akashiba T, Minemura H, Yamamoto H, Itoh D, Kosaka N, Saitoh O, Horie T: Effects of nasal continuous positive airway pressure on pulmonary haemodynamics and tissue oxygenation in patients with obstructive sleep apnoea. *Respirology* 1999; 4:83-87
2. Alchanatis M, Tourkohoriti G, Kakouros S, Kosmas E, Podaras S, Jordanoglou JB: Daytime pulmonary hypertension in patients with obstructive sleep apnea: the effect of continuous positive airway pressure on pulmonary hemodynamics. *Respiration* 2001; 68:566-572
3. Alchanatis M, Paradellis G, Pini H, Tourkohoriti G, Jordanoglou J: Left ventricular function in patients with obstructive sleep apnoea syndrome before and after treatment with nasal CPAP. *Respiration* 2000; 67:367-371
4. Anand VK, Ferguson PW, Schoen LS: Obstructive sleep apnea: a comparison of continuous positive airway pressure and surgical treatment. *Otolaryngol Head Neck Surg* 1991; 105:382-390
5. Becker H, Brandenburg U, Peter JH, Peter JH, Von Wichert P: Reversal of sinus arrest and atrioventricular conduction block in patients with sleep apnea during nasal continuous positive airway pressure. *Am J Respir Crit Care Med* 1995; 151:215-218
6. Behbehani K, Yen FC, Lucas EA, Burk JR: A sleep laboratory evaluation of an automatic positive airway pressure system for treatment of obstructive sleep apnea. *Sleep* 1998; 21:485-491
7. Carrera M, Barbe F, Sauleda J, Tomas M, Gomez C, Agusti AG: Patients with obstructive sleep apnea exhibit genioglossus dysfunction that is normalized after treatment with continuous positive airway pressure. *Am J Respir Crit Care Med* 1999; 159:1960-1966
8. Clark GT, Blummenfeld I, Yoffe N, Peled E, Lavie P: A crossover study comparing the efficacy of continuous positive airway pressure with anterior mandibular positioning devices on patients with obstructive sleep apnea. *Chest* 1996; 109:1477-1483
9. Collop NA, Block AJ, Hellard D: The effect of nightly nasal CPAP treatment on underlying obstructive sleep apnea and pharyngeal size. *Chest* 1991; 99:855-860
10. Ferguson KA, Ono T, Lowe AA, al-Majed S, Love LL, Fleetham JA: A short-term controlled trial of an adjustable oral appliance for the treatment of mild to moderate obstructive sleep apnoea. *Thorax* 1997; 52:362-368
11. Ferguson KA, Ono T, Lowe AA, Keenan SP, Fleetham JA: A randomized crossover study of an oral appliance vs nasal-continuous positive airway pressure in the treatment of mild-moderate obstructive sleep apnea. *Chest* 1996; 109:1269-1275
12. Harbison J, O'Reilly P, McNicholas WT: Cardiac rhythm disturbances in the obstructive sleep apnea syndrome: effects of nasal continuous positive airway pressure therapy. *Chest* 2000; 118:591-595
13. Hartzell CW: Sleeping beauty: a case of pickwickian syndrome. *J Emerg Nurs* 1989; 15:8-11
14. Henke KG, Grady JJ, Kuna SI: Effect of nasal continuous positive airway pressure on neuropsychological function in sleep apnea-hypopnea syndrome: a randomized, placebo-controlled trial. *Am J Respir Crit Care Med* 2001; 163:911-917
15. Issa FG, Sullivan CE: The immediate effects of nasal continuous positive airway pressure treatment on sleep pattern in patients with obstructive sleep apnea syndrome. *Electroencephalogr Clin Neurophysiol* 1986; 63:10-17



16. Jenkinson C, Stradling J, Petersen S: How should we evaluate health status? A comparison of three methods in patients presenting with obstructive sleep apnoea. *Qual Life Res* 1998; 7:95-100
17. Kiely JL, Murphy M, McNicholas WT: Subjective efficacy of nasal CPAP therapy in obstructive sleep apnoea syndrome: a prospective controlled study. *Eur Respir J* 1999; 13:1086-1090
18. Koehler U, Fus E, Grimm W, Pankow W, Schafer H, Stammnitz A, Peter JH: Heart block in patients with obstructive sleep apnea: pathogenetic factors and effects of treatment. *Eur Respir J* 1998; 11:434-439
19. Konermann M, Sanner BM, Vyleta M, Laschewski F, Groetz J, Sturm A, Zidek W: Use of conventional and self-adjusting nasal continuous positive airway pressure for treatment of severe obstructive sleep apnea syndrome: a comparative study. *Chest* 1998; 113:714-718
20. Krieger JE, Weitzenblum E, Monassier JP: Dangerous hypoxemia during continuous positive airways pressure treatment of obstructive sleep apnea. *Lancet* 1983; 2:1429-1430
21. Lamphere J, Roehrs T, Wittig R, Zorick F, Conway WA, Roth T: Recovery of alertness after CPAP in apnea. *Chest* 1989; 1364-1367
22. Loreda JS, Ancoli-Israel S, Dimsdale JE: Effect of continuous positive airway pressure vs placebo continuous positive airway pressure on sleep quality in obstructive sleep apnea. *Chest* 1999; 116:1545-1549
23. Marcus CL, Ward SLD, Mallory GB, Rosen CL, Beckerman RC, Weese-Mayer DE, Brouillette RT, Trant HT. Use of nasal continuous positive airway pressure as treatment of childhood obstructive sleep apnea. *J Pediatr* 1995; 127:88-94
24. Meurice JC, Marc I, Carrier G, Series F: Efficiency of auto-CPAP in the treatment of obstructive sleep apnea/hypopnea syndrome. *Am J Respir Crit Care Med* 1996; 153:794-798
25. Minemura H, Akashiba T, Yamamoto H, Akahoshi T, Kosaka N, Horie T: Acute effects of nasal continuous positive airway pressure on 24-hour blood pressure and catecholamines in patients with obstructive sleep apnoea. *Int Med* 1998; 37:1009-1013
26. Moura SM, Bittencourt LR, Bagnato MC, Lucas SR, Tufik S, Nery LE: Acute effect of nasal continuous positive air pressure on the ventilatory control of patients with obstructive sleep apnea. *Respiration* 2001; 68:243-249
27. Pepin JL, Leger P, Veale D, Langevin B, Robert D, Levy P: Side effects of nasal continuous positive airway pressure in sleep apnea syndrome. *Chest* 1995; 107:375-381
28. Planes C, D'Ortho MP, Foucher A, Berkani M, Leroux K, Essalhi M, Delclaux C, Quera-Salva MA, Lofaso F: Efficacy and cost of home-initiated auto-nCPAP versus conventional nCPAP. *Sleep* 2003; 26:156-160
29. Rama PR, Sharma SC: Sleep apnea and complete heart block. *Clin Cardiol* 1994; 17:675-677
30. Randerath WJ, Heise M, Hinz R, Ruehle KH: An individually adjustable oral appliance vs continuous positive airway pressure in mild-to-moderate obstructive sleep apnea syndrome. *Chest* 2002; 122:569-575
31. Resta O, Guido P, Picca V, Sabato R, Rizzi M, Scarpelli F, Sergi M: Prescription of nCPAP and nBIPAP in obstructive sleep apnoea syndrome: Italian experience in 105 subjects. A prospective two centre study. *Respir Med* 1998; 92:820-827
32. Sanders MH, Moore SE, Eveslage J: CPAP via nasal mask: A treatment for occlusive sleep apnea. *Chest* 1985; 83:114-115
33. Sanders MH: Nasal CPAP effect on patterns of sleep apnea. *Chest* 1984; 86:839-844

34. Schafer H, Ewig S, Hasper E, Luderitz B: Failure of CPAP therapy in obstructive sleep apnoea syndrome: predictive factors and treatment with bilevel-positive airway pressure. *Respir Med* 1998; 92:208-215
35. Sériès F, Marc I: Efficacy of automatic continuous positive airway pressure therapy that uses an estimated required pressure in the treatment of the obstructive sleep apnea syndrome. *Ann Intern Med* 1997; 127:588-595
36. Sharma S, Wali S, Pouliot Z, Peters M, Neufeld H, Kryger M: Treatment of obstructive sleep apnea with a self-titrating continuous positive airway pressure (CPAP) system. *Sleep* 1996; 19:497-501
37. Skinner MA, Kingshott RN, Filsell S, Taylor DR: Efficacy of the 'tennis ball technique' versus nCPAP in the management of position-dependent obstructive sleep apnoea syndrome. *Respirology* 2008; 13:708-715
38. Skinner MA, Kingshott RN, Jones DR, Taylor DR: Lack of efficacy for a cervicomandibular support collar in the management of obstructive sleep apnea. *Chest* 2004; 125:118-126
39. Sullivan CE, Berthon-Jones M, Issa FG: Remission of severe obesity-hypoventilation syndrome after short-term treatment during sleep with nasal continuous positive airway pressure. *Am Rev Respir Dis* 1983; 128:177-181
40. Sullivan CE, Issa FG, Berthon-Jones M: Reversal of obstructive sleep apnea by continuous positive airway pressure applied through the nares. *Lancet* 1981; 1:862-865
41. Wiest GH, Harsch IA, Fuchs FS, Kitzbichler S, Bogner K, Brueckl WM, Hahn EG, Ficker JH: Initiation of CPAP therapy for OSA: does prophylactic humidification during CPAP pressure titration improve initial patient acceptance and comfort? *Respiration* 2002; 69:406-412

***Noninvasive bilevel positive pressure ventilation versus no noninvasive bilevel positive pressure ventilation (non- perioperative studies):***

*Observational studies, case reports, or non-pertinent comparison groups*

1. Guilleminault C, Philip P, Robinson A: Sleep and neuromuscular disease: bilevel positive airway pressure by nasal mask as a treatment for sleep disordered breathing in patients with neuromuscular disease. *J Neurol Neurosurg Psychiatry* 1998; 65:225-232
2. Laursen SB, Dreijer B, Hemmingsen C, Jacobsen E: Bi-level positive airway pressure treatment of obstructive sleep apnoea syndrome. *Respiration* 1998; 65:114-119
3. Resta O, Guido P, Picca V, Sabato R, Rizzi M, Scarpelli F, Sergi M: Prescription of nCPAP and nBIPAP in obstructive sleep apnoea syndrome: Italian experience in 105 subjects. A prospective two centre study. *Respir Med* 1998; 92:820-827

***Mandibular appliance vs no mandibular appliance (non- perioperative studies):***

*Randomized controlled trials*

1. Bloch KE, Iseli A, Zhang JN, Xie X, Kaplan V, Stoeckli PW, Russi EW: A randomized, controlled crossover trial of two oral appliances for sleep apnea treatment. *Am J Respir Crit Care Med* 2000; 162:246-251
2. Mehta A, Qian J, Petocz P, Darendeliler MA, Cistulla PA: A randomized, controlled study of a mandibular advancement splint for obstructive sleep apnea. *Am J Respir Crit Care Med* 2001; 163:1457-1461

3. O'Sullivan RA, Hillman DR, Mateljan R, Pantin C, Finucane KE: Mandibular advancement splint: an appliance to treat snoring and obstructive sleep apnea. *Am J Respir Crit Care Med* 1995; 151:194-198
4. Tan YK, L'Estrange PR, Luo YM, Smith C, Grant HR, Simonds AK, Spiro SG, Battagel JM: Mandibular advancement splints and continuous positive airway pressure in patients with obstructive sleep apnoea: a randomized cross-over trial. *Eur J Orthod* 2002; 24:239-249

*Observational studies, case reports, or non-pertinent comparison groups*

1. Bonham PE, Currier GF, Orr WC, Othman J, Nanda RS: The effect of a modified functional appliance on obstructive sleep apnea. *Am J Orthod Dentofacial Orthop* 1988; 94:384-392
2. Cartwright RD, Samelson CF: The effects of a nonsurgical treatment for obstructive sleep apnea. *JAMA* 1982; 248:705-709
3. Clark GT, Arand D, Chung E, Tong D: Effect of anterior mandibular positioning on obstructive sleep apnea. *Am Rev Respir Dis* 1993; 147:624-629
4. Clark GT, Blummenfeld I, Yoffe N, Peled E, Lavie P: A crossover study comparing the efficacy of continuous positive airway pressure with anterior mandibular positioning devices on patients with obstructive sleep apnea. *Chest* 1996; 109:1477-1483
5. Eveloff SE, Rosenberg CC, Carlisle C, Millman RP: Efficacy of a Herbst mandibular advancement device in obstructive sleep apnea. *Am Rev Crit Care Med* 1994; 149:905-909
6. Ferguson KA, Ono T, Lowe AA, al-Majed S, Love LL, Fleetham JA: A short-term controlled trial of an adjustable oral appliance for the treatment of mild to moderate obstructive sleep apnoea. *Thorax* 1997; 52:362-368
7. Ferguson KA, Ono T, Lowe AA, Keenan SP, Fleetham JA: A randomized crossover study of an oral appliance vs nasal-continuous positive airway pressure in the treatment of mild-moderate obstructive sleep apnea. *Chest* 1996; 109:1269-1275
8. Ichioika M, Tojy N, Yoshizawa M, Chida M, Miyazato I, Taniyai S, Marumo F, Nakazawa K, Hasegawa M: A dental device for the treatment of obstructive sleep apnea: a preliminary study. *Otolaryngol Head Neck Surg* 1991; 104:555-558
9. Isono S, Tanaka A, Sho Y, Konno A, Nishino T: Advancement of the mandible improves velopharyngeal airway patency. *J Appl Physiol* 1995; 79:2132-2138
10. Nakazawa Y, Sakamoto T, Sasutake R, Yamaga K, Kotorii T, Miyahara Y, Ariyoshi Y, Kameyama T: Treatment of sleep apnea with prosthetic mandibular advancement (PMA). *Sleep* 1992; 15:499-514
11. Randerath WJ, Heise M, Hinz R, Ruehle KH: An individually adjustable oral appliance vs continuous positive airway pressure in mild-to-moderate obstructive sleep apnea syndrome. *Chest* 2002; 122:569-575
12. Schmidt-Nowara WW, Meade TE, Hays MB: Treatment of snoring and obstructive sleep apnea with a dental orthosis. *Chest* 1991; 99:1378-1385

***CPAP vs mandibular appliance (non- perioperative studies):***

***Randomized controlled trials***

1. Clark GT, Blummenfeld I, Yoffe N, Peled E, Lavie P: A crossover study comparing the efficacy of continuous positive airway pressure with anterior mandibular positioning devices on patients with obstructive sleep apnea. *Chest* 1996; 109:1477-1483
2. Ferguson KA, Ono T, Lowe AA, al-Majed S, Love LL, Fleetham JA: A short-term controlled trial of an adjustable oral appliance for the treatment of mild to moderate obstructive sleep apnoea. *Thorax* 1997; 52:362-368
3. Ferguson KA, Ono T, Lowe AA, Keenan SP, Fleetham JA: A randomized crossover study of an oral appliance vs nasal-continuous positive airway pressure in the treatment of mild-moderate obstructive sleep apnea. *Chest* 1996; 109:1269-1275

***Other preoperative treatment (non- perioperative studies):***

***Randomized controlled trials***

1. Fletcher EC, De Behnke RD, Lovoi MS, Gorin AB: Undiagnosed sleep apnea in patients with essential hypertension. *Ann Intern Med* 1985; 103:190-195
2. Harman EM, Wynne JW, Block AJ: The effect of weight loss on sleep-disordered breathing and oxygen desaturation in morbidly obese men. *Chest* 1982; 82:291-294
3. Schwartz AR, Gold AR, Schubert N, Stryzak RA, Wise S, Permutt S, Smith PL: Effect of weight loss on upper airway collapsibility in obstructive sleep apnea. *Am Rev Respir Dis* 1991; 144:494-498

***ASA algorithm:***

***Observational studies, case reports, or non-pertinent comparison groups***

1. Biddle C: Comparative aspects of the airway during general anesthesia in obese sufferers of sleep apnea and matched normals. *Adv Pract Nurs Q* 1996; 2:14-19
2. Biddle C: Orocephalometry and airway control in obese sleep-disordered breathers, obese normals, and matched controls undergoing general anesthesia. *CRNA* 1994; 5:97-103
3. Biro P, Kaplan V, Bloch KE: Anesthetic management of a patient with obstructive sleep apnea syndrome and difficult airway access. *J Clin Anesth* 1995; 7:417-421
4. Gentil B, de Larminat JM, Boucherez C, Lienhart A: Difficult intubation and obstructive sleep apnoea syndrome. *Br J Anaesth* 1994; 72:368
5. Hiremath AS, Hillman DR, James AL, Noffsinger WJ, Platt PR, Singer SL: Relationship between difficult tracheal intubation and obstructive sleep apnea. *Br J Anaesth* 1998; 80:606-611
6. Iyer US, Koh KF, Chia NC, Macachor J, Cheng A: Perioperative risk factors in obese patients for bariatric surgery: a Singapore experience. *Singapore Med J* 2011; 52:94-99
7. Kim JA, Lee JJ: Preoperative predictors of difficult intubation in patients with obstructive sleep apnea syndrome. *Can J Anaesth* 2006; 53:393-397
8. Neligan PJ, Porter S, Max B, Malhotra G, Greenblatt EP, Ochroch EA: Obstructive sleep apnea is not a risk factor for difficult intubation in morbidly obese patients. *Anesth Analg* 2009; 109:1182-1186

9. Plunkett AR, McLean BC, Brooks D, Plunkett MT, Mikita JA: Does difficult mask ventilation predict obstructive sleep apnea? A prospective pilot study to identify the prevalence of OSA in patients with difficult mask ventilation under general anesthesia. *J Clin Sleep Med* 2011; 7:473-477
10. Preis C, Czerny C, Preis I, Zimpfer M: Variations in ILMA external diameters: another cause of device failure. *Can J Anaesth* 2000; 47:886-889
11. Siyam MA, Benhamou D: Difficult endotracheal intubation in patients with sleep apnea syndrome. *Anesth Analg* 2002; 95:1098-1102

### ***III. Intraoperative Management***

#### **Anesthetic technique.**

##### ***Local or regional anesthesia versus general anesthesia:***

##### *Observational studies, case reports, or comparisons without pertinent control groups*

1. Strauss SG, Lynn AM, Bratton SL, Nespeca MK: Ventilatory response to CO<sub>2</sub> in children with obstructive sleep apnea from adenotonsillar hypertrophy. *Anesth Analg* 1999; 89:328-332

#### **Intraoperative Monitoring.**

##### ***Continuously monitor the respiratory depressant effects of sedatives and/or opioids (e.g., level of consciousness, pulmonary ventilation, oxygenation, automated apnea monitoring):***

##### *Observational studies, case reports, or comparisons without pertinent control groups*

1. Samuels SI, Rabinov W: Difficulty reversing drug-induced coma in a patient with sleep apnea. *Anesth Analg* 1986; 65:1222-1224

#### **Extubation.**

##### ***Awake vs asleep extubation:***

##### *Observational studies, case reports, or comparisons without pertinent control groups*

1. Biro P, Kaplan V, Bloch KE: Anesthetic management of a patient with obstructive sleep apnea syndrome and difficult airway access. *J Clin Anesth* 1995; 7:417-421
2. Pellecchia DJ, Bretz KA, Barnette RE: Postoperative pain control by means of epidural narcotics in a patient with obstructive sleep apnea. *Anesth Analg* 1987; 66:280-282

### ***IV. Postoperative Management***

#### **Analgesic use.**

##### ***Regional (central or peripheral) analgesic techniques without neuraxial opioids versus systemic (im, sc, iv, oral, rectal) opioids:***

##### *Observational studies, case reports, or comparisons without pertinent control groups*

1. Keamy MF, Cadieux RJ, Kofke WA, Kales A: The occurrence of obstructive sleep apnea in a recovery room patient. *Anesthesiology* 1987; 66:232-234

***Neuraxial (spinal & epidural) opioids versus systemic (im, sc, iv, oral, rectal) opioids:***

*Observational studies, case reports, or comparisons without pertinent control groups*

1. Lamarche Y, Martin R, Reiher J, Blaise G: The sleep apnoea syndrome and epidural morphine. *Can Anaesth Soc J* 1986; 33:231-233
2. Ostermeier AM, Roizen MF, Hautkappe M, Klock PA, Klafta JM: Three sudden postoperative respiratory arrests associated with epidural opioids in patients with sleep apnea. *Anesth Analg* 1997; 85:452-460
3. Pellecchia DJ, Bretz KA, Barnette RE: Postoperative pain control by means of epidural narcotics in a patient with obstructive sleep apnea. *Anesth Analg* 1987; 66:280-282

***Oral analgesics (opioids/NSAIDs) versus parenteral (im, sc, iv) opioids:***

*Observational studies, case reports, or comparisons without pertinent control groups*

1. Rafferty TD, Ruskis A, Sasaki C, Gee JB: Perioperative considerations in the management of tracheotomy for the obstructive sleep apnoea patient. Three illustrative case reports. *Br J Anaesth* 1980 ;52:619-622

***PCA without a basal infusion versus PCA with a basal infusion:***

*Observational studies, case reports, or comparisons without pertinent control groups*

1. Etches RC: Respiratory depression associated with patient-controlled analgesia: a review of eight cases. *Can J Anaesth* 1994; 41:125-132
2. Parikh SN, Stuchin SA, Maca C, Fallar E, Steiger D: Sleep apnea syndrome in patients undergoing total joint arthroplasty. *J Arthroplasty* 2002; 17:635-642
3. VanDercar DH, Martinez AP, De Lissier EA: Sleep apnea syndromes: a potential contraindication for patient-controlled analgesia. *Anesthesiology* 1991; 74:623-624

***Lower dosages versus higher dosages:***

*Randomized controlled trials*

1. Brown KA, Laferriere A, Lakheeram I, Moss IR: Recurrent hypoxemia in children is associated with increased analgesic sensitivity to opiates. *Anesthesiology* 2006; 105:665-669

*Observational studies, case reports, or comparisons without pertinent control groups*

1. Brown KA, Laferriere A, Moss IR: Recurrent hypoxemia in young children with obstructive sleep apnea is associated with reduced opioid requirement for analgesia. *Anesthesiology* 2004; 100:806-810

**Oxygenation.**

***Supplemental oxygen versus no supplemental oxygen:***

*Observational studies, case reports, or comparisons without pertinent control groups*

1. Cullen DJ: Obstructive sleep apnea and postoperative analgesia - a potentially dangerous combination. *J Clin Anesth* 2001; 13:83-85

***Postoperative CPAP versus no CPAP (oxygen or room air):***

***Randomized controlled trials***

1. Neligan PJ, Malhotra G, Fraser M, Williams N, Greenblatt EP, Cereda M, Ochroch EA: Continuous positive airway pressure via the Boussignac system immediately after extubation improves lung function in morbidly obese patients with obstructive sleep apnea undergoing laparoscopic bariatric surgery. *Anesthesiology* 2009; 110:878-884
2. Suzuki M, Saigusa H, Kurogi R, Morita S, Ishizuka Y: Postoperative monitoring of esophageal pressure in patients with obstructive sleep apnea-hypopnea syndrome who have undergone tonsillectomy with uvulopalatopharyngoplasty. *Ann Otol Rhinol Laryngol* 2008; 117:849-853

***Nonrandomized comparative studies***

1. Huerta S, DeShields S, Shpiner R, Li Z, Liu C, Sawicki M, Arteaga J, Livingston EH: Safety and efficacy of postoperative continuous positive airway pressure to prevent pulmonary complications after Roux-en-Y gastric bypass. *J Gastrointest Surg* 2002; 6:354-358
2. Meng L: Postoperative nausea and vomiting with application of postoperative continuous positive airway pressure after laparoscopic gastric bypass. *Obes Surg* 2010; 20:876-880

***Observational studies, case reports, or comparisons without pertinent control groups***

1. Gupta RM, Gay PC: Postoperative complications in patients with undiagnosed obstructive sleep apnea. *Sleep* 1999; 22(suppl):691
2. Reeder MK, Goldman MD, Loh L, Muir AD, Casey KR, Gitlin DA: Postoperative obstructive sleep apnoea. Haemodynamic effects of treatment with nasal CPAP. *Anaesthesia* 1991; 46:849-853
3. Rennotte MT, Baele P, Aubert G, Rodenstein DO: Nasal continuous positive airway pressure in the perioperative management of patients with obstructive sleep apnea submitted to surgery. *Chest* 1995; 107:367-374
4. Wiczorek PM, Carli F: Obstructive sleep apnea uncovered after high spinal anesthesia: a case report. *Can J Anaesth* 2005; 52:761-764

***Postoperative noninvasive bilevel positive pressure ventilation versus CPAP:***

***Randomized controlled trials***

1. Reeves-Hoche K, Hudgel DW, Meck R, Witteman R, Ross A, Zwillich CW: Continuous versus bilevel positive airway pressure for obstructive sleep apnea. *Am J Respir Crit Care Med* 1995; 151:443-449

***Postoperative noninvasive bilevel positive pressure ventilation versus oxygen or room air:***

***Randomized controlled trials***

1. Ebeo CT, Benotti PN, Byrd RP, Elmaghraby Z, Lui J: The effect of bi-level positive pressure airway pressure on postoperative pulmonary function following gastric surgery for obesity. *Respir Med* 2002; 96:672-676

2. Joris JL, Sottiaux TM, Chiche JD, Desai CJ, Lamy ML: Effect of bi-level positive airway pressure (BiPAP) nasal ventilation on the postoperative pulmonary restrictive syndrome in obese patients undergoing gastroplasty. *Chest* 1997; 111:665-670

### **Positioning patients in the lateral, prone, or tonsil position versus the supine position.**

#### Randomized controlled trials

1. Neill AM, Angus SM, Sajkov D, McEvoy D: Effects of sleep posture on upper airway stability in patients with obstructive sleep apnea. *Am J Respir Crit Care Med* 1997; 155:1999-2004

#### Nonrandomized comparative studies

1. Brown IB, McClean PA, Boucher R, Zamel N, Hoffstein V: Changes in pharyngeal cross-sectional area with posture and application of continuous positive airway pressure in patients with obstructive sleep apnea. *Am Rev Respir Dis* 1987; 136:628-632
2. Cartwright RD, Diaz F, Lloyd S: The effects of sleep posture and sleep stage on apnea frequency. *Sleep* 1991; 14:351-353
3. Cartwright RD: Effect of sleep position on sleep apnea severity. *Sleep* 1984; 7:110-114
4. Fernandes do Prado LB, Li X, Thompson R, Marcus CL: Body position and obstructive sleep apnea in children. *Sleep* 2002, 25:66-71
5. George CF, Millar TW, Kryger MH: Sleep apnea and body position during sleep. *Sleep* 1988; 11:90-99
6. Ingman T, Nieminen T, Hurmerinta K: Cephalometric comparison of pharyngeal changes in subjects with upper airway resistance syndrome or obstructive sleep apnoea in upright and supine positions. *Eur J Orthod* 2004; 26:321-326
7. Isono S, Tanaka A, Nishino T: Lateral position decreases collapsibility of the passive pharynx in patients with obstructive sleep apnea. *Anesthesiology* 2002; 97:780-785
8. Itasaka Y, Miyazaki S, Ishikawa K, Togawa K: The influence of sleep position and obesity on sleep apnea. *Psychiatry Clin Neurosci* 2000; 54:340-341
9. Lowe AA, Ono T, Ferguson KA, Pae EK, Ryan CF, Fleetham JA: Cephalometric comparisons of craniofacial and upper airway morphology by skeletal subtype and gender in patients with obstructive sleep apnea. *Am J Orthod Dentofacial Orthop* 1996; 110:653-654
10. McEvoy RD, Sharp DJ, Thornton AT: The effects of posture on obstructive sleep apnea. *Am Rev Respir Dis* 1986; 133:662-666
11. Pae E, Lowe AA, Sasaki K, Price C, Tsuchiya M, Fleetham JA: A cephalometric and electromyographic study of upper airway structures in the upright and supine position. *Am J Orthod Dentofac Orthop* 1994; 106:52-59
12. Penzel T, Moller M, Becker HF, Knaack L, Peter JH: Effect of sleep position and sleep stage on the collapsibility of the upper airways in patients with sleep apnea. *Sleep* 2001; 24:90-95
13. Pevernagie DA, Shepard JW: Relations between sleep stage, posture and effective nasal CPAP levels in OSA. *Sleep* 1992; 15:162-167
14. Pevernagie DA, Stanton AW, Sheedy PF 2nd, Daniels BK, Shepard JW Jr: Effects of body position on the upper airway of patients with obstructive sleep apnea. *Am J Respir Crit Care Med* 1995; 152:179-185



15. Phillips BA, Okeson J, Pawsani D, Gilmore R: Effect of sleep position on sleep apnea and parafunctional activity. *Chest* 1986; 90:424-429
16. Pracharktam N, Hans MG, Strohl KP, Redline S: Upright and supine cephalometric evaluation of obstructive sleep apnea syndrome and snoring subjects. *Angle Orthod* 1994; 64:63-73
17. Tagaito Y, Isono S, Tanaka A, Ishikawa T, Nishino T: Sitting posture decreases collapsibility of the passive pharynx in anesthetized paralyzed patients with obstructive sleep apnea. *Anesthesiology* 2010; 113:812-818
18. Yildirim N, Fitzpatrick MF, Whyte KF, Jalleh R, Wightman AJA, Douglas NJ: The effect of posture on upper airway dimensions in normal subjects and in patients with the sleep apnea/hypopnea syndrome. *Am Rev Respir Dis* 1991; 144:845-847

*Observational studies, case reports, or non-pertinent comparison groups*

1. Arai YCP, Nakayama M, Kato N, Wakao Y, Ito H, Komatsu T: The effects of jaw thrust and the lateral position on heart rate variability in anesthetized children with obstructive sleep apnea syndrome. *Anesth Analg* 2007; 104:1352-1355
2. Isono S, Tanaka A, Ishikawa T, Tagaito Y, Nishino T: Sniffing position improves pharyngeal airway patency in anesthetized patients with obstructive sleep apnea. *Anesthesiology* 2005; 103:489-494

**Postoperative Monitoring.**

***Telemetry monitoring systems (pulse oximetry, ECG, or ventilation) versus no telemetry monitoring systems:***

*Observational studies, case reports, or non-pertinent comparison groups*

1. Biro P, Kaplan V, Bloch KE: Anesthetic management of a patient with obstructive sleep apnea syndrome and difficult airway access. *J Clin Anesth* 1995; 7:417-421
2. Bolden N, Smith CE, Auckley D, Makarski J, Avula R: Perioperative complications during use of an obstructive sleep apnea protocol following surgery and anesthesia. *Anesth Analg* 2007; 105:1869-1870
3. Bolden N, Smith CE, Auckley D: Avoiding adverse outcomes in patients with obstructive sleep apnea (OSA): development and implementation of a perioperative OSA protocol. *J Clin Anesth* 2009; 21:286-293
4. Isono S, Suzukawa M, Sho Y, Ohmura A, Kudo Y, Misawa K, Inaba S, Nishino T: Preoperative nocturnal desaturations as a risk factor for late postoperative nocturnal desaturations. *Br J Anaesth* 1998; 80:602-605
5. Levy P, Pepin JL, Deschaux-Blanc C, Paramelle B, Brambilla C: Accuracy of oximetry for detection of respiratory disturbances in sleep apnea syndrome. *Chest* 1996; 109:395-399
6. Magalang UJ, Domochoowski J, Veeramachaneni S, Draw A, Mador MJ, El Solh A, Grant BJB: Prediction of the Apnea-Hypopnea Index From Overnight Pulse Oximetry. *Chest* 2003; 124:1694-1701
7. Olson LG, Ambrogetti A, Gyulay SG: Prediction of sleep-disordered breathing by unattended overnight oximetry. *J Sleep Res* 1999; 8:51-55
8. Reeder MK, Goldman MD, Loh L, Muir AD, Casey KR, Lehane JR: Late postoperative nocturnal dips in oxygen saturation in patients undergoing major abdominal vascular surgery: predictive value of pre-operative overnight pulse oximetry. *Anaesthesia* 1992; 47:110-115

9. Reeder MK, Goldman MD, Loh L, Muir AD, Casey KR, Gitlin DA: Postoperative obstructive sleep apnoea. Haemodynamic effects of treatment with nasal CPAP. *Anaesthesia* 1991; 46:849-853

***Monitored settings (observational, stepdown, ICU) versus routine hospital wards:***

*Observational studies, case reports, or non-pertinent comparison groups*

1. Cullen DJ: Obstructive sleep apnea and postoperative analgesia - a potentially dangerous combination. *J Clin Anesth* 2001; 13:83-85
2. Ulnick KM, Debo RF: Postoperative treatment of the patient with obstructive sleep apnea. *Otolaryngol Head Neck Surg* 2000; 122:233-236

***V. Discharge Criteria***

**Hospital admission versus discharge home.**

*Observational studies, case reports, or comparisons without pertinent control groups*

1. Spiegel JH, Raval TH: Overnight hospital stay is not always necessary after uvulopalatopharyngoplasty. *Laryngoscope* 2005; 115:167-171