# Appendix

**Table A1: Studies evaluating the association between OSA and difficult airway**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Difficulty airway** | **n** | **Total** | **OSA** | **Non- OSA** | **Significant Impact of OSA on difficulty airway** | | **GRADE**  **Level of evidence** |
| **Yes** | **No** |  |
| Difficult mask ventilation28,30,31,36,38,39 | 6 | 72,888 | 5129 | 67,759 | 5 | 1 | Moderate |
| Difficult intubation24-29,31-33,35,38,39 | 12 | 19,581 | 1,775 | 17,806 | 7 | 5 | Moderate |
| Difficult mask ventilation and intubation28,37 | 2 | 191,049 | 26,361 | 164,688 | 2 | 0 | Moderate |
| Failed supraglottic airway27,34 | 2 | 15,832 | 662 | 15,170 | 0 | 2 | Moderate |
| Surgical airway | 0 | 0 | 0 | 0 | 0 | 0 | - |

GRADE: Grading of Recommendations, Assessment, Development, and Evaluation

**Table A2: Studies reporting on opioid analgesia and postoperative outcomes in OSA**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Studies** | **No. of studies** | **Patients**  **(N)** | **Adverse impact**  **(Studies)** | **Beneficial impact**  **(Studies)** | **No significant impact**  **(Studies)** | **Oxford**  **LOE** |
| **Observational** |  |  |  |  |  |  |
| Impact on outcome | 777-80,88,90,91 | 1,043 | 577-80,88 | 290,91 | - | 3 |
| Critical anesthesia events | 761,81-84,86,87 | 109,354 | 761,81-84,86,87 | - | - | 4 |
| Morbid obesity | 266,85 | 821 | 185 | - | 166 | 3 |
| Systematic review | 189 | 63 | 189 | - | - | 4 |
| **RCTs** |  |  |  |  |  |  |
| Remifentanil | 194 | 19 | 194 | - | - | 2 |
| Meperidine | 197 | 90 | 197 | - | - | 2 |
| Butorphanol | 296,98 | 272 | - | 296,98 | - | 2 |
| Opioid dose reduction | 293,95 | 101 | 293,95 | - | - | 2 |
| **Neuraxial opioids** |  |  |  |  |  |  |
| Systematic review | 199 | 121 | 199 | - | - | 4 |
| Observational | 2100,101 | 1,711 | 1100 | - | 1101 | 3 |
| RCT | 1102 | 48 | 1102 | - | - | 2 |

LOE: level of evidence

**Table A3: Association between recurrent hypoxemia, sleep fragmentation and pain perception or opioid sensitivity.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Studies** | **Observational study design** | **Patients**  **(N)** | **Exposure or predictor variable** | **Effect** | **Pain Perception** | **Opioid analgesic effect** | **Oxford**  **LOE** |
| **Experimental pain** | | | | | | | |
| Doufas 2013111 | Cross-sectional | 43 | Nocturnal arterial oxygen desaturation | Hypoxemia increased  opioid analgesic effect | - | Increased | 3 |
| Khalid 2011110 | Prospective crossover comparison | 12 | CPAP, AHI, Sleep continuity | CPAP reduced pain sensitivity | Increased | - | 3 |
| Smith 2009109 | Cross-sectional | 32 | Respiratory disturbance index (RDI)  Primary insomnia (PI) | Pain perception decreased (RDI)  Hyperalgesia (PI) | Decreased | - | 3 |
| **Chronic pain complaints** | | | | | | | |
| Doufas 2013112 | Retrospective | 634 | Nocturnal arterial oxygen desaturation | Hypoxemia increased  pain perception | Increased | - | 3 |
| **Postoperative pain and opioid analgesia** | | | | | | | |
| Turan 2015117 | Retrospective | 218 | Nocturnal arterial oxygen desaturation,  Postoperative opioid consumption | Hypoxemia increased  opioid analgesic effect | - | Increased | 3 |
| Chung 2014118 | Prospective | 58 | Arterial SpO2 | No association between hypoxemia and opioid analgesic effect | - | - | 3 |
| Sadhasivam 2012115 | Prospective | 194 | OSA, Race | Opioid analgesic effect altered | Increased | Increased | 3 |
| Sanders 2006116 | Prospective | 82 | Respiratory disturbance index | Opioid analgesic effect decreased | - | Decreased | 3 |
| Brown 2006114 | Prospective | 22 | Nocturnal arterial oxygen desaturation | Hypoxemia increased  opioid analgesic effect | - | Increased | 3 |
| Brown 2004113 | Retrospective | 46 | Nocturnal arterial oxygen desaturation | Hypoxemia increased  opioid analgesic effect | - | Increased | 3 |

LOE: level of evidence, CPAP: continuous positive airway pressure, AHI: apnea-hypopnea index, PI: Primary insomnia, RDI: Respiratory disturbance index

**Table A4: Propofol for Drug-Induced Sleep Endoscopy (DISE)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Study | Study design | Biases/Limitations | N | Outcomes/Conclusions | Oxford LOE |
| DeVito 2011120  Propofol for DISE; TCI vs. manual boluses. | RCT | No blinding. Dosing basis (TBW, LBW, or ABW) not mentioned. | 40 | 20% in the bolus group vs. 85% in the TCI group achieved apnea at the oropharynx and/or hypopharynx levels. Those who failed had a too-rapid onset of unconsciousness with drug-induced muscular relaxation collapse or central apnea. | 2 |
| Rabelo 2013121  Propofol during PSG in non-OSA vs. OSA subjects. | Prospective cross-sectional | No difference in AHI and mean SpO2 between groups was used to infer that etiology of obstruction, and hence DISE findings, would not be affected by propofol. | 30 | Sleep architecture affected by propofol: Propofol PSG vs. non-propofol PSG subjects spent less time in N1 stage sleep (2.2 ± 2.5 vs. 28.4 ± 18.5, P <0.01), more time in N3 (43.1 ± 34.0 vs. 13.3 ± 13.5, P<0.01), and had total suppression of REM (0 vs. 10.6 ± 10.1, P<0.01). No significant differences between propofol vs. non-propofol PSG's for AHI (15.91 ± 20.91 vs. 16.75 ± 20.08, P= 0.72) or mean SpO2 (95.39 ± 1.66 vs. 95.67 ± 1.42, P= 0.17). | 3 |
| Dotan 2013122  Pharyngeal muscles and airway collapse during DISE. | Prospective laboratory study | Dosing basis (TBW, LBW, or ABW) not mentioned. | 17 | Under propofol, the response of pharyngeal dilator muscles to central neural activation was attenuated; genioglossus muscle was most affected. | 4 |
| Capasso 2016123  DISE propofol vs. dexmedetomidine. | Case series, chart review | Dosing basis (TBW, LBW, or ABW) not mentioned. | 216 | Propofol vs. dexmedetomidine group had a 75% vs. 42.7% rate of complete tongue base obstruction. Odds ratio: 4.0, 95% CI 2.0-8.1, P= 0.0001. | 4 |
| Kuyrukluyildiz et al. 2015124  DISE propofol vs. dexmedetomidine. | RCT | No blinding. DISE/VOTE findings not described. Basis for dosing (TBW, LBW, or ABW) not mentioned. | 40 | During DISE, the 2 groups’ MAP and HR did not differ. SpO2 and RR were lower with propofol. Time to sedation for prop 9.0 ± 1.26 min. vs. dex 15.5 ± 2.14 min, P< 0.001. BIS® scores significantly lower in propofol group. | 2 |

N: number of subjects, LOE: level of evidence, DISE: drug-induced sleep endoscopy, TCI: target-controlled infusion, RCT: randomized controlled trial, TBW: total body weight, LBW: lean body weight, ABW: adjusted body weight, PSG: polysomnography, OSA: obstructive sleep apnea, AHI: apnea-hypopnea index, SpO2: peripheral oxygen saturation, N1: first stage of non-rapid eye movement sleep, N3: third stage of non-rapid eye movement sleep, CI: confidence interval, VOTE: classification system identifying sites of obstruction during DISE- velum/ oropharynx/tongue base/epiglottis, MAP: mean arterial pressure, HR: heart rate, RR: respiratory rate, BIS®: bispectral index

**Table A5: Propofol, Pharmacokinetics and Obesity**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Study | Study Design | Biases/Limitations | N | Outcomes/Conclusions | Oxford LOE |
| Cortinez 2010127  PK of propofol, dosed TBW vs. ABW. | Data from 3 observation studies | No randomization or blinding. Some obese, some normal weight, some undergoing surgery, some not. | 51 | Allometric size model (clearance modeled with an allometric 3/4 power, and distribution volume was calculated with a linear [exponent of 1] model) using TBW worked best. Dosing with ABW resulted in propofol concentrations consistently lower than target concentration. | 3 |
| Servin 1993128  MO dosed by ABW and nonobese by TBW. | Two observation- al studies of propofol PK. | No randomization or blinding. Some undergoing surgery, some not. | 18 | Total body clearance and volume at steady state correlated linearly with body weight in obese and controls, but distribution clearance did not. Context-sensitive half time (time required for the central compartment drug concentration at the end of infusion to decrease by 50%) was much faster than elimination half-life. Propofol dosage could be based upon TBW without risk of accumulation. | 4 |
| La Colla 2009129  Propofol TCI in MO, using ABW vs. TBW. | Prospective, randomized, double-blinded | No mention of how many dosage adjustments were made because of cardiovascular or CNS pharmacodynamics. | 24 | Propofol blood levels lower than predicted in both groups, more so for the ABW group. Marsh TCI model may underestimate total body clearance and central volume of distribution at steady state, underdosing the patient, especially if ABW is used. | 2 |
| Dong 2016130  Propofol dosed by TBW or LBW in MO; non-obese by TBW. | RCT | Non-obese controls were undergoing a different surgery, with more potential for underlying co-morbidity or intraoperative confounders, even though all were ASA I-II. | 29 | MO subjects had increased systemic clearance and peripheral compartment volume, resulting in a decreased propofol levels. Propofol maintenance infusion can be based on TBW in MO. | 2 |

N: number of subjects, LOE: level of evidence, PK: pharmacokinetics, TBW: total body weight, ABW: adjusted body weight, MO: morbidly obese, TCI: target-controlled infusion, CNS: central nervous system, LBW: lean body weight, RCT: randomized controlled trial, ASA: American Society of Anesthesiologists’ physical status classification

**Table A6: Adverse effects of propofol in patients with obstructive sleep apnea undergoing procedures with sedation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Study** | **Study Design** | **Biases/Limitations** | **N** | **Outcomes/Conclusions** | **Oxford LOE** |
| Mehta 2014138  STOP/BANG scores to predict complications during EGD or colonoscopy with propofol. | Observational | AI were left to the anesthesiologist's discretion without set criteria. | 243 | Incidence of AI and SRAE were not significantly different for S/B ≥3. AI and SRAE increased with BMI, age, loading dose of propofol, and smoking. 47.3% of all subjects required AI. | 3 |
| Coté 2010139  Airway interventions when propofol was used for advanced endoscopic procedures. | Observational | Airway interventions (AI) were left to the anesthesiologist's discretion without set criteria for doing AI. | 799 | AI were performed in 14.4% of subjects. 12.8% had SpO2 <90%. BMI, male gender and ASA ≥ III: significant predictors of AI. | 3 |
| Friedrich-Rust 2014140  Monitoring with vs. without capnography during colonoscopy with propofol. | RCT | Midazolam and/or ketamine used. Propofol dosing was not standardized. Anesthesia performed by either an anesthesiologist, nurse (not CRNA), or endoscopist-directed. | 533 | SpO2 <90%: less often in the capnography group. Apnea or hypopnea was detected in 183 (69%) of the capnography group, and 23% of those patients developed hypoxemia. Risk factors for hypoxemia: age ≥ 55, obesity, OSA, total dose of propofol, and use of ketamine in addition to propofol. | 2 |
| Nagels 2014141  Dentistry with propofol and remifentanil, monitored for oxygen desaturation events. | Prospective observational study | Complexity of dental case (simple vs. surgical) not mentioned. | 150 | Oxygen desaturation events, defined as SpO2 < 94%, correlated with BMI and male gender. | 3 |
| McVay 2017143  Obese vs. non-obese, having EGD. | Retrospective | Propofol used on all patients; opioids used at the nurse's discretion. | 395 | Obese subjects were more likely to have longer procedure times, episodes of SpO2 <90%, and need for airway interventions. | 3 |

N: number of subjects, LOE: level of evidence, STOP/BANG: acronym of a proprietary sleep apnea screening tool, EGD: esophagogastroduodenoscopy, AI: airway interventions, SRAE: sedation-related adverse events, S/B: STOP/BANG, BMI: body mass index, SpO2: peripheral oxygen saturation, RCT: randomized controlled trial, CRNA: certified registered nurse anesthetist, OSA: obstructive sleep apnea

**Table A7: Comparative effectiveness of Inhalational agents and IV propofol in obesity - RCTs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study | N | BMI kg/m2 | Surgery | Outcome/Conclusion | Effect in favor of | Oxford  LOE |
| Comparison: Propofol (TIVA) versus Sevoflurane | | | | | | |
| Fassbender151 2018 | 54 | 30.3±7.2 | Various | Neither propfol nor sevoflurane worsened the incidence of postoperative obstructive (AHI) or hypoxemic events. No difference between propofol and sevoflurane. | Both | 2 |
| Salihoglu152 2001 | 40 | 50 (35-64) | Bariatric | No difference anesthesia recovery; mean art. pressue ↓ and HR↓ with propofol. | Sevoflurane | 2 |
| Siampalioti153 2015 | 100 | >50 | Bariatric | Faster anesthesia recovery and improved hemodynamic stability with sevoflurane. | Sevoflurane | 2 |
| Comparison: Propofol (TIVA) versus Isoflurane | | | | | | |
| Hendolin1541994 | 41 | 29.3 ± 5.1 | UPPP (OSA) | Respiratory control recovery faster and lower pain with propofol. | Propofol | 2 |
| Pizzirani155 1992 | 40 | NA | Bariatric | Anesthesia recovery time shorter with propofol ( not stat. significant). | Propofol | 2 |
| Comparison: Propofol (TIVA) versus Desflurane | | | | | | |
| Tanaka156 2017 | 100 | >30 | Orthopedic | No difference in anesthesia recovery, delirium or cognitive impairment. | Neither | 2 |
| Zoremba157 2011 | 134 | 31 ± 3.5 | Minor | Impaired lungfunction and oxygen saturation ↓with propofol; particualry with higher obesity. | Desflurane | 2 |
| Comparison: Sevoflurane versus Isoflurane | | | | | | |
| Sollazzi158 2001 | 90 | >45 | Bariatric | Extubation time shorter and Aldtrete score ↑ in sevoflurane; no cardioresp. difference. | Sevoflurane | 2 |
| Torri159 2001 | 30 | >35 | Bariatric | Faster anesthesia recovery and PACU discharge with sevoflurane, no hemodynamic difference. | Sevoflurane | 2 |
| Torri160 2002 | 14 | >35 | Bariatric | More rapid wash-in and wash-out curves with sevoflurane. | Sevoflurane | 2 |
| Sudre652015 | 407 | 46.2 ± 6.4 | Bariatric | Anesthesia recovery longer, respiratory complications ↑, PACU stay ↑ with isoflurane | Sevoflurane\*  (short acting) | 2 |
| Comparison: Sevoflurane versus Desflurane | | | | | | |
| Arain161 2005 | 40 | ≥35 | Elective | No difference in anesthesia recovery, hemodynamics or cognitive function. | Neither | 2 |
| De Baerdemaeker162 2003 | 50 | 41 ± 5 | Bariatric | Faster anesthesia recovery, improved hemodynamic stability with desflurane. | Desflurane | 2 |
| De Baerdemaeker163 2006 | 50 | >35 | Bariatric | No differences in anesthesia recovery. | Neither | 2 |
| Bilotta164 2009 | 56 | 28 ± 6 | Craniotomy | Faster cognitive recovery and reversal to normocapnia and normal pH with desflurane. | Desflurane | 2 |
| Mc Kay174 2010\*\* | 120 | >30 | Various | Prolonged sevoflurane administration and higher BMI delay airway reflex recovery. | Desflurane | 3 |
| Ozdogan165 2016\*\* | 84 | >40 | Bariatric | No difference in hemodynamic and postoperaitve respiratory functions. | Neither | 3 |
| Strum166 2004 | 50 | ≥35 | Bariatric | Faster anesthesia recovery, aldrete score ↑, oxygen saturation ↑, PONV ↓ with desflurane | Desflurane | 2 |
| Vallejo167 2007 | 70 | >35 | Bariatric | No differences in anesthesia recovery, Aldrete score and pain. | Neither | 2 |
| La Colla168 2007 | 28 | 50.6 ± 5.4 | Bariatric | Faster anesthesia recovery; faster wash-in and -out with desflurane. | Desflurane | 2 |
| Kaur169 2013 | 40 | 49.23 ± 10.5 | Bariatric | Faster anesthesia recovery, Aldtere score ↑ with desflurane; no difference in hemodynamics. | Desflurane | 2 |

\*Sevoflurane embedded in a short acting anesthesia regimen with remifentanil, rocuronium, ropivacaine. \*\* Observational studies.

LOE: level of evidence, PACU: postoperative anesthesia care unit, PONV: postoperative nausea and vomiting, UPPP: uvulopalatopharyngoplasty

**Table A8: Comparative effectiveness of Inhalational agents, IV propofol and anesthesia monitoring in obesity – RCTs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study | N | BMI kg/m2 | Surgery | Conclusion | Effect in favor of | Oxford  LOE |
| Comparison: Propofol (TIVA) versus Desflurane, Isoflurane or Sevoflurane | | | | | | |
| Juvin170 2000 | 36 | 46.5 ± 5.3 | Bariatric | Faster Anesthesia recovery, oxygen saturation ↑, sedation ↓, mobility ↑ with desflurane. | Desflurane | 2 |
| Liu171 2015  Meta-analysis (RCTs) | 11 RCTs | 37.7-54.0 | Various | Faster anesthesia recovery with desflurane. | Desflurane | 1 |
| BIS or AAI\* monitoring for titration of anesthetic dosage | | | | | | |
| Ibraheim172 2008 | 30 | 43.2±5.07 | Bariatric | Faster anesthesia recovery, sevoflurane dose ↓, cost ↓ with BIS. | BIS monitoring | 2 |
| Freo173 2011 | 60 | 46 ± 6 | Bariatric | Improved anesthesia recovery, sevoflurane dose ↓ with AAI monitoring. | AAI monitoring | 2 |

**\***AAI: A-line Autoregression Index, TIVA: total intravenous anesthesia, BIS: bispectral index

**Table A9: Intravenous benzodiazepine sedation**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Study | Substance | Study design | Population | Procedure | Outcomes | Conclusion | Oxford LOE |
| Adler215 2011 | Midazolam and Fentanyl | Retrospective | OSA/non-OSA  N=103 | EGD and colonoscopy | Desaturation, hypotension, other unspecified complications | OSA did not increase the risk for complications | 3 |
| Cha216 2013 | Midazolam | Prospective / Observational | OSA / non-OSA  N=96 | EGD | Cardiopulmonary complications | OSA did not increase the risk for complications | 3 |
| Lee213 2009 | Midazolam | Retrospective | OSA / simple snorers  N=63 | Sleep videofluoroscopy | Oxygen desaturation | OSA increased the risk for desaturation | 3 |
| Sadaoka209 1996 | Diazepam | Prospective / Observational | OSA / simple snorers  N=50 | DISE | Oxygen desaturation, apneas | OSA increased the risk for complications | 3 |
| Mador219 2012 | Midazolam and Fentanyl | Prospective / Observational | high risk / low risk for OSA according to Berlin questionnaire  N=904 | Upper, lower or combined endoscopy | Cardiorespiratory complications | High risk status for OSA did not increase the risk for complications | 3 |

LOE: level of evidence, EGD: esophagogastroduodenoscopy

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Study** | **Study design** | **Patients (n)** | **α-2 agonist** | **Comparison drug** | **Outcome findings in α-2 agonist group** | **Effect** | **Oxford LOE** |
| Capasso 2016123 | Case series | 216 | Dex | Propofol | * ↓ likelihood of complete tongue base obstruction vs. partial or no obstruction; no significant differences pattern or degree of obstruction at other sites | Unclear | 4 |
| Cho 2015220 | RCT | 66/64\* | Dex-Remifentanil | Propofol (P)  Propofol- Remifentanil  (P-R) | * More patients had obstruction at oropharynx, tongue base and epiglottis, but did not reach significance * No difference in airway obstruction scores * Lower incidence of desaturations and higher mean SpO2 vs. P-R; no difference in desaturations or mean SpO2 vs. P; no difference in minimum SpO2 * RR < P at several time points; RR > P-R at 1 time point * No difference in intra-procedural hypotension, bradycardia, arrhythmia; No difference in intra-procedural MAP, HR; Less cough vs. P, no difference vs. P-R | Unclear | 2 |
| Kuyrukluyildiz 2015124 | RCT | 40 | Dex | Propofol | * SpO2 higher intra- and post-procedure * RR higher intra- and post-procedure * MAP no difference intra-procedure, lower post-procedure * HR no difference intra-procedure, lower post-procedure | Unclear | 2 |
| Yoon 2016221 | Prospective, observational | 50# | Dex | Propofol | * No difference in site or degree of obstruction * % of patients with desaturations lower; mean minimal SpO2 higher * Mean HR lower, no difference in MAP * Lesser % of patients had > 20% change from baseline HR or BP | Unclear | 3 |
| Chang 2017222 | Systematic review | Summary of conclusions: Dexmedetomidine appeared to provide greater cardiopulmonary stability. Benefits of propofol included faster onset and shorter half-life. When considering these DISE studies (plus data from other endoscopy studies), propofol seemed to induce greater airway obstruction and desaturations. In the context of DISE where the goal is to induce airway obstruction, propofol may be favored, but whether this obstruction reflects the obstruction during REM sleep is not established. | | | | | 2 | |

**Table A10: Studies using α-2 agonists (dexmedetomidine) in DISE**

\* = n enrolled/ n analyzed; # = 50 individual patients underwent DISE on two consecutive days, first with propofol, then with dexmedetomidine. LOE: level of evidence Dex: Dexmedetomidine, P: Propofol, P-R: Propofol-Remifentanil, SpO2: peripheral oxygen saturation, RR: respiratory rate, MAP: mean arterial pressure, HR: heart rate, BP: blood pressure

**Table A11: Alpha-2 agonists and perioperative adverse events in OSA patients**

| Study | Study design | Patients (n) | α-2 agonist | Comparison drug | Procedure | Outcome findings in α-2 agonist group | Effect | Oxford  LOE |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Airway and Respiratory Effects | | | | | | | | |
| Abdelmageed 201193 | RCT | 43/39\* | Dex | Placebo | Uvuloplasty | Less respiratory depression, Higher mean RR and SpO2 | Not detrimental | 2 |
| Bamgbade 2009224 | Case Series | 22 | Dex | N/A | Laparoscopic (lap) gastric bypass | Described uneventful extubations, adequate saturations with supplemental oxygen, and no need for CPAP | Not detrimental | 4 |
| Chawla 2010227 | Retrospective | 268 | Dex | No Dex | Airway reconstruction surgery | General statement that no interventions required for airway compromise in either group | Not detrimental | 3 |
| Dholakia 2007225 | Retrospective | 71# | Dex | No Dex | Lap gastric bypass;  Lap gastric band | No difference in initial PACU RR for both surgical groups | Not detrimental | 3 |
| Hannallah 2013134 | Prospective case series | 20  (7 w/ OSA) | Dex + propofol | N/A | Endoscopy | Description that 13 patients required nasal trumpet, 2 patients required intervention for desaturations | Unclear | 4 |
| Issa 1992228 | RCT, crossover | 8 | Clonidine | Placebo | None (Sleep) | * Suppressed REM sleep, decreased apnea duration during REM sleep, no difference in AHI over entire sleep cycle * Described varying effects on the breathing patterns and resulting obstructive events during REM sleep * Small differences in mean SpO2 and apnea duration assessed over entire sleep cycle (clincial significance unclear) | Unclear | 2 |
| Jayaraman 2013233 | RCT | 40 | Intranasal dex | Alprazolam | Bariatric surgery | No difference in preoperative SpO2 | Not detrimental | 2 |
| Ma 2012223 | RCT | 60 | Dex | Propofol | Coblation-assisted upper respiratory procedure | Lower incidence of desaturation, Higher SpO2 at most time points; RR higher at one time point | Not detrimental | 2 |
| Pawlik 2005229 | RCT | 30 | Clonidine | Placebo | ENT surgery | No difference in AHI or desaturation index compared to placebo; minimal oxygen saturation significantly higher with clonidine on day of surgery; general statement at that no adverse respirarory events observed | Not detrimental | 2 |
| Xu 2015226 | RCT | 124 | Dex | Propofol | UPPP | Less respiratory depression; less coughing at extubation and coughing less severe; no patients in either group reintubated | Not detrimental | 2 |
| Hemodynamic Effects | | | | | | | | |
| Abdelmageed 201193 | RCT | 43/39\* | Dex | Placebo | Uvuloplasty | General statement that no hemodynamic differences, no interventions required for cardiovascular problems in either group | Not detrimental | 2 |
| Chawla 2010227 | Retrospective | 268 | Dex | No Dex | Airway reconstruction surgery | * Less use of rescue anti-hypertensives intraoperatively * More patients with stable MAP (< 100 mmHg) postoperatively * General statement describing transient loading dose HTN, followed by “titratable, controlled hypotension and bradycardia” intraoperatively * General statement that there were no significant cardiovascular complications in either group | Not detrimental | 3 |
| Dholakia 2007225 | Retrospective | 71# | Dex | No Dex | Lap gastric bypass;  Lap gastric band | No difference in mean PACU HR or SBP for both surgical groups | Not detrimental | 3 |
| Feld 2006230 | RCT | 20 | Dex  (6 w/ OSA) | Fentanyl  (4 w/ OSA) | Open gastric bypass | Lower MAP and HR intraoperatively and postoperatively; lower minimum HR during induction, no difference in lowest MAP during induction | Unclear | 2 |
| Feld 2007232 | RCT | 40 | Dex  (5 w/ OSA) | Fentanyl  (6 w/ OSA) | Lap gastric band | No difference b/w MAP and HR | Not detrimental | 2 |
| Hannallah 2013134 | Prospective case series | 20  (7 w/ OSA) | Dex + propofol | N/A | Endoscopy | Transient hypotension (SBP < 90 mmHg) requiring vasopressor use in 3 patients during procedure, 3 patients post-procedure | Unclear | 4 |
| Jayaraman 2013233 | RCT | 40 | Intranasal dex | Alprazolam | Bariatric surgery | * No difference in preop HR, MAP * No difference in MAP at laryngoscopy, intubation * Lower HR at laryngoscopy, no difference at intubation | Unclear | 2 |
| Ma 2012223 | RCT | 60 | Dex | Propofol | Coblation-assisted upper respiratory procedure | * Lower MAP at one time point * Lower HR at several time points * No difference in need for atropine/ephedrine * Less need for rescue beta blocker | Unclear | 2 |
| Pawlik 2005229 | RCT | 30 | Clonidine | Placebo | ENT surgery | * MAP lower preoperatively, during operation, emergence and in recovery; no difference in MAP at intubation * No difference in HR preoperatively, during intubation, emergence; HR lower in recovery room * 2 pts required atropine for HR, not required in placebo pts * Lower need for anti-HTN meds in recovery | Unclear | 2 |
| Sollazzi 2009234 | RCT | 50 | Clonidine + ketamine | No Clonidine + ketamine | Bariatric Surgery | Description of less spikes in BP and HR, but did not reach statistical signficance | Unclear | 2 |
| Tufanogullari 2008231 | RCT | 80/77\* | Dex (3 different doses) | Placebo | Bariatric Surgery | * Lower MAP at skin incision, no difference in HR; no difference in MAP at intubation * More patients in highest dose dex group required intraoperative phenylephrine, while more patients in control group required beta-blocker * Lower MAP, no difference in HR in PACU | Unclear | 2 |
| Xu 2015226 | RCT | 124 | Dex | Propofol | UPPP | Hypertension and tachycardia less frequent, bradycardia more frequent, no difference in hypotension; lower BP and HR at extubation | Unclear | 2 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time to Extubation | | | | | | | | |
| Abdelmageed 201193 | RCT | 43/39\* | Dex | Placebo | Uvuloplasty | Longer time to extubation | Detrimental | 2 |
| Feld 2006230 | RCT | 20 | Dex  (6 w/ OSA) | Fentanyl  (4 w/ OSA) | Open gastric bypass | Shorter time to extubation | Not detrimental | 2 |
| Sollazzi 2009234 | RCT | 50 | Clonidine + ketamine | No Clonidine + ketamine | Bariatric Surgery | Shorter time to extubation | Not detrimental | 2 |
| Tufanogullari 2008231 | RCT | 80/77\* | Dex (3 different doses) | Placebo | Bariatric Surgery | No difference | Not detrimental | 2 |
| Xu 2015226 | RCT | 124 | Dex | Propofol | UPPP | Shorter time to extubation | Not detrimental | 2 |
| Post-procedure Sedation | | | | | | | | |
| Abdelmageed 201193 | RCT | 43/39\* | Dex | Placebo | Uvuloplasty | No difference in postoperative sedation scores | Not detrimental | 2 |
| Hannallah 2013134 | Prospective case series | 20  (7 w/ OSA) | Dex + propofol | N/A | Endoscopy | Described prolonged sedation as main reason for discharge delay; 16 pts reported drowsiness after discharge | Detrimental | 4 |
| Postoperative Nausea and Vomiting | | | | | | | | |
| Abdelmageed 201193 | RCT | 43/39\* | Dex | Placebo | Uvuloplasty | Less nausea/vomiting | Not detrimental | 2 |
| Dholakia 2007225 | Retrospective | 71# | Dex | No Dex | Lap gastric bypass;  Lap gastric band | No difference in antiemetic dose in gastric bypass; Less antiemetic dose in gastric band | Not detrimental | 3 |
| Tufanogullari 2008231 | RCT | 80 | Dex (3 different doses) | Placebo | Bariatric Surgery | Less nausea/vomiting; lower incidence of need for rescue antiemetic | Not detrimental | 2 |
| Xu 2015226 | RCT | 124 | Dex | Propofol | UPPP | No difference in nausea/vomiting | Not detrimental | 2 |

\* = n enrolled/ n analyzed; # Dholakia et al. analyzed gastric bypass (Dex n = 23, no Dex = 19) and gastric band (Dex n = 11, no Dex n = 18) patients separately.

LOE: level of evidence, Dex: Dexmedetomidine, PACU: postoperative anesthesia care unit, UPPP: uvulopalatopharyngoplasty, SpO2: peripheral oxygen saturation, HTN: hypertension, BP: blood pressure, SBP: systolic blood pressure, MAP: mean arterial pressure, RR: respiratory rate, CPAP: continuous positive airway pressure, pts: patients

**Table A12: Anesthesia technique**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Study | Study design | Patients (N) | Surgery | Outcomes | Conclusion | Effect of general anesthesia | Oxford  LOE |
| Anesthesia technique as a modifier of postoperative outcome | | | | | | | |
| Ambrosii 2016236 | Observational/  prospective | 400 | Orthopedic, abdominal | Post-operative complications | General anesthesia associated with higher risk for complications | adverse | 4 |
| Liu 2009237 | Observational/  prospective | 653 | UPPP | Postoperative complications | General anesthesia associated with higher risk for complications | adverse | 3 |
| Liu SS 2011238 | Observational/  retrospective | 527 | Orthopedic | Postoperative complications | General anesthesia  associated with higher risk for hypoxemia | adverse | 3 |
| Memtsoudis 2013235 | Observational/  retrospective | 30,024 | THA/TKA | Postoperative complications,  LOS, cost | General anesthesia associated with higher risk for complications | adverse | 2 |
| Naqvi 2017239 | Observational/  retrospective | 4,984 | TJA | Postoperative  complications | General anesthesia associated with higher risk for complications | adverse | 2 |
| Ramachandran 201761 | Observational  /retrospective | 108,479 | Various | Postoperative respiratory complications | In general anesthesia, OSA a predictor of complications | adverse | 3 |
| Deterioration of sleep disordered breathing | | | | | | | |
| Chung 201479 | Observational/  prospective | 376 | Various | Apnea-Hypopnea Index  Central Apnea Index | General anesthesia associated with increased central apnea index | adverse | 3 |
| Residual neuromuscular blockade and general anesthesia | | | | | | | |
| Pereira 201367 | Observational/  prospective | 304 | Various | Residual neuromuscular blockade | Higher incidence of residual neuromuscular blockade in OSA | adverse | 3 |
| Xara 2015242 | Observational/  prospective | 108 | Various | Residual neuromuscular blockade | Higher incidence of residual neuromuscular blockade in OSA | adverse | 3 |
| Pre- and postoperative airway management complications | | | | | | | |
| Biddle 1996240 | Observational/  prospective | 76 | Various | Airway management complications | Airway management complications more frequent in OSA | adverse | 3 |
| Loube 1997241 | Observational  /retrospective | 48 | UPPP | Airway management complications | Airway management complications more frequent in OSA | adverse | 3 |

LOE: level of evidence, THA: total hip arthroplasty, TKA: total knee arthroplasty, TJA: total joint arthroplasty, UPPP: uvulopalatopharyngoplasty, LOS: length of stay