Practice Guidelines for Moderate Procedural Sedation and Analgesia

##### American Society of Anesthesiologists

**Bibliography by Section**

***I. Pre-procedure patient evaluation and preparation***

**Reviewing medical records (patient condition)**

***Underlying medical problems.***

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

1. Andrade C, Gill J, Kulkarni P, Amodeo D, Goldsmith S, Boyd W, Anderson W, Klein M, Vidyarthi G: Evaluation of the safety of conscious sedation and gastrointestinal endoscopy in the veteran population with sleep apnea. American Journal of Gastroenterology 2013; 108:S480
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**Physical examination.**

No entries

**Consultation with a medical specialist.**

No entries

**Patient preparation.**

1. Bell A, Treston G, McNabb C, Monypenny K, Cardwell R: Profiling adverse respiratory events and vomiting when using propofol for emergency department procedural sedation. Emerg Med Australas 2007; 19:405-10
2. Ingebo KR, Rayhorn NJ, Hecht RM, Shelton MT, Silber GH, Shub MD: Sedation in children: adequacy of two-hour fasting. J Pediatr 1997; 131:155-158
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***II. Patient monitoring***

**Level of consciousness (e.g., responsiveness)**

No entries

**Breathing/ventilation (observation, auscultation, chest excursion**

No entries

**Continual end tidal carbon dioxide monitoring**

*Randomized controlled trials*

1. Beitz A, Riphaus A, Meining A, Kronshage T, Geist C, Wagenpfeil S, Weber A, Jung A, Bajbouj M, Pox C, Schneider G, Schmid RM, Wehrmann T, von Delius S: Capnographic monitoring reduces the incidence of arterial oxygen desaturation and hypoxemia during propofol sedation for colonoscopy: a randomized, controlled study (ColoCap Study). Am J Gastroenterol 2012; 107:1205-12
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*Nonrandomized comparative studies*

1. Barnett S, Hung A, Tsao R, Sheehan J, Bukoye B, Sheth SG, Leffler DA: Capnographic monitoring of moderate sedation during low-risk screening colonoscopy does not improve safety or patient satisfaction: A prospective cohort study. Am J Gastroenterol 2016; 111:388-94
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6. Soto RG, Fu ES, Vila H Jr.,Miguel RV: Capnography accurately detects apnea during monitored anesthesia care. Anesth Analg 2004; 99:379 –82

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

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2. Brady P, Wilson K, Meeke R, Girdler N, McCreary C: Capnometry monitoring during intravenous sedation with midazolam for oral surgery. Oral Surg 2016; 9:94–101
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**Plethysmography**

No entries

**Pulse oximetry**

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

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8. Conlong P, Rees W: The use of hypnosis in gastroscopy: a comparison with intravenous sedation. Postgrad Med J 1999; 75:223-5
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27. Wright SW: Conscious sedation in the emergency department: The value of capnography and pulse oximetry. Ann Emerg Med 1992; 21:551-5

**Hemodynamic monitoring**

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

1. Gilger MA, Jeiven SD, Barrish JO, McCarroll LR: Oxygen desaturation and cardiac arrhythmias in children during esophagogastroduodenoscopy using conscious sedation. Gastrointest Endosc 1993; 39:392-5
2. Hartke R, Gonzalez Rothi R, Abbey N: Midazolam-associated alterations in cardiorespiratory function during colonoscopy. Gastro Endosc 1989; 35:232-8
3. Herman LL, Kurtz RC, McKee KJ, Sun M, Thaler HT, Winawer J: Risk factors associated with vasovagal reactions during colonoscopy. Gastrointest Endosc 1993; 39:388-91

**Contemporaneous recording of monitored parameters**

No entries

**Presence of an individual dedicated to monitoring**

No entries

**Creation and implementation of QI processes**

*Nonrandomized comparative studies*

1. Thurman RJ, Bryce S, Phillips L: Use of a novel electronic pre-sedation checklist improves safety documentation in emergency department sedations. Acad Emerg Med. 2013; 20 (Suppl 1):S65

***III. Supplemental oxygen***

**Supplemental oxygen versus room air or no supplemental oxygen**

*Randomized controlled trials*

1. Arakawa H, Kaise M, Sumiyama K, Saito S, Suzuki T, Tajiri H: Does pulse oximetry accurately monitor a patient's ventilation during sedated endoscopy under oxygen supplementation? Singapore Med J 2013; 54:212-5
2. Bowling TE, Hadjiminas CL, Polson RJ, Baron JH, Foale RA: Effects of supplemental oxygen on cardiac rhythm. Gut 1993; 34:1492-7
3. Deitch K, Chudnofsky CR, Dominici P: The utility of supplemental oxygen during emergency department procedural sedation and analgesia with midazolam and fentanyl: a randomized, controlled trial. Ann Emerg Med 2007; 49:1-8
4. Deitch K, Chudnofsky CR, Dominici P, Latta D, Salamanca Y: The utility of high-flow oxygen during emergency department procedural sedation and analgesia with propofol: a randomized, controlled trial. Ann Emerg Med 2011; 58:360-4
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8. Rohlfing GK, Dilley DC, Lucas WJ, Vann WF, Jr: The effect of supplemental oxygen on apnea and oxygen saturation during pediatric conscious sedation. Ped Dent 1998; 20:8-16
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*Nonrandomized comparative studies*

1. Gross JB, Long WB: Nasal oxygen alleviates hypoxemia in colonoscopy patients sedated with midazolam and meperidine. Gastrointest Endosc 1990; 36:26-9
2. Holm C, Christensen M, Schulze S, Rosenberg J: Effect of oxygen on tachycardia and arterial oxygen saturation during colonoscopy. Eur J Surg 1999; 165:755-8

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

1. Bell GD, Antrobus JHL, Lee J, Coady T, Morden A: Bolus or slow titrated injection of midazolam prior to upper gastrointestinal endoscopy? Relative effect on oxygen saturation and prophylactic value of supplemental oxygen. Aliment Pharmacol Ther 1990; 4:393-401
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3. Bell GD, Quine A, Antrobus JHL, Morden A, Burridge SM, Lee J, Coady TJ: Upper gastrointestinal endoscopy: A prospective randomized study comparing continuous supplemental oxygen via the nasal or oral route. Gastrointest Endosc 1992; 38:319-25
4. Breuer HWM, Charchut St, Worth H: Effects of diagnostic procedures during fiberoptic bronchoscopy on heart rate, blood pressure, and blood gases. Klin-Wochenschr 1989; 67:524-9
5. McKee CC, Ragland JJ, Myers JO: An evaluation of multiple clinical variables for hypoxia during colonoscopy. Surg Gynecol Obstet 1991; 173:37-40
6. Rubin DM, Eisig S, Freeman K, Kraut RA: Effect of supplemental gases on end-tidal CO2 and oxygen saturation in patients undergoing fentanyl and midazolam outpatient sedation. Anesth Prog 1997; 44:1-4

**Method of oxygen administration (e.g., nasal cannula, face mask, specialized devices)**

*Randomized controlled trials*

1. Sago T, Harano N, Chogyoji Y, Nunomaki M, Shiiba S, Watanabe S: A nasal high-flow system prevents hypoxia in dental patients under intravenous sedation. J Oral Maxillofac Surg 2015; 73:1058-64

***IV. Emergency support***

**Presence of individual(s) capable of establishing a patent airway, positive pressure ventilation and resuscitation**

No entries

**Presence of emergency and airway equipment**

No entries

**Presence of an individual to establish intravenous access**

No entries

**Intravenous access versus no intravenous access**

No entries

***V. Sedative/analgesic medications not intended for general anesthesia***

**Sedatives**

***Benzodiazepines versus opioids.***

*Randomized controlled trials*

1. Sandler ES, Weyman C, Conner K, Reilly K, Dickson N, Luzins J, McGorray S: Midazolam versus fentanyl as premedication for painful procedures in children with cancer. Pediatrics 1992; 89:631-634

***Dexmedetomidine versus other non-GA sedatives or analgesics.***

*Randomized controlled trials: dexmedetomidine alone vs non-GA sedatives or analgesics*

1. Demiraran Y, Korkut E, Tamer A, Yorulmaz I, Kocaman B, Sezen G, Akcan Y: The comparison of dexmedetomidine and midazolam used for sedation of patients during upper endoscopy: A prospective, randomized study. Can J Gastroenterol 2007; 21:25-9
2. Surendar MN, Pandey RK, Saksena AK, Kumar R, Chandra G: A comparative evaluation of intranasal dexmedetomidine, midazolam and ketamine for their sedative and analgesic properties: a triple blind randomized study. J Clin Pediatr Dent 2014; 38:255-61

*Randomized controlled trials: dexmedetomidine alone vs non-GA sedatives combined with analgesics*

1. Jalowiecki P, Rudner R, Gonciarz M, Kawecki P, Petelenz M, Dziurdzik P: Sole use of dexmedetomidine has limited utility for conscious sedation during outpatient colonoscopy. Anesthesiology 2005; 103:269-73
2. Parikh DA, Kolli SN, Karnik HS, Lele SS, Tendolkar BA: A prospective randomized double-blind study comparing dexmedetomidine vs. combination of midazolam-fentanyl for tympanoplasty surgery under monitored anesthesia care. J Anaesthesiol Clin Pharmacol 2013; 29:173-8
3. Ramaswamy SS, Parimala B: Comparative evaluation of two different loading doses of dexmedetomidine with midazolam-fentanyl for sedation in vitreoretinal surgery under peribulbar anaesthesia. Indian J Anaesth 2016; 60:89-93
4. Zeyneloglu P, Pirat A, Candan S, Kuyumcu S, Tekin I, Arslan G: Dexmedetomidine causes prolonged recovery when compared with midazolam/fentanyl combination in outpatient shock wave lithotripsy. Eur J Anaesthesiol 2008; 25:961-7

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

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2. Candiotti KA, Bergese SD, Bokesch PM, Feldman MA, Wisemandle W, Bekker AY: Monitored anesthesia care with dexmedetomidine: a prospective, randomized, double-blind, multicenter trial. Anesth Analg 2010; 110:47-56
3. Lubisch N, Roskos R, Sattler SM: Improving outcomes in pediatric procedural sedation. Jt Comm J Qual Patient Saf 2008; 34:192-5
4. Makary L, Vornik V, Finn R, Lenkovsky F, McClelland AL, Thurmon J, Robertson B: Prolonged recovery associated with dexmedetomidine when used as a sole sedative agent in office-based oral and maxillofacial surgery procedures. J Oral Maxillofac Surg 2010; 68:386-91
5. Mason KP, Fontaine PJ, Robinson F, Zgleszewski S: Pediatric sedation in a community hospital-based outpatient MRI center. AJR Am J Roentgenol 2012; 198:448-52
6. Mason KP, Lubisch NB, Robinson F, Roskos R: Intramuscular dexmedetomidine sedation for pediatric MRI and CT. AJR Am J Roentgenol 2011; 197:720-5
7. Mason KP, Robinson F, Fontaine P, Prescilla R: Dexmedetomidine offers an option for safe and effective sedation for nuclear medicine imaging in children. Radiology 2013; 267:911-7
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**Sedative/opioid combinations**

***Benzodiazepines+opioids versus benzodiazepines (all routes of administration).***

*Randomized controlled trials*

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***Benzodiazepines+opioids versus opioids.***

*Randomized controlled trials*

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***Dexmedetomidine+other sedatives or analgesics versus combinations of other sedatives and/or analgesics.***

*Randomized controlled trials*

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

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***Intravenous versus non-intravenous non-GA sedative/analgesic drugs.***

*Randomized controlled trials*

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

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***Titration of non-GA sedative/analgesic drugs versus single dose, repeat bolus, continuous infusion.***

*Randomized controlled trials*

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

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***VI. Sedative/analgesic medications intended for general anesthesia***

**Propofol**

***Propofol versus non-general anesthesia sedatives or analgesics.***

*Randomized controlled trials: propofol alone versus non-general anesthesia sedative/analgesics alone*

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*Randomized controlled trials: propofol combined with other sedatives intended for general anesthesia versus propofol (alone or in combination)*

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**Ketamine**

***Ketamine versus non-general anesthesia sedatives or analgesics.***

*Randomized controlled trials: ketamine alone versus non-general anesthesia sedative/analgesics alone*

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*Randomized controlled trials: ketamine alone versus non-general anesthesia sedative/analgesic combinations*

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*Randomized controlled trials: ketamine combined with non-general anesthesia sedative/analgesics versus ketamine alone*

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*Randomized controlled trials: ketamine combined with non-general anesthesia sedative/analgesics versus non-general anesthesia sedative/analgesics (alone or in combination)*

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***Ketamine versus other sedatives or analgesics intended for general anesthesia.***

*Randomized controlled trials: ketamine alone versus other general anesthesia sedatives (alone or in combination)*

1. Genzlinger MA, Salen P, Grossman M, Stehly C, Stoltzfus J: "Put me out doc": Ketamine versus etomidate for the reduction of orthopedic dislocations. Ann Emerg Med 2012; 60:S52-S53
2. Milazzo A, Villaneuve R, Salen P, Stoltzfus J, Grossman M: A comparison of ketamine versus etomidate for procedural sedation for the reduction of joint dislocations. Annals Emerg Med 2014; 1:S130
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*Randomized controlled trials: ketamine combined with sedatives intended for general anesthesia versus other sedatives intended for general anesthesia (alone or in combination)*

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*Randomized controlled trials: ketamine combined with other sedatives intended for general anesthesia versus ketamine (alone or in combination)*

No entries

*Nonrandomized comparative studies: ketamine (alone or in combination) versus non-general anesthesia sedative/analgesics (alone or in combination) or general anesthesia sedative/analgesics (alone or in combination)*

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*Observational studies, case reports, or non-pertinent comparison groups: ketamine (alone or in combination with non-general anesthesia or general anesthesia sedative/analgesics)*

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**Etomidate**

***Etomidate versus non-general anesthetic (GA) sedatives or analgesics.***

*Randomized controlled trials: etomidate alone versus non-general anesthesia sedative/analgesics alone*

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*Randomized controlled trials: etomidate alone versus non-general anesthesia sedative/analgesic combinations*

No entries

*Randomized controlled trials: etomidate combined with non-general anesthesia sedative/analgesics versus etomidate alone*

No entries

*Randomized controlled trials: etomidate combined with non-general anesthesia sedative/analgesics versus non-general anesthesia sedative/analgesics (alone or in combination)*

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***Etomidate versus other sedatives or analgesics intended for general anesthesia.***

*Randomized controlled trials: etomidate alone versus other general anesthesia sedatives (alone or in combination)*

1. Genzlinger MA, Salen P, Grossman M, Stehly C, Stoltzfus J: "Put me out doc": Ketamine versus etomidate for the reduction of orthopedic dislocations. Ann Emerg Med 2012; 60:S52-S53
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*Randomized controlled trials: etomidate combined with sedatives intended for general anesthesia versus other sedatives intended for general anesthesia (alone or in combination)*

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*Randomized controlled trials: etomidate combined with other sedatives intended for general anesthesia versus etomidate (alone or in combination)*

No entries

*Nonrandomized comparative studies: etomidate (alone or in combination) versus non-general anesthesia sedative/analgesics (alone or in combination) or general anesthesia sedative/analgesics (alone or in combination)*

No entries

*Observational studies, case reports, or non-pertinent comparison groups: etomidate (alone or in combination with non-general anesthesia or general anesthesia sedative/analgesics)*

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***Intravenous versus non-intravenous sedatives intended for general anesthesia.***

*Randomized controlled trials*

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2. Sener S, Eken C, Schultz CH, Serinken M, Ozsarac M: Ketamine with and without midazolam for emergency department sedation in adults: a randomized controlled trial. Ann Emerg Med 2011; 57:109-14

*Nonrandomized comparative studies*

1. Treston G, Bell A, Cardwell R, Fincher G, Chand D, Cashion G: What is the nature of the emergence phenomenon when using intravenous or intramuscular ketamine for paediatric procedural sedation? Emerg Med Australas 2009; 21:315-22
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4. Ramaswamy P, Babl FE, Deasy C, Sharwood LN: Pediatric procedural sedation with ketamine: time to discharge after intramuscular versus intravenous administration. Acad Emerg Med 2009; 16:101-7

***Titration of GA sedative/analgesic drugs versus single dose, repeat bolus, continuous infusion.***

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

1. Bell A, Treston G, Cardwell R, Schabort WJ, Chand D: Optimization of propofol dose shortens procedural sedation time, prevents resedation and removes the requirement for post-procedure physiologic monitoring. Emerg Med Australas 2007; 19:411-7
2. Heuss LT, Schnieper P, Drewe J, Pfimlin E, Beglinger C: Conscious sedation with propofol in elderly patients: a prospective evaluation. Aliment Pharmacol Ther 2003; 17:1493-1501
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5. Novak H, Karlsland Akeson P, Akeson J: Sedation with ketamine and low-dose midazolam for short-term procedures requiring pharyngeal manipulation in young children. Paediatr Anaesth 2008; 18:48-54

***VII. Reversal agents***

**Naloxone**

*Randomized controlled trials: naloxone versus placebo.*

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*Randomized controlled trials: intravenous versus non-intravenous (e.g., oral, nasal, IM, rectal, transdermal, sublingual, iontophoresis) naloxone.*

No entries

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

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2. Balsells F, Wyllie R, Kay M, Steffen R: Use of conscious sedation for lower and upper gastrointestinal endoscopic examinations in children, adolescents, and young adults: a twelve-year review. Gastrointest Endosc 1997; 45:375-80
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**Flumazenil**

***Flumazenil versus placebo.***

*Randomized controlled trials: flumazenil to reverse benzodiazepines alone.*

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3. Andrews PJD, Wright DJ, Lamont MC: Flumazenil in the outpatient: a study following midazolam as sedation for upper gastrointestional endoscopy. Anaesthesia 1990; 45:445-8
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*Nonrandomized comparative studies: flumazenil to reverse benzodiazepines alone.*

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*Observational studies, case reports, or non-pertinent comparison groups: flumazenil to reverse benzodiazepines alone.*

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***Intravenous versus non-intravenous (e.g., oral, nasal, IM, rectal, transdermal, sublingual, iontophoresis) flumazenil.***

No entries

***VIII. Recovery care***

**Continued observation and monitoring until discharge**

No entries

**Predetermined discharge criteria**

No entries