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Master thesis | Original study

Use of Dexmedetomidine in patients undergoing ambulatory anesthesia: a narrative review

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Abstract

Background: **Dexmedetomidine (DEX) is a potent alpha-2 adrenoceptor agonist with a high degree of selectivity. Its pharmacologic effects include sedation, anxiolysis, analgesia, sympatholysis, opioid-sparing properties and preservation of respiratory function, making it suitable for sedation and analgesia throughout the perioperative period. Ambulatory anesthesia concerns all patients who require anesthesia for a procedure or surgery without requiring an overnight hospital stay. In this setting and due to its properties, DEX may be beneficial. The aim of this narrative review is to draw a picture of the potential indications for the use of DEX in current outpatient practice.**

Materials and methods: **PubMed and Embase were searched for relevant articles from January 1, 2008, to January 31, 2023. Studies were eligible for inclusion if they reported the use of DEX in adults or children receiving any type of anesthesia for outpatient procedures.**

Results: **After screening the literature according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses criteria, 104 studies were retained for the final analysis.**

Conclusion: **The currently available literature supports the safety and efficacy of DEX in ambulatory anesthesia. Its use as premedication, as an anesthetic adjunct to general and regional anesthesia, and as a postoperative analgesic has demonstrated its benefits. Its use in children has shown great interest, especially in the prevention of emergence delirium. These advantages must be weighed against several disadvantages of DEX administration, such as potentially prolonged induction and recovery times, high price, and lack of a reversal agent. In the ambulatory care setting, the use of DEX must be done under the supervision of a professional who knows the advantages and disadvantages of the molecule in this context, and patients should be informed of post-procedure safety measures to follow after hospital discharge.**

Keywords: **Dexmedetomidine, Ambulatory care, Ambulatory surgical procedures, Outpatients.**

Introduction

In the past few decades, the number of procedures performed in daycare centers has increased. In Belgium, for example, the surgical day case rate increased from 34.8% in 2000 to 47.2 % in 2016[1].

The ideal anesthetic agent in this context must meet a certain number of requirements: allow rapid induction, optimal surgical conditions, and rapid recovery. It must be free of major intraoperative or postoperative side effects, have the ability to rapidly change its concentration at the site of effect to easily modulate the depth of anesthesia, and be cost-effective[2]. Currently, there is no single anesthetic agent who completely meets all of these requirements. The purpose of this review is to determine the place of dexmedetomidine (DEX) in the practice of day-care anesthesia. We define day-care as a surgery or procedure that does not require an overnight hospital stay, but for which the patient requires monitoring prior to discharge.

Dexmedetomidine is a potent agonist of the alpha-2 adrenoceptor that displays a high degree of selectivity. Its pharmacologic effects include sedation, anxiolysis, analgesia, sympatholysis, opioid-sparing properties[3,4]. Dexmedetomidine also

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produces a distinct sedative response characterized by a smooth transition from sleep to wakefulness, which allows patients to remain responsive and cooperative when stimulated. Moreover, DEX has minimal impact on respiratory rate and preserves the ventilatory response to carbon dioxide[5]. Nonetheless, DEX induces a characteristic biphasic hemodynamic response in which higher concentrations result in hypertension and bradycardia, while low plasma concentrations result in hypotension[6]. Administration of the loading dose over a period of 10 minutes prevents the onset of initial hypertension.

Approximately 94% of DEX in the plasma is bound to serum albumin and glycoprotein[7]. DEX is almost completely metabolized in the liver, yielding less than 5% of the drug in its unchanged form[3]. These metabolites are believed to be pharmacologically inactive and are eliminated by renal excretion[8]. Renal dysfunction does not exert a substantial effect on the pharmacokinetics of DEX but hepatic dysfunction can affect its metabolism.

Recently, the end of the patent linking DEX to a single firm and the introduction on the market of generics have made it possible to reduce its cost (according to the Belgian Center for Pharmacotherapeutic Information: in 2020, a 2 ml vial of 200 µg would cost €17.2, compared to €6.20 in 2023). This is an opportunity to promote the rediscovery of this molecule.

In this article, we discuss the use of DEX during ambulatory procedures, both regarding the indications retained by the European Medicines Agency (EMA) (i.e. only IV route of administration for mild sedation in intensive care and for diagnostic or procedural anesthesia) and for its off-label use.

Methodology

We searched PubMed/MEDLINE database using a combination of the following search terms: "dexmedetomidine", "ambulatory care", "ambulatory surgical procedures", "ambulatory care facilities", "outpatients". Boolean operators (OR / AND) were applied and the search included both Medical Subject Heading (MeSH) terms and keywords. In the Embase database, we used the Emtree tool in the same way. The search strategy is specified in Table I. We limited our search to articles published between the 1st of January 2008 and the 31st of January 2023. This starting date was chosen because in 2008, the Food and Drug Administration (FDA) extended marketing authorization to the sedation of non-intubated patients during surgical or medical procedures outside of intensive care units. The selected papers were screened by title and abstract and the following exclusion criteria were used: 1/ animals or in vitro studies; 2/ not in English language; 3/ not a randomized controlled trial (RCT), a systematic review or a meta-analysis; 4/ no full text available or still in process; 5/ retracted article; 6/ not relevant, use of DEX not or briefly mentioned, ambulatory nature of the procedure not clearly mentioned. Finally, references cited in the selected articles were searched manually to identify additional manuscripts of interest that were not found via databases. Despite the narrative character of this review, a flow-diagram according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses criteria (PRISMA)9 was build.

Results

Results are summarized in Figure 1. We obtained 453 results. After exclusion of 65 duplicate articles, 325 articles were excluded after reading their title, abstract, or full text. In addition, 41 articles were included via cross-reference. In all, 104 articles were included in this narrative review, consisting of 94 RCTs and 10 meta-analysis.

Results are presented in different subcategories referring to the different types of procedures performed in the outpatient setting, with a special subgroup dedicated to diagnostic anesthesia and another to pediatric anesthesia.

An overview of the authors, population, anesthesia, and primary outcome of the included studies is provided in Table II.

Discussion

Although the literature on this topic is extensive, it must keep in mind that the majority of studies have been performed outside of European countries or the

Table I. — Research strategy.

PubMed	Search: ((((((“Dexmedetomidine”[Mesh]) AND (“Outpatients”[Mesh])) OR ((“Dexmedetomidine”[Mesh]) AND (“Ambulatory Care”[Mesh]))) OR ((“Dexmedetomidine”[Mesh]) AND (“Ambulatory Care Facilities”[Mesh]))) OR ((“Dexmedetomidine”[Mesh]) AND (“Ambulatory Surgical Procedures”[Mesh]))) OR ((“Dexmedetomidine”[Mesh]) AND (“Day Care, Medical”[Mesh]))) OR (dexmedetomidine ambulatory OR dexmedetomidine daycare) Filters: from 2008/1/1 - 2023/1/31
Embase	(‘dexmedetomidine’ AND ‘ambulatory surgery’ OR (‘dexmedetomidine’ AND ‘outpatient care’) OR (‘dexmedetomidine’ AND ‘ambulatory care’) OR (‘dexmedetomidine’ AND ‘outpatient department’) OR (‘dexmedetomidine’ AND ‘outpatient’)) AND [2008-2023]/py

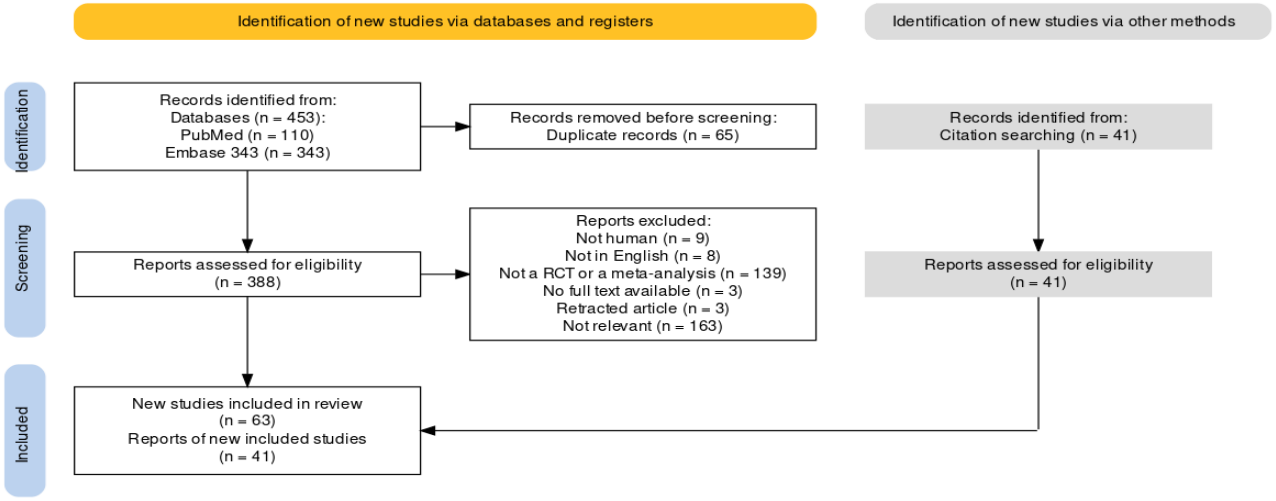

Fig. 1 — Literature selection according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses criteria.

United States due to the recent recognition of limited indications for DEX in this part of the world. Ethical considerations or editorial board requirements may vary from one part of the world to another. Sample sizes are small for the majority of RCTs and primary outcomes are not always clearly defined. The DEX dose for the same issue is also inconsistent, leading to numerous biases. All these considerations mean that the results should be interpreted with extreme caution in our daily outpatient practice. We then decided to discuss the use of DEX in different areas of our ambulatory practice.

Orthopedic surgery

Several studies evaluate the use of DEX added to local anesthetic or intravenously (IV) to extend the duration of peripheral nerve blocks for patients undergoing orthopedic surgery. Animal experiments indicate that DEX administered perineurally does not produce neurotoxicity[10,11] and may even decrease the toxicity of local anesthetics[12,13].

One study chose to compare the effects of IV versus perineural DEX in an interscalene brachial plexus block (ISB) for shoulder surgeries[14]. Patients were randomized to a group receiving ropivacaine 0.5% with DEX 0.5 µg/kg for the block, a group receiving ropivacaine 0.5% for the block with DEX 0.5 µg/kg IV, or a control group receiving ropivacaine 0.5% alone. It was observed that both perineural and IV DEX prolonged the analgesic duration (10.9 h and 9.8 h respectively) compared to ropivacaine alone (6.7 h) and demonstrated a reduction in opioid intake for 24 hours postoperatively, all of this without prolonging the duration of motor block.

Rodrigues et al. evaluated the effects of IV dexamethasone, DEX, or their combination on the analgesic duration of ISB in patients undergoing arthroscopic shoulder surgery[15]. In this study, dexamethasone alone gives an advantage in analgesic block duration compared to DEX. This study has also shown that analgesic duration in patients receiving both drugs was no longer than that in patients receiving dexamethasone alone. This finding is supported by a meta-analysis by Albrecht et al. in which dexamethasone appears to be a superior perineural adjunct for peripheral nerve blocks, prolonging the duration of analgesia by 2.5 hours more than DEX without the risk of sedation or hypotension[16]. In another recent study, Albrecht et al. found that taking DEX in combination with dexamethasone administrated by IV route and performing an ISB for arthroscopic rotator cuff repair shortened the time to first morphine intake and may have even increased the dose of morphine needed[17]. Margulis et al., who compared the addition of perineural DEX or dexamethasone as an adjuvant to ropivacaine in ISB for arthroscopic shoulder surgery, did not demonstrate superiority of using DEX or dexamethasone to reduce opioid use in the first 48 hours compared to ropivacaine alone. However, intraoperative opioid use was significantly lower with DEX and block duration was significantly longer in both adjuvant groups compared to ropivacaine alone. The authors conclude by suggesting the use of DEX as an alternative when dexamethasone use may be contraindicated[18].

As an adjunct to supraclavicular brachial plexus block for upper limb surgery, IV DEX produced earlier onset of sensory block (but not of motor block), longer duration of sensory and motor block, and longer duration of analgesia (but not longer mean time to rescue analgesia) as compared with perineural administration[19].

No significant hypotension or bradycardia was noted at the doses of perineural DEX used (75 µg, 0.5 to 1 µg/kg) in these studies[14,18,19].

For minor surgical procedures on the extremities under intravenous regional anesthesia, DEX IV

Table II. — Summary of included randomized clinical trials.

First author (Year of publication, country)	Population	Main anesthesia	Timing of DEX	Route	Bolus (µg/kg)	Continuous administration (µg/kg/h)	Other treatment group(s)	Primary outcome(s)
Orthopedic surgery								
Abdallah[14] (2016, Canada)	Sample size: 99 Age (y): 18-65 ASA: I-III Surgery: unilateral arthroscopic shoulder	Interscalene brachial plexus block (ISB) (ropivacaine) + General anesthesia (desflurane)	During ISB or After induction	ISB or IV	0.5 or 0.5	0	Normal saline	Duration of postoperative analgesia + cumulative 24-h analgesic consumption
Albrecht[17] (2022, France)	Sample size: 122 Age (y) ≥ 18 ASA: I-III Surgery: arthroscopic rotator cuff repair	ISB (ropivacaine + dexamethasone IV) + General anesthesia (propofol + sufentanil)	After induction	IV	1	0	Normal saline	Time from block to first morphine intake
Breebaart[22] (2019, Belgium)	Sample size: 131 Age (y): 18-70 ASA: I Surgery: knee arthroscopy	Intrathecal anesthesia (IT) (chloroprocaine)	During IT or Just after IT	IT or IV	5 µg or 0.5	0	Chloroprocaine 40 mg alone	Onset and duration of the sensory and motor block.
Margulis[18] (2021, USA)	Sample size: 89 Age (y): 18-60 ASA: I-II Surgery: arthroscopic shoulder	ISB (ropivacaine) + General anesthesia (sevoflurane)	During ISB	ISB	75 µg	0	Ropivacaine + dexamethasone 3 mg or Plain ropivacaine	Prolongation of postoperative analgesia, time to first pain medication, total opioid consumption
Mizrak[20] (2010, Turkey)	Sample size: 45 Age (y): ≤ 18 ASA: I-II Surgery: carpal tunnel and tendon release	Intravenous regional anesthesia (IVRA) (lidocaine)	Before IVRA or During IVRA	IV or IVRA	0.5 or 0.5	0	/	Not clearly defined
Mizrak[21] (2011, Turkey)	Sample size: 54 Age (y): ≥ 18 ASA: I-II Surgery: carpal tunnel and tendon release	IVRA (lidocaine)	Premedication	IV	0.5	0	Normal saline	Not clearly defined

Rodrigues[15] (2021, Canada)	Sample size: 198 Age (y): ≤ 18 ASA: I-III Surgery: arthroscopic shoulder	ISB (bupivacaine)	During ISB	IV	50 µg	0	Dexamethasone 4mg alone or DEX 50 µg + dexamethasone 4mg	Analgesic block duration
Samar[19] (2020, India)	Sample size: 40 Age (y): 18-60 ASA: I-II Surgery: upper limb	Supraclavicular plexus block (SCB) (lidocaine + bupivacaine)	Maintenance or During SCB	IV or SCB	1 or 1	0.4 or 0	/	Sensory and motor block characteristics
Urology								
Akça[26] (2016, Turkey)	Sample size: 75 Age (y): 18-75 ASA: I-II Surgery: cystoscopy	General anesthesia (sevoflurane + N2O)	End of surgery	IV	1	0	Ketamine 250 µg/kg or Normal saline	Postoperative bladder catheter-related discomfort/pain
Arpaci and Bozkirli[24] (2013, Turkey)	Sample size: 40 Age (y): 20-70 ASA: I-II Surgery: cystoscopy	Sedation (remifentanil) + local anesthesia of the urethra	Sedation	IV	0	0.2-0.7	Midazolam infusion rate 0.05-0.15 µg/kg/h	Postoperative cognitive functions
Kaygusuz[27] (2008, Turkey)	Sample size: 40 Age (y): 18-60 ASA: I-II Surgery: extra-corporeal shock wave lithotripsy	Sedation (fentanyl)	Sedation	IV	1	0.2	Propofol loading infusion 6 mg/kg/h, then infusion rate 2.4 mg/kg/h	Analgesic efficacy
Kose[25] (2012, Turkey)	Sample size: 60 Age (y): 18-80 ASA: I-II Surgery: transurethral procedure	Sedation	Sedation	IV	1 or 1	0.2 or 0.2	+ Ketamine 1mg/kg or + Midazolam 0.05 mg/kg	Recovery parameters
Salem[28] (2016, Egypt)	Sample size: 52 Age (y): 20-60 ASA: I-II Surgery: extra-corporeal shock wave lithotripsy	Sedation (fentanyl)	Sedation	IV	1	0.3	Propofol loading dose 1 mg/kg, then infusion rate 3 mg/kg/h.	Efficacity of analgesia

Shariffuddin[23] (2018, Malaysia)	Sample size: 60 Age (y): 18-65 ASA: I-II Surgery: ureteroscopy, ureteric stenting	General anesthesia (sevoflurane)	Premedication	IV	0.5	0	Normal saline	Intraoperative anesthetic agent requirements (MAC of sevoflurane)
Zeyneloglu[29] (2008, Turkey)	Sample size: 49 Age (y): 18-80 ASA: I-II Surgery: extra-corporeal shock wave lithotripsy	Sedation (rescue fentanyl + midazolam)	Sedation	IV	1	0.2	Midazolam 0.05 mg/kg + fentanyl 1 µg/kg, then normal saline infusion	Recovery time
Gynecology and obstetrics								
Bingol Tanriverdi[35] (2019, Turkey)	Sample size: 60 Age (y): 18-65 ASA: I-II Surgery: minor hysteroscopic	Sedation (fentanyl + midazolam)	Sedation	IV	1	0.7	Propofol loading dose 1.5 mg/kg, then infusion rate 2.5 mg/kg/h	Postoperative pain and anxiety level
Das[39] (2018, India)	Sample size: 100 Age (y): 30-60 ASA: I-II Surgery: breast cancer	General anesthesia (isoflurane + N2O)	Induction and maintenance	IV	0	0.6	Normal saline	Incidence on the discharge six hours after surgery
Elnabtity and Selim[37] (2017, Saudi Arabia)	Sample size: 52 Age (y): 25-38 ASA: I-II Surgery: oocyte retrieval	Sedation (fentanyl + propofol in rescue) + Paracervical block (lidocaine)	Sedation	IV	1	0.5	Midazolam 0.06 mg/kg, then 0.5 mg incremental doses	Length of PACU stay
Hakim[32] (2019, Egypt)	Sample size: 80 Age (y): 21-50 ASA: I-II Surgery: gynecological laparoscopic	General anesthesia (propofol)	Induction and maintenance	IV	0.6	0.2	Fentanyl loading dose 1 µg/kg, then infusion rate 0.5 µg/kg/h	Postoperative quality of recovery
Kaur[30] (2021, India)	Sample size: 120 Age (y): 18-60 ASA: I-II Surgery: minor gynecological	General anesthesia (propofol)	Premedication	IV	1	0	Ketamine 0.5 mg/kg or Normal saline	Discharge readiness

Kumari[31] (2018, India)	Sample size: 150 Age (y): 18-50 ASA: I-II Surgery: minor gynecological	General anesthesia (propofol)	Premedication	IV	0.1	0	Midazolam 0.04 mg/kg or Normal saline	Sedation score, dose of additional propofol, recovery
Maurya[36] (2020, Sri Lanka)	Sample size: 40 Age (y): 18-65 ASA: I-II Surgery: minor gynecological	Sedation (fentanyl)	Sedation	IV	1	0.2-0.7	Propofol infusion rate 75-100 µg/kg/min	Multiple psychomotor recovery characteristics
Salman[33] (2009, Turkey)	Sample size: 60 Age (y): 20-40 ASA: I-II Surgery: gynecologic laparoscopic	General anesthesia (desflurane)	After induction	IV	1	0.4	Remifentanil loading dose 1 µg/kg, then infusion rate 0.2 µg/kg/min	Not clearly defined
Saravanaperumal and Udhayakumar[38] (2021, India)	Sample size: 62 Age (y): 23-38 ASA: I-II Surgery: oocyte retrieval	Sedation (propofol)	Before induction + Start surgery	IV	0.5 + 0.5	0	Fentanyl 1 µg/kg 10 min before starting and 1 µg/kg at the start	Quality of recovery
Techanivate[34] (2012, Thailand)	Sample size: 40 Age (y): ≥ 18 ASA: I-II Surgery: gynecologic diagnostic laparoscopy	General anesthesia (desflurane + N2O)	After intubation	IV	0.5	0	Fentanyl 0.5 µg/kg	Postoperative analgesia
General surgery								
Gupta[49] (2022, India)	Sample size: 150 Age (y): 18-65 ASA: II-III Surgery: umbilical	IT (chloroprocaine)	During IT	IT	10 µg	0	Chloroprocaine 40 mg alone or Chloroprocaine 40 mg + nalbuphine 0.4 mg	Time until complete recovery of sensory and motor block
Kapoor and Sharma[46] (2022, India)	Sample size: 50 Age (y): ≤ 18 ASA: I-II Surgery: perianal	IT (bupivacaine)	During IT	IT	5 µg	0	Distilled water	Recovery time of the motor and sensory block
Nethra[47] (2015, India)	Sample size: 40 Age (y): 18-55 ASA: I-II Surgery: perianal	IT (bupivacaine)	During IT	IT	5 µg	0	Normal saline	Duration of sensory block and time to first analgesic administration

Siddiqui[40] (2021, India)	Sample size: 90 Age (y): 18-60 ASA: I-II Surgery: cholecystectomy	General anesthesia (propofol)	Induction and maintenance	IV	1	0.5	Fentanyl loading dose 2.0 µg/kg, then infusion rate 1.0 µg/kg/h	Discharge time from PACU
Sudheesh[48] (2015, India)	Sample size: 48 Age (y): ≥ 18 ASA: I-II Surgery: perianal	IT (bupivacaine)	During spinal anesthesia	IT	3 or 5	0	/	Time to ambulation, duration of analgesia
Tomar[133] (2015, India)	Sample size: 60 Age (y): 20-50 ASA: I-II Surgery: various with duration < 45 min	Sedation	Sedation	IV	1	0.6, then titrated to achieve desired clinical effect with dose ranging from 0.2 to 0.7 µg/kg	Midazolam IV 0.02 mg/kg + fentanyl IV 2 µg/kg, then propofol loading dose 0.5–1 mg/kg and infusion rate 1–3 mg/kg/h	Postoperative analgesia
Wang[134] (2017, China)	Sample size: 80 Age (y): 18-70 ASA: I-II Surgery: inguinal hernia repair	Local anesthesia (lidocaine) + blockage the nerves of the groin region (ropivacaine)	Sedation	IV	0.5	0.5	Propofol loading dose 2mg/kg, then infusion rate 1.5mg/kg/h	Requirement of fentanyl
Xie[41] (2021, China)	Sample size: 168 Age (y): 18-65 ASA: I-II Surgery: thyroidectomy	General anesthesia (remifentanil + propofol)	Induction and maintenance	IV	0.5	0.1	Normal saline	Incidence of PONV
Stomatology and dental surgery								
Cheung[50] (2011, Hong Kong)	Sample size: 60 Age (y): 18-50 ASA: I-II Surgery: third molar removal	Local anesthesia (lidocaine) + propofol in rescue	Premedication	IN	1	0	Normal saline	Postoperative pain relief
Fan[53] (2012, Singapore)	Sample size: 60 Age (y): ≤ 18 ASA: I-II Surgery: third molar removal and dental implant	Local anesthesia (lidocaine)	Sedation	IV	1	0.2	Midazolam loading infusion 0.005 mg/kg/min, then infusion rate 0.01 mg/kg/h	Effectiveness of sedation

Mandal[58] (2016, India)	Sample size: 76 Age (y): 20-40 ASA: I-II Surgery: unilateral traumatic maxillofacial	General anesthesia (isoflurane + N2O) + Local anesthesia (lidocaine)	During local anesthesia (after general anesthesia)	Wound infiltration	1	0	Normal saline	Intraoperative hemodynamics parameters and postoperative pain
Mishra[54] (2017, India)	Sample size: 60 Age (y): 18-65 ASA: I-II Surgery: oral and maxillofacial	Nerve block or regional anesthesia (lidocaine)	Sedation	IV	1	0.5	Midazolam loading dose 0.08 mg/kg, then infusion rate 0.05 mg/kg/h	Not clearly defined
Nolan[55] (2020, USA)	Sample size: 141 Age (y): 18-35 ASA: I-II Surgery: third molar extractions	Sedation (midazolam)	Sedation	IV	1	0.5	Fentanyl 8 µg/kg, then propofol infusion rate 125 µg/kg/min for 10 min, then bolus of 0.1 µg/kg..	Respiratory events requiring intervention
Nooh[51] (2013, Saudi Arabia)	Sample size: 18 Age (y): 20-28 ASA: I Surgery: third molar removal	Local anesthesia (lidocaine)	Premedication	IN	1.5	0	Water	Quality of sedation
Ryu[52] (2016, Republic of Korea)	Sample size: 240 Age (y): 16-55 ASA: I-II Surgery: third molar extraction	Local anesthesia (lidocaine)	Before local anesthesia	IN or IV	1.5 + 0.5 after 20 min or 1	0	Local anesthesia only	Not clearly defined
Taylor[56] (2020, USA)	Sample size: 12 Age (y): 32-74 ASA: I-II Surgery: maxillary and mandibular arch extractions with associated dentoalveolar preprosthetic	Sedation (midazolam, fentanyl, propofol) + Local anesthesia (lidocaine, bupivacaine)	Induction and maintenance	IV	0	4	Normal saline	Efficiency in terms of anesthesia and surgery times, vital signs, subjective patient experience

Ophthalmic surgery								
Apan[61] (2009, Turkey)	Sample size: 90 Age (y): ≥ 18 ASA: I-III Surgery: cataract	Peribulbar block (lidocaine) + Fentanyl bolus in rescue	Sedation	IV	0	0.25	Midazolam infusion rate 25 µg/kg/h or Normal saline	Not clearly defined
Kaya[63] (2022, Turkey)	Sample size: 80 Age (y): 65-80 ASA: I-III Surgery: cataract	Propofol bolus +Peribulbar block and periorbital infiltration (lidocaine)	Sedation	IV	1	0.4	Remifentanil loading dose 0.05 µg/kg, then infusion rate 0.05 µg/kg/min	Quality of sedation
Moradi Farsani[65] (2022, Iran)	Sample size: 135 Age (y): 50-80 ASA: I-II Surgery: cataract	Sedation (midazolam, fentanyl, ketamine) + Eye drops (tetracaine)	After induction	IV	0.5	0	Acetaminophen 15 mg/kg or Normal saline	Postoperative pain intensity
Na[62] (2011, Republic of Korea)	Sample size: 31 Age (y): 20-75 ASA: I-III Surgery: cataract	Eye drops (proparacaine)	Sedation	IV	0	0.6	Propofol infusion rate 2 mg/kg/h + alfentanil infusion rate 20 µg/kg/h	Patients' satisfaction
Poorzamany Nejat Kermany[64] (2016, Iran)	Sample size: 100 Age (y): 40-70 ASA: I-II Surgery: cataract	Local anesthesia (lidocaine)	Sedation	IV	0.5	0.1-0.4	Remifentanil loading dose 0.1 µg/kg, then infusion rate 0.025-0.1 µg/kg/min	Safety for patients' cognitive function
Yagan[60] (2015, Turkey)	Sample size: 60 Age (y): ≥ 45 ASA: I-III Surgery: cataract	Retro-bulbar block (lidocaine)	Sedation	IV	0.5	0.2-0.7	Propofol 4 mg/ml + ketamine 2 mg/ml: loading dose 0.125ml/kg, then infusion rate 0.05–0.125 ml/kg	Hemodynamic and respiratory effects
Paediatrics								
Ali and Abdellatif[77] (2013, Egypt)	Sample size: 120 Age (y): 2-6 ASA: I-II Surgery: adenotonsillectomy	General anesthesia (sevoflurane + N20)	End of surgery	IV	0.3	0	Propofol 1 mg/kg or Normal saline	Emergence agitation

Al Taher[97] (2010, Egypt)	Sample size: 60 Age (y): 4-10 ASA: I Surgery: dental	Local anesthesia (lidocaine)	Sedation	IV	2	0.4	Midazolam 0.05 mg/kg + propofol loading dose 1 mg/kg, then infusion rate 5 mg/kg/h	Hemodynamic parameters + effectiveness of sedation
Bedirli[76] (2017, Turkey)	Sample size: 77 Age (y): 2-12 ASA: I-II Surgery: adenotonsillectomy	General anesthesia (sevoflurane)	After intubation	IV	1	0	Tramadol 2 mg/kg	Need for rescue morphine in PACU
Bhadla[90] (2013, India)	Sample size: 60 Age (y): 5-12 ASA: I-II Surgery: ophthalmic	General anesthesia (sevoflurane)	Premedication	IV	0.4	0	Midazolam 0.05 mg/kg	Sedation score
Bharti[107] (2014, India)	Sample size: 78 Age (y): 1-8 ASA: I-II Surgery: lower abdominal and perineal	General anesthesia (sevoflurane, N2O) + Caudal block (ropivacaine)	Caudal block	Caudal	0 or 0.5 or 1 or 1.5	0	/	Analgesic efficacy
Chauhan[111] (2020, India)	Sample size: 70 Age (y): 2-12 ASA: I Surgery: sclerotherapy	Sedation	Sedation	IV	2	0.3	Propofol loading dose 1 mg/kg, then infusion rate 100 µg/kg/min	Hemodynamic parameters
Cho[108] (2015, Republic of Korea)	Sample size: 80 Age (y): 1-6 ASA: I Surgery: unilateral orchiopexy	General anesthesia (sevoflurane) + Caudal block (ropivacaine)	Caudal block	Caudal	1	0	Normal saline	Time to the first oral acetaminophen ask after discharge
Das[112] (2022, India)	Sample size: 90 Age (y): 3-6 ASA: I-III Surgery: fractionated radiation treatment	Sedation	Sedation	IN	2	0	Midazolam 0.2 mg/kg + ketamine 5 mg/kg, orally	Incidence of patients who could lie still
Di[78] (2017, China)	Sample size: 75 Age (y): 3-7 ASA: I-II Surgery: adenotonsillectomy	General anesthesia (sevoflurane)	Premedication	IV	1 or 2	0	Normal saline	Success of tracheal extubation

Erdil[71] (2009, Turkey)	Sample size: 90 Age (y): 2-7 ASA: I Surgery: adenoidectomy	General anesthesia (sevoflurane+ N2O)	After intubation	IV	0.5	0	Fentanyl 2.5 µg/kg or Normal saline	Emergence agitation
Ghai[104] (2017, India)	Sample size: 59 Age (y): 1-6 ASA: I-II Surgery: computed tomography scan procedures	Sedation (ketamine in rescue)	Premedication	IN	2.5	0	Midazolam orally 0.5 mg/kg	Effectiveness of sedation
Gyanesh[101] (2014, India)	Sample size: 150 Age (y): 1-10 ASA: uninformed Surgery: MRI	Sedation (propofol)	Premedication	IN	1	0	Ketamine 5mg/kg or Normal saline	Ease of IV cannulation
Heard[102] (2008, USA)	Sample size: 40 Age (y): 1-10 ASA: I-II Surgery: MRI	Sedation	Sedation	IV	1 + Midazolam IV 0.1 mg/kg	0.5	Propofol loading infusion 300 µg/kg/min, then infusion rate 250 µg/kg/min	Time interval from discontinuation of the infusion until full recovery of responsiveness
Kim[87] (2014, Republic of Korea)	Sample size: 94 Age (y): 1-5 ASA: I-II Surgery: strabismus	General anesthesia (propofol + desflurane)	After induction	IV	0	0.2	Normal saline	Emergence agitation
Kim[135] (2014, Republic of Korea)	Sample size: 40 Age (y): 1-5 ASA: I Surgery: hernioplasty or orchiopexy	General anesthesia (sevoflurane) + Caudal block (ropivacaine)	After induction	IV	1	0.1	Normal saline	Intraoperative anesthetic agent requirements (MAC of sevoflurane)
Lee-Archer[136] (2020, Australia)	Sample size: 247 Age (y): 2-7 ASA: I-II Surgery: various	General anesthesia	Premedication or After induction	IN or IV	2 0.1	0	Normal saline IN or Normal saline IV	Incidence of negative behaviour on postoperative day three
Li[88] (2020, China)	Sample size: 122 Age (y): 6-10 ASA: I-II Surgery: strabismus	General anesthesia (sevoflurane) + Eye drops (oxybuprocaine)	During induction	IV	0.3 or 0.5	0	Normal saline	Incidence of PONV
Lundblad[109] (2015, Sweden)	Sample size: 43 Age (y): 1½–8 ASA: I-II Surgery: inguinal hernia repair	General anesthesia (sevoflurane) + Ilioinguinal/ iliohypogastric nerve block (IINB) (ropivacaine)	During IINB	IINB	0.3	0	Plain ropivacaine	Time to first postoperative administration of analgesia

Miller[106] (2018, USA)	Sample size: 279 Age (y): 3-24 months ASA: II-III Surgery: transthoracic echocardio-graphic	Sedation	Sedation	IN	2.5	0	Pentobar-bital oral 5 mg/kg	Adequate sedation within 30 minutes
Mizrak[89] (2011, Turkey)	Sample size: 60 Age (y): 4.5-11 ASA: I Surgery: strabismus	General anesthesia (ketamine, fentanyl)	Before induc-tion	IV	0.5	0	Normal saline	Not clearly defined
Mukherjee[99] (2015, India)	N: 80 Age (y): 3-7 ASA: I-II Surgery: various	General anesthesia (sevoflurane)	Premedi-cation	IN	1	0	Clonidine 4 µg/kg	Incidence and severity of emergence agitation
Naveen[95] (2022, India)	Sample size: 72 Age (y): 1-4 ASA: I-II Surgery: oral rehabilitation	General anesthesia (sevoflurane, N2O)	Induc-tion and mainte-nance	IV	0.25	0.4	Fentanyl loading dose 1 µg/kg, then infusion rate 1 µg/kg/h	Time to extubation
Olutoye[72] (2010, USA)	Sample size: 109 Age (y): 3-12 ASA: I-II Surgery: adenotonsil-lectomy	General anesthesia (sevoflurane + N2O)	After intuba-tion	IV	0.75 or 1	0	Morphine 50 µg/kg or 100 µg/kg	Amount of postoperative morphine required
Patel[73] (2010, USA)	Sample size: 122 Age (y): 2-10 ASA: II-III Surgery: adenotonsil-lectomy	General anes-thesia (sevoflurane + N2O)	After in-duction	IV	2	0.7	Fentanyl 1 µg/kg	Amount of postoperative morphine required
Pestieau[74] (2011, USA)	Sample size: 101 Age (y): 2-12 ASA: I-II Surgery: ton-sillectomy	General anesthesia (desflurane + N2O)	After intuba-tion	IV	2 or 4	0	Fentanyl 1 µg/kg or 2 µg/kg	Time to first morphine-rescue requirement
Rehman[96] (2021, India)	Sample size: 30 Age (y): 2-5 ASA: I Surgery: endodontic treatment	Sedation (propofol) + Local anesthesia (lidocaine)	Before induc-tion	IV	1	0	Normal saline	Requirement of propofol
Sado-Filho[91] (2021, Brazil)	Sample size: 88 Age (y): 1-7 ASA: I-II Surgery: endodontic treatment	Sedation	Sedation	IN	2 or 2.5	0	+ Ket-amine 1mg/kg or Alone	Children's behaviour

Sato[98] (2010, Japan)	Sample size: 81 Age (y): 1-9 ASA: I-II Surgery: various	General anesthesia (sevoflurane)	After induction	IV	0.3	0	Normal saline	Emergence agitation
Shafa[79] (2021, Iran)	Sample size: 105 Age (y): 3-10 ASA: I-II Surgery: adenotonsillectomy	General anesthesia (isoflurane)	15 min before surgery	IV	2 or 1	0	Normal saline	Not clearly defined
Sharma[80] (2019, India)	Sample size: 60 Age (y): 5-10 ASA: I-II Surgery: adenotonsillectomy	General anesthesia (Isoflurane + N2O)	Premedication	IV	1	0	Normal saline	Emergence agitation
Sheta[92] (2014, Saudi Arabia)	Sample size: 72 Age (y): 3-6 ASA: I-II Surgery: full-mouth dental rehabilitation	General anesthesia (sevoflurane + N2O) + Local anesthesia (lidocaine)	Premedication	IN	1	0	Midazolam 0.2 mg/kg	Level of Sedation upon separation from their parent
Tsiotou[81] (2018, Greece)	Sample size: 60 Age (y): 3-14 ASA: I-II Surgery: adenotonsillectomy	General anesthesia (propofol + remifentanil)	After induction	IV	1	0	Normal saline	Emergence delirium
Wang[93] (2020, China)	Sample size: 60 Age (y): 3-6 ASA: I Surgery: full-mouth dental rehabilitation	General anesthesia (propofol + remifentanil)	Premedication	IN	2	0	Midazolam 0.5 mg/kg	Emergence delirium
Wang[110] (2022, China)	Sample size: 80 Age (y): 5-12 ASA: uninformed Surgery: laparoscopic treatment of cryptorchidism and hydrocele	General anesthesia (propofol 4 mg/kg/h in DEX group or 5 mg/kg/h in group control)	Premedication	IN	1	0	Propofol alone	Not clearly defined
Zanaty and El Metainy[94] (2015, Egypt)	Sample size: 60 Age (y): 3-6 ASA: I-II Surgery: Dental	General anesthesia (sevoflurane)	Premedication	Nebulized	2 or 1	0	Alone or + ketamine 1 mg/kg	Level of sedation after premedication

Diagnostic procedure								
Amri[119] (2018, Iran)	Sample size: 80 Age (y): 20-70 ASA: I-II Surgery: colonoscopy	Sedation (propofol bolus in rescue)	Sedation	IV	1	0.5	Fentanyl bolus 0.5 µg/kg + normal saline infusion	Hemodynamic parameters + pain score
Chen[113] (2022, China)	Sample size: 146 Age (y): 45–65 ASA: I-II Surgery: flexible bronchoscopy	Sedation (remifentanil) + Airway nebulization (lidocaine)	Induction and maintenance	IV	0.5	0.2-0.7	Remimazolam tosilate initial dose 12 mg/kg/h for 10 min, then infusion rate 1-2mg/kg/h	Success of the fibroscopy procedure
Dere[120] (2010, Turkey)	Sample size: 60 Age (y): 20-80 ASA: I-II Surgery: colonoscopy	Sedation (fentanyl)	Sedation	IV	1	0.5	Midazolam 0.05 mg/kg + normal saline infusion	Effects on preoperative hemodynamic parameters, sedation, pain, satisfaction, and recovery scores
Eberl[121] (2016, The Netherlands)	Sample size: 63 Age (y): ≥ 18 ASA: I-III Surgery: endoscopic esophageal procedures	Sedation (propofol in rescue)	Sedation	IV	1	0.7-1	Propofol via target-controlled infusion, starting with a targeted plasma concentration of 2 µg/ml	Patients and endoscopists satisfaction
Edokpolo[122] (2019, USA)	Sample size: 101 Age (y): 18-75 ASA: I-III Surgery: colonoscopy	Sedation (propofol)	During induction	IV	0.3	0	Normal saline	Percentage of patients meeting discharge criteria within 30 min from procedure end-time
Gu[114] (2019, China)	Sample size: 60 Age (y): ≥ 18 ASA: I-II Surgery: flexible bronchoscopy	General anesthesia (propofol + remifentanil) + Airway nebulization (lidocaine)	Premedication	Nebulized or IV	0.6 or 0.6	0	Normal saline	Incidence of moderate to severe coughing
Karanth[118] (2018, India)	Sample size: 60 Age (y): 25-60 ASA: I-II Surgery: colonoscopy	Sedation (fentanyl + N20)	Sedation	IV	1	0.2-0.8	Propofol loading dose 2–3 mg/kg, then infusion rate 25–100 µg/kg/min	Effectiveness of sedation

Ramkiran[125] (2015, India)	Sample size: 72 Age (y): 18-75 ASA: I-III Surgery: endoscopic retrograde cholangio pancreatography	Sedation (propofol)	During induction	IV	1	0.5	Ketamine loading dose 0.25mg/kg, then infusion rate 5µg/kg/min or Normal saline	Total propofol consumption
Ryu[115] (2012, Republic of Korea)	Sample size: 70 Age (y): 18-70 ASA: I-III Surgery: flexible bronchoscopy	Sedation (propofol) + Airway nebulization (lidocaine)	Sedation	IV	0.2	0.4-2	Remifentanil loading dose 0.5 µg/kg, then infusion rate 1-5 µg/kg/h	Incidence of oxygen desaturation (SaO2 < 90%)
Sruthi[131] (2018, India)	Sample size: 50 Age (y): 18-60 ASA: II-III Surgery: transesophageal echocardiography	Sedation	Sedation	IV	10	0.5	KETOFOL: ketamine: 3.2 mg/ml + propofol: 9.5 mg/ml. Loading dose 1ml/kg/h, then infusion rate 0.05 ml/kg/h	Time to achieve Ramsay sedation score ≥ 3
Wu[126] (2014, China)	Sample size: 60 Age (y): 20-60 ASA: I-II Surgery: upper gastrointestinal endoscopy	Sedation (fentanyl)	Sedation	IV	0.3	0.2-0.3	Midazolam 0.05 mg/kg, then 0.01 mg/kg at intervals of 2–5 min until a satisfactory sedation + 0.01 mg/kg for rescue	Not clearly defined
Wu[127] (2015, China)	Sample size: 67 Age (y): 18-65 ASA: I-II Surgery: oeso-gastro-duodenoscopy	Sedation (fentanyl)	Sedation	IV	1	0.5	Propofol loading dose 0.6 mg/kg, then additional doses of 10–20 mg.	Not clearly defined

DEX: Dexmedetomidine; IINB: Ilioinguinal/iliohypogastric nerve block; IN: Intranasal (route of administration); ISB: Interscalene brachial plexus block; IT: Intrathecal (route of administration); IV: Intravenous (route of administration); IVRA: Intravenous regional anesthesia; MAC: Minimum alveolar concentration; MRI: Magnetic resonance imaging; PACU: Post-anesthesia care unit; PONV: Postoperative nausea and vomiting; SCB: Supraclavicular plexus block.

as premedication or when added to lidocaine improves the quality of anesthesia and perioperative analgesia[20, 21].

One study compared IV or intrathecal (IT) administration of DEX for ambulatory knee arthroscopy[22]. This Belgian study indicates that the duration of sensory block after spinal anesthesia with chloroprocaine can be prolonged without any adverse effects on hemodynamics or neurological function by supplementing with spinal DEX. This approach was found to be associated with a slight delay in time to first urination and hospital discharge following day case knee arthroscopy. Block onset times and motor block intensity with DEX were comparable to chloroprocaine alone. It should be noted that a single dose of IV DEX did not result in prolongation of sensory block when used in conjunction with spinal chloroprocaine[22].

DEX as an adjuvant anesthetic in ambulatory orthopedic surgeries has shown promising results in pain control and duration of sensorimotor block in different regions with an interesting safety profile. Further studies are needed to determine the appropriate dose of DEX, route of administration, and optimal combination with other drugs.

Urology

Several authors have studied the use of DEX in various drug combinations as premedication[23], sedative[24,25] or as an adjunct to general anesthesia[26] in transurethral procedures performed on an outpatient basis. One of these studies compared the effect of DEX-remifentanil combination versus midazolam-remifentanil combination on postoperative cognitive function in outpatients undergoing cystoscopy. It was observed that the DEX-remifentanil combination achieved sedation levels faster, impaired cognitive functions lesser and resulted in shorter recovery times than midazolam-remifentanil combination. Moreover, surgeon and patient satisfaction scores were superior with the DEX-remifentanil combination[24]. In another study, Kose et al. demonstrated that both DEX-ketamine and DEX-midazolam combinations can provide satisfactory levels of sedation during transurethral procedures. However, the DEX-ketamine combination resulted in superior analgesia and hemodynamic stability, coupled with a lower incidence of postoperative nausea and vomiting (PONV) and a shorter recovery time[25]. In their study about the use of a single preoperative dose of DEX (0.5 μg/kg) in patients undergoing ureteroscopy or ureteral stenting, Shariffuddin et al. concluded that DEX was a useful adjuvant in reducing the amount of anesthetic required to achieve adequate sedation (lowering the minimum alveolar concentration of sevoflurane) and opioid consumption both intraoperatively and postoperatively through day three. This extended analgesic duration allowed a significantly higher proportion of patients to return to their daily activities after 48 hours as compared to the placebo (normal saline) group[23].

Dexmedetomidine has also been tried in the context of extracorporeal shock wave lithotripsy. This procedure is often not well-tolerated by patients in the absence of analgesia and sedation because the impact of the shock waves causes transient pain at the site of entry and a deep visceral discomfort. Two studies compared the use of a combination of DEX (initial loading dose of 1 μg/kg infused IV over 10 min, followed by an infusion rate of 0.2-0.3 μg/kg/h) and fentanyl to a combination of propofol-fentanyl in this indication[27,28]. The primary outcome measure was improved analgesia for both studies. They concluded that the use of DEX in this context is effective, safe and better than propofol regarding analgesic, sedative and respiratory variables. When compared to midazolam-fentanyl combination, DEX showed a longer recovery time and required more rescue sedatives and analgesics, resulting in lower patient satisfaction[29].

In urology, not all studies show similar results. Nevertheless, it seems that as a sedative and compared to midazolam or propofol, DEX (loading dose of 1 μg/kg and then infusion rate of 0.2 to 0.7 μg/kg/h) shows a better efficacy and safety profile.

Gynecology and obstetrics

Minor gynecologic procedures such as dilatation and curettage, hysteroscopy or diagnostic laparoscopy are routinely performed on an outpatient basis.

From the seven studies concerning IV DEX in gynecologic patients, three studies documented a propofol sparing effect compared with ketamine30, midazolam[31] or fentanyl[32]. Three studies comparing DEX with opioids, in the spirit of opioid-free anesthesia, showed an improvement in analgesia with DEX and a better outcome on the occurrence of PONV[32,33,34].

Extubation time and sedation in the early recovery phase were prolonged with DEX in two studies, with no effect on hospital discharge time[30,33]. Two more studies reported no delay in discharge time[32,34], while two studies reported early discharge[31,35].

When used in combination with fentanyl for sedation, DEX resulted in a significant decrease in mean arterial pressure and heart rate compared to the use of propofol. Patients in the DEX group reported lower postoperative pain scores in the Bingol[35] et al. study, while all patients in both groups were pain free in the postoperative period in the Maurya[36] et al. study.

Two RCTs have demonstrated the usefulness of DEX as an adjunct to sedation for oocyte retrieval. The use of DEX instead of midazolam[37] or fentanyl[38] resulted in less total propofol consumption, less use of rescue analgesia, and less PONV. It is interesting to note that the number of oocytes retrieved, embryos transferred, and percentage of pregnancy per embryo transfer were comparable in both midazolam and DEX groups[37].

One article suggests the use of an infusion of 0.6 µg/kg/h of DEX as an adjunct to general anesthesia in breast cancer surgery to facilitate early discharge. In this study, the addition of DEX significantly reduced the number of overnight admissions, in part by reducing the need for postoperative analgesia and the incidence of PONV[39].

We take this opportunity to remind the readers that, according to the EMA, the use of DEX in pregnant women is not recommended due to increased uterine contractions and limited data about fetal exposure[7]. Also, DEX is excreted in human milk, with levels below the limit of detection 24 hours after discontinuation of treatment.

General surgery

The use of DEX has been proposed as an adjunct to general anesthesia in outpatients undergoing cholecystectomy in an opioid-free anesthesia approach. In their study, Siddiqui et al. compared the use of opioid (fentanyl) with non-opioid (DEX) based technique with propofol infusion. The opioid group had better hemodynamic stability, required less rescue analgesia in the first hour after surgery and experienced early discharge because of less residual sedation, possibly because the consumption of propofol was higher in the DEX group. In this study, the only benefit found with the use of DEX is the prevention of PONV[40]. The addition of DEX with azasetron has been evaluated to reduce the occurrence of PONV compared with the use of azasetron alone in patients undergoing ambulatory thyroidectomy, which proved to be a failure41.

This section also provides an opportunity to discuss the use of DEX as an adjunct to spinal anesthesia. Indeed, neuraxial administration of DEX may be an appropriate route, as a number of studies conducted in animals have reported no neurological deficits[42-45]. Intrathecal DEX 3 or 5 µg added to hyperbaric bupivacaine 4 or 6 mg has been studied for outpatient anorectal surgery. It was found that DEX prolonged the duration of sensory and motor block, resulting in a prolonged first time to analgesic administration, but delayed ambulation and therefore delayed discharge from the hospital[46-48]. A study by Gupta et al. aimed to compare the effect of adding DEX or nalbuphine as an adjunct to chloroprocaine for spinal anesthesia in patients undergoing umbilical surgery[49]. The DEX group had prolonged time to onset, duration, and complete resolution of sensory and motor block compared with the nalbuphine or chloroprocaine alone groups. Sedation scores and hemodynamic variables were comparable, and there were no major adverse effects in either group[49].

The delayed recoveries observed with IT use of DEX (at doses ranging from 3 µg to 10 µg) raise the question of whether it is a good indication in the outpatient setting. Currently, we would not recommend the use of IT DEX for outpatient management.

Stomatology and dental surgery

Although local anesthesia usually provides adequate analgesia for dental surgery, patients may experience discomfort and fear. In this context, DEX has been used as premedication[50,52] or for intraoperative sedation[53-56].

For its use as a premedication drug, the intranasal (IN) route has been extensively studied because its pharmacologic effects have been found to be comparable to IV administration, with the exception of a faster onset of action with IV administration[57]. In their study, Ryu et al. compared the use of IV with IN administration of DEX in third molar surgery and showed that the two modes of administration produced similar sedative and analgesic effects and similar patients satisfaction[52]. Nooh et al. showed that 1.5 µg/kg inhaling DEX as premedication for the surgical removal of third-molar teeth could significantly increase patient relaxation after the first 20–30 minutes of the surgical procedure, with a peak effect reached after 40–50 minutes and a return to placebo effect after 70–80 minutes[51]. No significant difference was observed between the DEX and placebo groups in pain control during local anesthesia, time to first oral analgesic and number of analgesic tablets used. In another study, patient satisfaction and psychomotor recovery was similar compared to placebo, even if IN DEX was accompanied with less post-procedural pain scores[50].

Concerning its use for perioperative conscious sedation, Fan et al. compared IV DEX with midazolam and suggested that DEX produced comparable sedation with lower heart rate and blood pressure without the need for intervention, higher cooperation rate, and less anxiety[53]. Their conclusion, corroborated by one other study[54], is that IV DEX can be a safe replacement for midazolam for sedation purposes. Nolan et al. tried IV DEX as an alternative to a combination of propofol and fentanyl[55]. Compared to both these drugs, DEX is associated with fewer respiratory events requiring

intervention, resulting in fewer interruptions during the sedation process and improved patient safety. DEX also provides powerful pain relief, anxiety reduction, and muscle relaxation. However, it should be noted that DEX cannot reliably provide anterograde amnesia[55].

Mandal et al. had the idea to infiltrate a combination of DEX and lidocaine around the surgery site during general anesthesia for reconstructive maxillofacial surgeries[58]. The results showed that it was effective in reducing surgical bleeding and anesthetic and opioid requirements. Surgeon satisfaction was also better and discharge from the post-anesthesia care unit (PACU) was earlier in the DEX group.

In maxillofacial surgery, the use of IN DEX as premedication (at doses ranging from 1 to 1.5 µg/kg) or IV DEX as sedation (at doses ranging from 0.2 to 0.5 µg/kg/h after a bolus dose of 1 µg/kg) appears to be effective in reducing anxiety and improving patient satisfaction with their care.

Ophthalmic surgery

Cataract surgery, a common ambulatory procedure among the elderly, is usually performed with regional anesthesia (i.e., retrobulbar, peribulbar, and subTenon's blocks) supported by sedation to achieve patient immobilization, facilitate cooperation, maintain low to moderate intraocular pressure (IOP), and create a clean surgical field[59]. However, achieving adequate depth of sedation and hemodynamic stabilization in the geriatric patient can be challenging for the anesthesiologist due to the onset of systemic diseases and altered response to medications with advancing age[59].

In various studies, sedatives such as ketamine60, midazolam[61], propofol[62], remifentanil[63,64], acetaminophen[65], either alone or in various combinations, were compared with DEX. Intravenous bolus doses of DEX were administered over 10 minutes and ranged from 0.5 to 1 µg/kg[60,63,64]. Continuous infusion of DEX ranged from 0.1 to 0.7 µg/kg/h[60-64]. A systematic review of DEX in cataract surgery was performed by Jones and Aldwinckle in 2020[66] and included four of our selected studies[60-62,64]. Main conclusions of this review are in favor of DEX in terms of analgesia, respiratory function, IOP (reduced) and patient satisfaction. However, the use of DEX is often associated with hypotension with or without bradycardia (after bolus doses) and a tendency to prolong recovery time. Therefore, they recommended that the use of DEX should be considered only in individual circumstances after careful evaluation, and they questioned its suitability in ambulatory surgical settings[66].

In a more recent study, Kaya et al. conducted a comparison of DEX and remifentanil infusion in geriatrics for cataract surgery. They found that DEX is superior to remifentanil in terms of sedation quality (reaching targeted and recovery), analgesia levels, hemodynamic stability (less esmolol administration frequency), respiratory rates and surgeon satisfaction[63]. Finally, Farsani et al. compared acetaminophen or normal saline with DEX in terms of postoperative pain intensity. They found that DEX was as effective as acetaminophen in controlling pain after cataract surgery but with a longer recovery time[65].

In light of the conflicting results of the current studies, the use of DEX as a sedative in the elderly should be done with caution because it may be responsible for more pronounced hemodynamic side effects and a longer recovery time in this population.

Pediatrics

Despite the lack of pediatric labeling, DEX is frequently used in pediatric anesthesiology settings.

One of the most common procedures performed on children in the day hospital setting is adenoidectomy with or without tonsillectomy[67]. The immediate postoperative period following tonsillectomy and adenoidectomy (T&A) can be challenging because these children often experience severe pain and emergence agitation68. Children with obstructive sleep apnea are particularly sensitive to the respiratory depressant effects of perioperative opioids[69], and the use of nonsteroidal anti-inflammatory drugs may be associated with increased bleeding after this procedure[70]. A drug that can keep the child awake, comfortable and settled after surgery while minimizing respiratory and airway compromise is necessary. A meta-analysis of data from 5 RCTs (452 patients), including 4 articles obtained during our research[71-74], compared DEX versus morphine or fentanyl in the management of children after T&A[75]. They suggested that intraoperative use of DEX has the same efficacy as opioids for preventing postoperative pain and emergence agitation. In addition, the use of DEX was significantly associated with a shorter time to regaining consciousness and eye opening in response to verbal stimuli compared to the use of opioids. When compared with tramadol, DEX is equally effective in controlling pain and emergence agitation, but may cause intraoperative hypotension, bradycardia, prolonged extubation time, and prolonged sedation[76]. One study compared DEX with propofol given at the end of surgery and showed significant superiority of DEX in terms of emergence agitation incidence, pain intensity, but also time to emergence and extubation[77]. This is consistent with the results of 4 more recent studies in which the use of DEX at the dose of 1 µg/kg in

children undergoing T&A resulted in favorable effect on intraoperative hemodynamics, easier deep, smooth extubation, significant decrease in emergence agitation, in duration of surgery and in postoperative pain scores, without causing any excessive sedation, desaturation, or any other drug-related adverse events[78-81]. These findings may prove beneficial in the context of pediatric T&A.

Another common pediatric surgery that can be done on an outpatient basis is strabismus surgery. This surgery is an independent risk factor for PONV in pediatric patients[82]. Like T&A, it is also a great provider of emergence agitation[83] and can be associated with significant postoperative pain caused by the conjunctiva[84]. In addition, arrhythmias such as bradycardia may occur as a result of triggering the oculocardiac reflex by pulling on the extraocular muscles or by applying sudden pressure to the eye[85]. A systematic review and meta-analysis by Chiang et al. examined the efficiency of DEX in preventing these complications86. Three of the studies included in our search are part of this meta-analysis[87-89]. Their results showed a significant reduction in the incidence and severity of emergence agitation with the use of DEX. In addition, there was a reduction in the incidence of PONV, pain scores, and the use of analgesia. Compared to placebo (normal saline), the use of DEX was associated with a lower incidence of oculocardiac reflex. All of this without increasing PACU length of stay[86]. As a premedication before ophthalmological minor surgery, IV DEX 0.4 µg/kg leads to better parental separation acceptance and better sedation compared with midazolam; along with hemodynamic stability and no respiratory depression.

Dental rehabilitation is another typical procedure that can be performed in a day hospital. While this type of treatment is performed under local anesthesia in adults, children's anxiety and lack of cooperation require a pharmacological approach. In young children between the ages of 3 to 6 years who were given general anesthesia for dental work, preoperative administration of 1 to 2.5 µg/kg of DEX via the nasal route has been describe[91-94]. The results showed that the majority of children were easily separated from their parents and were cooperative when presented with the anesthesia mask when IN DEX was used. In addition, IN DEX resulted in better immediate postoperative pain relief, less emergence delirium, and a lower incidence of shivering compared to midazolam, but with a slower onset of sedation[92,93]. In their study, Zanaty and El Metainy reported that the combination of nebulized ketamine and DEX may result in better sedation, smoother induction of general anesthesia, faster recovery, and fewer side effects compared to nebulized ketamine or nebulized DEX alone[94]. Using DEX in pediatric dental rehabilitation has also been described to help avoid opiates[95]. To build their study, Naveen et al speculated that the application of a low-dose of DEX as an opioid substitute would accelerate recovery. They compared a group receiving infusion of DEX with a group receiving infusion of fentanyl perioperatively. The results showed a time to extubation and an awakening time lower with DEX. Heart rate was significantly lower across all time points in the DEX group, without resulting in bradycardia and with a mean arterial pressure who showed no difference between the groups. Sevoflurane end-tidal concentration required, postoperative sedation and pain scores were also lower in the DEX group. No significant differences were observed in this study in the length of PACU stay or PONV frequency[95]. In another study, the use of DEX reduced the dose of propofol required compared to placebo, confirming that DEX has a dose-sparing effect on sedatives[96]. When used as the sole sedative agent in pediatric dental patients and compared to a combination of propofol and midazolam, DEX resulted in faster recovery but slower induction, less analgesic supplementation, and relatively more stable hemodynamic and respiratory parameters[97].

As illustrated, emergence agitation is a major concern after anesthesia in children. The efficacy of DEX in preventing emergence agitation has been demonstrated in several previous studies using different routes of administration and different doses. Sato et al. showed that emergence agitation was significantly lower in patients receiving a single low dose of DEX (0.3 µg/kg) after induction of anesthesia (28%) compared to the saline group (64%). It also reduced postoperative pain intensity[98]. Compared with clonidine, IN DEX for premedication has been shown to reduce the incidence and severity of emergence agitation and opioid consumption in the PACU[99]. A recent meta-analysis including 33 RCTs (2549 patients) confirms that DEX is an excellent choice for preventing emergence agitation compared to many other medications[100].

Sedation with DEX is also commonly used in imaging procedures such as magnetic resonance imaging (MRI)[101-103], computed tomography (CT)[104], nuclear medicine imaging[105] or echocardiography[106], to ensure that pediatric patients remain calm and still for good image quality. A recent Belgian systematic review looked at the IN use of DEX as a sedative for medical imaging in young children[105]. The team conducted this review with the goal of providing a roadmap for an evidence-based clinical protocol, which can be read at the end of their paper[105]. A meta-analysis (including 6 studies with

368 subjects) aimed to compare the efficacy of DEX versus propofol in children undergoing MRI[103]. The results showed that propofol had a shorter onset and recovery time than DEX. There was no significance between DEX and propofol on MRI quality. In addition, the incidence of emergence delirium was lower with propofol. Their conclusions were in favor of propofol for its better sedative effects and lower incidence of emergence delirium[103]. Two other studies were designed to determine the efficacy of IN DEX at a dose of 2.5 μg/kg as the sole premedication before transthoracic echocardiography[106] or CT scan[104]. Compared with oral phenobarbital, the use of IN DEX was noninferior in efficacy, although the onset of sedation was slightly faster with phenobarbital[106]. Compared with oral midazolam, IN DEX was superior in achieving satisfactory sedation with a reduction in the need for additional IV sedatives and their associated adverse effects[104]. Another study compared IN administration of DEX (1 μg/kg) with either ketamine (5 μg/kg) or placebo (normal saline), combined with propofol for sedation of children undergoing MRI. They found no significant differences in children's discomfort with drug administration and IV cannulation between DEX and ketamine. The mean dose of propofol in children receiving DEX was lower than in children receiving ketamine, which was also lower than in children receiving saline. There were no significant differences in adverse effects between the groups. Finally, both IN premedications decreased time to wake and discharge and resulted in better radiologist, anesthesiologist, and parent's satisfaction compared to placebo[101].

DEX at a dose of 0.5 to 1.5 μg/kg has been successfully used as an adjuvant to ropivacaine for caudal blocks in children undergoing lower abdominal and perineal surgeries to reduce postoperative pain without inducing significant respiratory or hemodynamic effects and without delaying hospital discharge[107,108]. Same results were found when DEX was added to ropivacaine for ilioinguinal-iliohypogastric nerve block in the pediatric population undergoing inguinal hernia repair: the time to first postoperative analgesia was extended by 88% compared to plain ropivacaine, with no adverse event[109].

One study examined the effect of DEX combined with propofol on serum inflammatory cytokines in laparoscopic day urologic surgery. The levels of TNF-a, CRP, IL-6 and other inflammatory factors in the control group (propofol alone) were significantly higher than those in the DEX group 24 hours after surgery[110].

We conclude this section by noting the successful use of DEX as a sedative agent for pediatric patients undergoing sclerotherapy for superficial venous malformations[111] and for repeated sedation during fractionated radiotherapy in pediatric oncology[112].

Based on the current best available evidence, DEX appears to be both appropriate and safe for a range of indications in pediatric patients. However, in order to fully explore its potential and to determine optimal dosing, indications, preferred route of administration, and safety profiles across a range of age groups and procedures, it is imperative that high-quality pediatric clinical trials be conducted without delay.

Diagnostic procedures

Flexible Bronchoscopy: Combination of DEX and opioid infusion[113,114] and/or propofol infusion[114,115] with local anesthesia have been investigated several times in the literature. However, it has been reported that IV DEX is associated with longer recovery time and poorer bronchoscopist satisfaction due to more frequent use of local anesthesia rescue for cough[115]. The observed outcome can be rationalized on the grounds that DEX does not have antitussive properties, and the manipulation of flexible bronchoscope through the vocal folds may elicit cough reflex[115]. Because animal experiments have indicated that the local application of DEX to the airway has direct actions on peripheral alpha-2 receptors, expanding the smooth muscle of the trachea and inhibiting the cough reflex[116,117], Gu et al. have experimented the use of DEX as an additive to local anesthetic and found several advantages over conventional IV route of administration[114]. In this study, the prevalence of moderate to severe cough was observed to be 15% in the group receiving nebulized DEX, 50% in the group receiving IV DEX, and 55% in the group receiving lidocaine alone. No significant differences were observed in the rates of complete relaxation of the jaw and limb movement during the procedure among the three groups, and the rates of glottal closure were also similar. In addition, the time to recovery was significantly shorter in the nebulized DEX group compared to the IV DEX group[114].

Gastrointestinal Endoscopy: There are several RCTs and review articles on DEX in the field of endoscopic sedation[118-127]. The usual dose used in these studies for sedation is 1 μg/kg for 10 minutes, followed by an IV infusion of 0.2 to 1 μg/kg/h. Comparing the analgesic effect and hemodynamic changes of DEX versus fentanyl as single sedative for patients undergoing colonoscopy, Amri et al. found that the pain score was lower in the DEX group, with lower dose of rescue propofol, but with more bradycardia when compared to the fentanyl group[119].

When compared to midazolam for sedation during colonoscopy, although no significant differences in mean arterial pressure and pain score were detected between the two groups, heart rate was lower and SpO2 was higher in the DEX group. In terms of quality of sedation and endoscopist satisfaction, DEX showed better results[120]. Wu et al assessed the efficacy and safety of DEX versus midazolam for conscious sedation in patients undergoing upper gastrointestinal endoscopy. Patients in the DEX group experienced lower pain scores and had higher overall satisfaction[126]. Nishizawa et al performed a meta-analysis of data from 6 RCTs (including 361 patients) comparing DEX with propofol for gastrointestinal endoscopy[124]. Two of the studies included in our search are part of this meta-analysis[121,127]. They concluded that patient satisfaction was lower with DEX administration than with propofol administration, while the risk of complications (including hypotension, hypoxemia and bradycardia) was similar. In contrast, a recent meta-analysis by Liu et al. of data from 7 RCTs (including 477 patients) found that DEX was associated with a lower risk of hypoxia and a higher risk of bradycardia compared with propofol[123]. There were no differences in the risk of hypotension or PONV. In addition, induction time and recovery time were similar[123]. Karanth et al. observed a different result with respect to blood pressure, as DEX administration was associated with a significant decrease in systolic blood pressure in their study[118].

Drug-Induced Sleep Endoscopy: The available scientific evidence suggests that DEX has a neuropharmacological profile that closely mimics the natural pathways of sleep compared to other sedatives[128]. This could make this molecule interesting in this context. In a recent meta- analysis of data from 5 RCTs (including 270 patients), Chen et al compared the use of propofol versus DEX[129] for drug-induced sleep endoscopy. Results showed that the minimum oxygen saturation was higher and the risk of oxygen desaturation was lower in patients receiving DEX. Also, the use of DEX was associated with risks of sedation failure while propofol provided a shorter time to fall asleep. No significant difference was found in the duration of endoscopic sedation, hemodynamic profile, and patient satisfaction between the propofol group and the DEX group, while endoscopic operator satisfaction was higher with DEX[129]. In a previous systematic review, DEX appeared to offer an overall safer and more stable hemodynamic profile, while propofol had not only a faster onset and shorter half-life, but also a potentially greater degree of airway obstruction. The authors emphasized that neither propofol nor DEX have been validated to replicate the obstruction that occurs during natural sleep[130].

Transesophageal Echocardiography (TEE): Sruthi et al. compared ketofol (a combination of propofol and ketamine) with DEX for sedating outpatients undergoing TEE. They reported that the time to achieve appropriate level of sedation was significantly shorter in the ketofol group than in the DEX group. Both agents had a stable respiratory profile with no need for rescue sedation. Patient satisfaction was comparable, while ketofol provided higher cardiologist satisfaction. According to this study, ketofol is preferable to DEX as a sedative agent for diagnostic TEE[131].

The use of DEX for the sedation of non-intubated adult patients before and/or during diagnostic procedures requiring sedation is an EMA-approved indication. According to the EMA, the induction of sedation is achieved by a loading infusion of 1 µg/kg DEX over 10 minutes. Maintenance of sedation is achieved by an infusion initiated at 0.6-0.7 µg/kg/h and titrated to achieve the desired level of sedation, with doses ranging from 0.2 to 1 µg/kg/h[7].

Conclusion

Most of the studies about the use of DEX in day-care come from Asia, where its use is approved and recommended in many indications. In Europe, the off-label use of this drug is becoming more common in various areas of medicine due to its excellent sedative properties and safety. The currently available literature supports the safety and efficacy of DEX in ambulatory anesthesia. Its use as premedication, as an anesthetic adjunct to general and regional anesthesia, and as a postoperative analgesic has demonstrated its benefits. Its use in children has shown great interest, especially in the prevention of emergence delirium.

If the practitioner plans to incorporate DEX into daily practice, there are several limitations to its use that should be considered. First, the method of administration of DEX is somewhat complicated because the loading dose should be given over at least 10 minutes to avoid the undesirable hemodynamic changes that occur with a faster infusion. In addition, induction times appear to be longer than with other sedatives and results regarding speed of recovery and time to hospital discharge are conflicting. These arguments do not support its use in an ambulatory care context where patient turnover is important and procedure times are relatively short. There is a need for high-quality, large-sample, randomized controlled trials to verify the efficacy of DEX on procedure times.

Another current drawback remains price. Despite the introduction of generics, the cost of DEX can still be an issue.

The lack of a reversal agent is a further disadvantage. A safe and quick reversal of sedative and hemodynamic effects would benefit clinical practice, and probably lead to a more widespread use of DEX. There is one in veterinary medicine, the selective a2-antagonist atipamezole[132], but it is not FDA or EMA approved for human use.

The aim of this work was to review the indications with an established level of evidence and to promote the extension of the use of DEX. The recent health crisis related to the SARS-COV2 virus and the shortage of some molecules used in anesthesia and resuscitation that have occurred must support practitioners to master the possible alternatives in order to accomplish their missions.

To conclude, it is essential to remember that the use of DEX in an outpatient setting requires supervision by a qualified professional. Patients should be advised not to drive or perform any hazardous tasks. They should also be advised not to use other sedatives such as benzodiazepines, opioids, and alcohol for a period appropriate to the observed effects of DEX, as well as to the nature of the procedure, concomitant treatments, patient age, and health status.

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References

1. Devos C, Cordon A, Lefèvre M, et al. Performance of the Belgian health system – Report 2019. Health Services Research (HSR). Brussels. Belgian Health Care Knowledge Centre (KCE). 2019. KCE Reports 313.
2. Lee JH. Anesthesia for ambulatory surgery. Korean Journal of Anesthesiology 2017; 70(4):398-406.
3. Weerink MAS, Struys MMRF, Hannivoort LN, et al. Clinical Pharmacokinetics and Pharmacodynamics of Dexmedetomidine. Clinical Pharmacokinetics 2017; 56(8):893-913.
4. Li A, Yuen VMY, Goulay-Dufay S, Kwok PCL. Pharmacokinetics and pharmacodynamics of dexmedetomidine. Drug Development and Industrial Pharmacy 2016; 42(12):1917-27.
5. Hsu YW, Cortinez LI, Robertson KM, et al. Dexmedetomidine pharmacodynamics: part I: crossover comparison of the respiratory effects of dexmedetomidine and remifentanil in healthy volunteers. Anesthesiology 2004; 101(5):1066-76.
6. Bloor BC, Ward DS, Belleville JP, Maze M. Effects of intravenous dexmedetomidine in humans. II. Hemodynamic changes. Anesthesiology 1992; 77(6):1134-42.
7. European Medicines Agency. European Public Assessment Report 11 May 2023. Available from: https://www.ema.europa.eu/en/documents/product-information/dexmedetomidine-accord-epar-product-information_en.pdf.
8. Karol MD, Maze M. Pharmacokinetics and interaction pharmacodynamics of dexmedetomidine in humans. Best Practice & Research Clinical Anaesthesiology 2000; 14(2):261-9.
9. Haddaway NR, Page MJ, Pritchard CC, McGuinness LA. PRISMA2020: An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis. Campbell Systematic Reviews 2022; 18(2):e1230.
10. Wang HL, Zhang GY, Dai WX, et al. Dose-dependent neurotoxicity caused by the addition of perineural dexmedetomidine to ropivacaine for continuous femoral nerve block in rabbits. J Int Med Res 2019; 47(6):2562-70.
11. Yu ZY, Geng J, Li ZQ, et al. Dexmedetomidine enhances ropivacaine-induced sciatic nerve injury in diabetic rats. Br J Anaesth 2019; 122(1):141-9.
12. Kim BS, Choi JH, Baek SH, Lee DH. Effects of Intraneural Injection of Dexmedetomidine in Combination With Ropivacaine in Rat Sciatic Nerve Block. Reg Anesth Pain Med 2018; 43(4):378-84.
13. Memari E, Hosseinian MA, Mirkheshti A, et al. Comparison of histopathological effects of perineural administration of bupivacaine and bupivacaine-dexmedetomidine in rat sciatic nerve. Exp Toxicol Pathol 2016; 68(10):559-64.
14. Abdallah FW, Dwyer T, Chan VWS, et al. IV and perineural dexmedetomidine similarly prolong the duration of analgesia after interscalene brachial plexus block: A randomized, three-arm, triple-masked, placebo-controlled trial. Anesthesiology 2016; 124(3):683-95.
15. Rodrigues D, Amadeo RJJ, Wolfe S, et al. Analgesic duration of interscalene block after outpatient arthroscopic shoulder surgery with intravenous dexamethasone, intravenous dexmedetomidine, or their combination: a randomized-controlled trial. Can J Anaesth 2021; 68(6):835-45.
16. Albrecht E, Vorobeichik L, Jacot-Guillarmod A, Fournier N, Abdallah FW. Dexamethasone Is Superior to Dexmedetomidine as a Perineural Adjunct for Supraclavicular Brachial Plexus Block: Systematic Review and Indirect Meta-analysis. Anesth Analg 2019; 128(3):543-54.
17. Albrecht E, Capel D, Rossel JB, et al. A randomised controlled trial of intravenous dexmedetomidine added to dexamethasone for arthroscopic rotator cuff repair and duration of interscalene block. Anaesthesia 2023; 78(3):315-9.
18. Margulis R, Francis J, Tischenkel B, et al. Comparison of Dexmedetomidine and Dexamethasone as Adjuvants to Ultra-Sound Guided Interscalene Block in Arthroscopic Shoulder Surgery: A Double-Blinded Randomized Placebo-Controlled Study. Anesth Pain Med 2021; 11(3):e117020.
19. Samar P, Dhawale TA, Pandya S. Comparative Study of Intravenous Dexmedetomidine Sedation With Perineural Dexmedetomidine on Supraclavicular Approach Brachial Plexus Block in Upper Limb Orthopaedic Surgery. Cureus 2020; 12(10):e10768.
20. Mizrak A, Gul R, Erkutlu I, Alptekin M, Oner U. Premedication with dexmedetomidine alone or together with 0.5% lidocaine for IVRA. J Surg Res 2010; 164(2):242-7.
21. Mizrak A, Gul R, Ganidagli S, et al. Dexmedetomidine premedication of outpatients under IVRA. Middle East J Anaesthesiol 2011; 21(1):53-60.
22. Breebaart MB, Saerens L, Branders J, et al. Spinal or Intravenous Dexmedetomidine for Spinal Anesthesia with Chloroprocaine in Ambulatory Knee Arthroscopies: A Double-Blind Randomized Trial. Local Reg Anesth 2021; 14:153-60.
23. Shariffuddin, II, Teoh WH, Wahab S, Wang CY. Effect of single-dose dexmedetomidine on postoperative recovery

after ambulatory ureteroscopy and ureteric stenting: a double blind randomized controlled study. BMC Anesthesiol 2018; 18(1):3.
24. Arpaci AH, Bozkirli F. Comparison of sedation effectiveness of remifentanil-dexmedetomidine and remifentanil-midazolam combinations and their effects on postoperative cognitive functions in cystoscopies: A randomized clinical trial. Journal of Research in Medical Sciences 2013; 18(2):107-14.
25. Kose EA, Honca M, Ylmaz E, Batislam E, Apan A. Comparison of effects of dexmedetomidine-ketamine and dexmedetomidine- midazolam combinations in transurethral procedures. Urology 2012; 79(6):1214-9.
26. Akça B, Aydoğan-Eren E, Canbay Ö, et al. Comparison of efficacy of prophylactic ketamine and dexmedetomidine on postoperative bladder catheter-related discomfort. Saudi Med J 2016; 37(1):55-9.
27. Kaygusuz K, Gokce G, Gursoy S, et al. A comparison of sedation with dexmedetomidine or propofol during shockwave lithotripsy: a randomized controlled trial. Anesth Analg 2008; 106(1):114-9, table of contents.
28. Salem RA, Mohamed AA, Moghazy HEL, Alsagheer GA. A comparative study between dexmedetomidine and propofol in combination with fentanyl for conscious sedation during extracorporeal shock wave lithotripsy. Egyptian Journal of Anaesthesia 2016; 32(1):1-6.
29. Zeyneloglu P, Pirat A, Candan S, et al. Dexmedetomidine causes prolonged recovery when compared with midazolam/fentanyl combination in outpatient shock wave lithotripsy. Eur J Anaesthesiol 2008; 25(12):961-7.
30. Kaur G, Kaur P, Gupta R, et al. Discharge readiness after minor gynaecological surgeries comparing dexmedetomidine and ketamine premedication in bispectral index (BIS) guided propofol-based anaesthesia. Indian J Anaesth 2021; 65(Suppl 1):S34-s40.
31. Kumari A, Singh AP, Vidhan J, et al. The Sedative and Propofol-Sparing Effect of Dexmedetomidine and Midazolam as Premedicants in Minor Gynecological Day Care Surgeries: A Randomized Placebo-Controlled Study. Anesth Essays Res 2018; 12(2):423-7.
32. Hakim KYK, Wahba WZB. Opioid-Free Total Intravenous Anesthesia Improves Postoperative Quality of Recovery after Ambulatory Gynecologic Laparoscopy. Anesth Essays Res 2019; 13(2):199-203.
33. Salman N, Uzun S, Coskun F, et al. Dexmedetomidine as a substitute for remifentanil in ambulatory gynecologic laparoscopic surgery. Saudi Med J 2009; 30(1):77-81.
34. Techanivate A, Dusitkasem S, Anuwattanavit C. Dexmedetomidine compare with fentanyl for postoperative analgesia in outpatient gynecologic laparoscopy: a randomized controlled trial. J Med Assoc Thai 2012; 95(3):383-90.
35. Bingol Tanriverdi T, Koceroglu I, Devrim S, Gura Celik M. Comparison of sedation with dexmedetomidine vs propofol during hysteroscopic surgery: Single-centre randomized controlled trial. Journal of Clinical Pharmacy and Therapeutics 2019; 44(2):312-7.
36. Maurya I, Reddy HKV, Velraj J. Recovery characteristics in patients undergoing short gynaecological day care procedures under sedation with dexmedetomidine vs propofol infusion. Sri Lankan Journal of Anaesthesiology 2020; 28(1):19-24.
37. Elnabtity AM, Selim MF. A Prospective Randomized Trial Comparing Dexmedetomidine and Midazolam for Conscious Sedation During Oocyte Retrieval in An In Vitro Fertilization Program. Anesth Essays Res 2017; 11(1):34-9.
38. Saravanaperumal G, Udhayakumar P. Opioid-free TIVA Improves Post- operative Quality of Recovery (QOR) in Patients Undergoing Oocyte Retrieval. J Obstet Gynaecol India 2022; 72(1):59-65.
39. Das R, Das RK, Sahoo S, Nanda S. Role of dexmedetomidine as an anaesthetic adjuvant in breast cancer surgery as a day-care procedure: A randomised controlled study. Indian J Anaesth 2018; 62(3):182-7.
40. Siddiqui TH, Choudhary N, Kumar A, et al. Comparative evaluation of dexmedetomidine and fentanyl in total intravenous anesthesia for laparoscopic cholecystectomy: A randomised controlled study. J Anaesthesiol Clin Pharmacol 2021; 37(2):255-60.
41. Xie C, Zhang C, Sun H, Lu Y. Effects of Dexmedetomidine on Postoperative Nausea and Vomiting in Adult Patients Undergoing Ambulatory Thyroidectomy: A Randomized Clinical Trial. Front Med (Lausanne) 2021; 8:781689.
42. Kalso EA, Pöyhiä R, Rosenberg PH. Spinal Antinociception by Dexmedetomidine, a Highly Selective α2-Adrenergic Agonist. Pharmacology & Toxicology 1991; 68(2):140-3.
43. Lo WC, Harris J, Clarke RW. Endogenous opioids support the spinal inhibitory action of an α2-adrenoceptor agonist in the decerebrated, spinalised rabbit. Neuroscience Letters 2003; 340(2):95-8.
44. Xu M, Kontinen Vesa K, Kalso E. Effects of Radolmidine, A Novel α2-Adrenergic Agonist Compared with Dexmedetomidine in Different Pain Models in the Rat. Anesthesiology 2000; 93(2):473-81.
45. Eisenach JC, Shafer SL, Bucklin BA, Jackson C, Kallio A. Pharmacokinetics and pharmacodynamics of intraspinal dexmedetomidine in sheep. Anesthesiology 1994; 80(6):1349-59.
46. Kapoor J, Sharma AK. Kapoor J, Sharma AK. Evaluation of intrathecal dexmedetomidine for spinal anaesthesia for perianal ambulatory surgeries. European Journal of Molecular and Clinical Medicine 2022; 9(4):1187-91.
47. Nethra SS, Sathesha M, Aanchal D, et al. Intrathecal dexmedetomidine as adjuvant for spinal anaesthesia for perianal ambulatory surgeries: A randomised double-blind controlled study. Indian Journal of Anaesthesia 2015; 59(3):177-81.
48. Sudheesh K, Raghavendra Rao RS, Kavya M, et al. Comparative study of two doses of intrathecal dexmedetomidine as adjuvant with low dose hyperbaric bupivacaine in ambulatory perianal surgeries: A prospective randomised controlled study. Indian Journal of Anaesthesia 2015; 59(10):648-52.
49. Gupta P, Suthar A, Deganwa M, Goyal V, Devgan S. A Comparative Study of Dexmedetomidine versus Nalbuphine Used as an Adjuvant to Chloroprocaine for Daycare Surgeries Performed under Subarachnoid Block. Anesth Essays Res 2022; 16(3):336-9.
50. Cheung CW, Ng KF, Liu J, et al. Analgesic and sedative effects of intranasal dexmedetomidine in third molar surgery under local anaesthesia. Br J Anaesth 2011; 107(3):430-7.
51. Nooh N, Sheta SA, Abdullah WA, Abdelhalim AA. Intranasal atomized dexmedetomidine for sedation during third molar extraction. Int J Oral Maxillofac Surg 2013; 42(7):857-62.
52. Ryu DS, Lee DW, Choi SC, Oh IH. Sedation Protocol Using Dexmedetomidine for Third Molar Extraction. Journal of Oral and Maxillofacial Surgery 2016; 74(5):926.e1-.e7.
53. Fan TW, Ti LK, Islam I. Comparison of dexmedetomidine and midazolam for conscious sedation in dental surgery monitored by bispectral index. Br J Oral Maxillofac Surg 2013; 51(5):428-33.
54. Mishra N, Birmiwal KG, Pani N, et al. Sedation in oral and maxillofacial day care surgery: A comparative study between intravenous dexmedetomidine and midazolam. Natl J Maxillofac Surg 2016; 7(2):178-85.
55. Nolan PJ, Delgadillo JA, Youssef JM, et al. Dexmedetomidine Provides Fewer Respiratory Events Compared With Propofol and Fentanyl During Third Molar Surgery: A Randomized Clinical Trial. Journal of Oral and Maxillofacial Surgery 2020; 78(10):1704-16.
56. Taylor DC, Ferguson HW, Stevens M, et al. Does Including Dexmedetomidine Improve Outcomes After

Intravenous Sedation for Outpatient Dentoalveolar Surgery? J Oral Maxillofac Surg 2020; 78(2):203-13.
57. Iirola T, Vilo S, Manner T, et al. Bioavailability of dexmedetomidine after intranasal administration. Eur J Clin Pharmacol 2011; 67(8):825-31.
58. Mandal D, Das A, Chhaule S, et al. The effect of dexmedetomidine added to preemptive (2% lignocaine with adrenaline) infiltration on intraoperative hemodynamics and postoperative pain after ambulatory maxillofacial surgeries under general anesthesia. Anesth Essays Res 2016; 10(2):324-31.
59. Kumar CM, Seet E, Eke T, Irwin MG, Joshi GP. Perioperative considerations for sedation-analgesia during cataract surgery: a narrative review. Anaesthesia 2019; 74(12):1601-10.
60. Yağan Ö, Karakahya RH, Taş N, Küçük A. Comparison of Dexmedetomidine Versus Ketamine-Propofol Combination for Sedation in Cataract Surgery. Turk J Anaesthesiol Reanim 2015; 43(2):84-90.
61. Apan A, Doganci N, Ergan A, Büyükkoçak U. Bispectral index-guided intraoperative sedation with dexmedetomidine and midazolam infusion in outpatient cataract surgery. Minerva Anestesiol 2009; 75(5):239-44.
62. Na HS, Song IA, Park HS, et al. Dexmedetomidine is effective for monitored anesthesia care in outpatients undergoing cataract surgery. Korean Journal of Anesthesiology 2011; 61(6):453-9.
63. Kaya C, Celebi NO, Debbag S, Canbay O, Onal O. Comparison of dexmedetomidine and remifentanil infusion in geriatric patients undergoing outpatient cataract surgery: a prospective, randomized, and blinded study. Med Gas Res 2022; 12(4):146-52.
64. Poorzamany Nejat Kermany M, Dahi M, Yamini Sharif R, Radpay B. Comparison of the effects of dexmedetomidine and remifentanil on cognition state after cataract surgery. Anesthesiology and Pain Medicine 2016; 6(3).
65. Moradi Farsani D, Mortazavi SA, Masjedi S, Heidari SM, Nazemroaya B. Comparison between the Effects of Acetaminophen, Dexmedetomidine, and Normal Saline Infusion on Pain Severity after Cataract Surgery. Adv Biomed Res 2022; 11:71.
66. Jones JH, Aldwinckle R. Perioperative Dexmedetomidine for outpatient cataract surgery: a systematic review. BMC Anesthesiol 2020; 20(1):75.
67. Mitchell RB, Archer SM, Ishman SL, et al. Clinical Practice Guideline: Tonsillectomy in Children (Update)—Executive Summary. Otolaryngology–Head and Neck Surgery 2019; 160(2):187-205.
68. Voepel-Lewis T, Malviya S, Tait AR. A prospective cohort study of emergence agitation in the pediatric postanesthesia care unit. Anesth Analg 2003; 96(6):1625-30.
69. Brown KA, Laferrière A, Moss IR. Recurrent hypoxemia in young children with obstructive sleep apnea is associated with reduced opioid requirement for analgesia. Anesthesiology 2004; 100(4):806-10; discussion 5A.
70. Møiniche S, Rømsing J, Dahl JB, Tramèr MR. Nonsteroidal antiinflammatory drugs and the risk of operative site bleeding after tonsillectomy: a quantitative systematic review. Anesth Analg 2003; 96(1):68-77, table of contents.
71. Erdil F, Demirbilek S, Begec Z, et al. The effects of dexmedetomidine and fentanyl on emergence characteristics after adenoidectomy in children. Anaesth Intensive Care 2009; 37(4):571-6.
72. Olutoye OA, Glover CD, Diefenderfer JW, et al. The effect of intraoperative dexmedetomidine on postoperative analgesia and sedation in pediatric patients undergoing tonsillectomy and adenoidectomy. Anesth Analg 2010; 111(2):490-5.
73. Patel A, Davidson M, Tran MC, et al. Dexmedetomidine infusion for analgesia and prevention of emergence agitation in children with obstructive sleep apnea syndrome undergoing tonsillectomy and adenoidectomy. Anesth Analg 2010; 111(4):1004-10.
74. Pestieau SR, Quezado ZM, Johnson YJ, et al. High-dose dexmedetomidine increases the opioid-free interval and decreases opioid requirement after tonsillectomy in children. Can J Anaesth 2011; 58(6):540-50.
75. He XY, Cao JP, Shi XY, Zhang H. Dexmedetomidine versus morphine or fentanyl in the management of children after tonsillectomy and adenoidectomy: a meta-analysis of randomized controlled trials. Ann Otol Rhinol Laryngol 2013; 122(2):114-20.
76. Bedirli N, Akçabay M, Emik U. Tramadol vs dexmedetomidine for emergence agitation control in pediatric patients undergoing adenotonsillectomy with sevoflurane anesthesia: prospective randomized controlled clinical study. BMC Anesthesiol 2017; 17(1):41.
77. Ali MA, Abdellatif AA. Prevention of sevoflurane related emergence agitation in children undergoing adenotonsillectomy: A comparison of dexmedetomidine and propofol. Saudi J Anaesth 2013; 7(3):296-300.
78. Di M, Han Y, Yang Z, et al. Tracheal extubation in deeply anesthetized pediatric patients after tonsillectomy: a comparison of high-concentration sevoflurane alone and low-concentration sevoflurane in combination with dexmedetomidine pre-medication. BMC Anesthesiol 2017; 17(1):28.
79. Shafa A, Aledavud H, Shetabi H, Shahhosseini S. Effects of the Two Doses of Dexmedetomidine on Sedation, Agitation, and Bleeding During Pediatric Adenotonsillectomy. Anesth Pain Med 2021; 11(5):e118424.
80. Sharma K, Kumar M, Gandhi R. Effect of Single-Dose Dexmedetomidine on Intraoperative Hemodynamics and Postoperative Recovery during Pediatric Adenotonsillectomy. Anesth Essays Res 2019; 13(1):63-7.
81. Tsiotou AG, Malisiova A, Kouptsova E, et al. Dexmedetomidine for the reduction of emergence delirium in children undergoing tonsillectomy with propofol anesthesia: A double-blind, randomized study. Paediatr Anaesth 2018; 28(7):632-8.
82. Eberhart LHJ, Geldner G, Kranke P, et al. The development and validation of a risk score to predict the probability of postoperative vomiting in pediatric patients. Anesth Analg 2004; 99(6):1630-7.
83. Aouad MT, Yazbeck-Karam VG, Nasr VG, et al. A single dose of propofol at the end of surgery for the prevention of emergence agitation in children undergoing strabismus surgery during sevoflurane anesthesia. Anesthesiology 2007; 107(5):733-8.
84. Shende D, Das K. Comparative effects of intravenous ketorolac and pethidine on perioperative analgesia and postoperative nausea and vomiting (PONV) for paediatric strabismus surgery. Acta Anaesthesiol Scand 1999; 43(3):265-9.
85. Choi SR, Park SW, Lee JH, Lee SC, Chung CJ. Effect of different anesthetic agents on oculocardiac reflex in pediatric strabismus surgery. J Anesth 2009; 23(4):489-93.
86. Chiang FW, Chang JL, Hsu SC, et al. Dexmedetomidine use in pediatric strabismus surgery: A systematic review and meta-analysis. PLoS One 2020; 15(10):e0240553.
87. Kim J, Kim SY, Lee JH, Kang YR, Koo BN. Low-dose dexmedetomidine reduces emergence agitation after desflurane anaesthesia in children undergoing strabismus surgery. Yonsei Med J 2014; 55(2):508-16.
88. Li S, Liu T, Xia J, Jia J, Li W. Effect of dexmedetomidine on prevention of postoperative nausea and vomiting in pediatric strabismus surgery: a randomized controlled study. BMC Ophthalmol 2020; 20(1):86.
89. Mizrak A, Erbagci I, Arici T, et al. Dexmedetomidine use during strabismus surgery in agitated children. Med Princ Pract 2011; 20(5):427-32.

90. Bhadla S, Prajapati D, Louis T, et al. Comparison between dexmedetomidine and midazolam premedication in pediatric patients undergoing ophthalmic day-care surgeries. Anesth Essays Res 2013; 7(2):248-56.
91. Sado-Filho J, Corrêa-Faria P, Viana KA, et al. Intranasal dexmedetomidine compared to a combination of intranasal dexmedetomidine with ketamine for sedation of children requiring dental treatment: A randomized clinical trial. Journal of Clinical Medicine 2021; 10(13).
92. Sheta SA, Al-Sarheed MA, Abdelhalim AA. Intranasal dexmedetomidine vs midazolam for premedication in children undergoing complete dental rehabilitation: a double-blinded randomized controlled trial. Paediatr Anaesth 2014; 24(2):181-9.
93. Wang L, Huang L, Zhang T, Peng W. Comparison of Intranasal Dexmedetomidine and Oral Midazolam for Premedication in Pediatric Dental Patients under General Anesthesia: A Randomised Clinical Trial. Biomed Res Int 2020; 2020:5142913.
94. Zanaty OM, El Metainy SA. A comparative evaluation of nebulized dexmedetomidine, nebulized ketamine, and their combination as premedication for outpatient pediatric dental surgery. Anesth Analg 2015; 121(1):167-71.
95. Naveen NB, Jaiswal MK, Ganesh V, et al. Improved postoperative recovery profile in pediatric oral rehabilitation with low-dose dexmedetomidine as an opioid substitute for general anesthesia: a randomized double-blind clinical trial. J Dent Anesth Pain Med 2022; 22(5):357-67.
96. Rehman F, Goyal A, Gauba K, Jain K, Kapur A. Safety and Efficacy of IV Dexmedetomidine as an Adjunct to Propofol to Sedate Anxious and Uncooperative Pediatric Dental Patients: A Randomized Controlled Trial. The Journal of clinical pediatric dentistry 2021; 45(6):428-32.
97. Al Taher WMA, Mansour EE, El Shafei MN. Comparative study between novel sedative drug (dexmedetomidine) versus midazolam-propofol for conscious sedation in pediatric patients undergoing oro-dental procedures. Egyptian Journal of Anaesthesia 2010; 26(4):299-304.
98. Sato M, Shirakami G, Tazuke-Nishimura M, et al. Effect of single-dose dexmedetomidine on emergence agitation and recovery profiles after sevoflurane anesthesia in pediatric ambulatory surgery. J Anesth 2010; 24(5):675-82.
99. Mukherjee A, Das A, Basunia SR, et al. Emergence agitation prevention in paediatric ambulatory surgery: A comparison between intranasal Dexmedetomidine and Clonidine. J Res Pharm Pract 2015; 4(1):24-30.
100. Yang X, Hu Z, Peng F, et al. Effects of Dexmedetomidine on Emergence Agitation and Recovery Quality Among Children Undergoing Surgery Under General Anesthesia: A Meta-Analysis of Randomized Controlled Trials. Frontiers in Pediatrics 2020; 8.
101. Gyanesh P, Haldar R, Srivastava D, et al. Comparison between intranasal dexmedetomidine and intranasal ketamine as premedication for procedural sedation in children undergoing MRI: a double-blind, randomized, placebo-controlled trial. J Anesth 2014; 28(1):12-8.
102. Heard C, Burrows F, Johnson K, et al. A comparison of dexmedetomidine-midazolam with propofol for maintenance of anesthesia in children undergoing magnetic resonance imaging. Anesth Analg 2008; 107(6):1832-9.
103. Zhou Q, Shen L, Zhang X, Li J, Tang Y. Dexmedetomidine versus propofol on the sedation of pediatric patients during magnetic resonance imaging (MRI) scanning: a meta-analysis of current studies. Oncotarget 2017; 8(60):102468-73.
104. Ghai B, Jain K, Saxena AK, Bhatia N, Sodhi KS. Comparison of oral midazolam with intranasal dexmedetomidine premedication for children undergoing CT imaging: a randomized, double-blind, and controlled study. Paediatr Anaesth 2017; 27(1):37-44.
105. Hermans K, Ramaekers L, Toelen J, Vanhonsebrouck K, Allegaert K. Intranasal Dexmedetomidine as Sedative for Medical Imaging in Young Children: A Systematic Review to Provide a Roadmap for an Evidence-Guided Clinical Protocol. Children (Basel) 2022; 9(9).
106. Miller JW, Ding L, Gunter JB, et al. Comparison of intranasal dexmedetomidine and oral pentobarbital sedation for transthoracic echocardiography in infants and toddlers: A prospective, randomized, double-blind trial. Anesthesia and Analgesia 2018; 126(6):2009-16.
107. Bharti N, Praveen R, Bala I. A dose-response study of caudal dexmedetomidine with ropivacaine in pediatric day care patients undergoing lower abdominal and perineal surgeries: a randomized controlled trial. Paediatr Anaesth 2014; 24(11):1158-63.
108. Cho JE, Kim JY, Park SJ, Kil HK. The Effect of 1 μg/kg Dexmedetomidine Combined with High-Volume/Low-Concentration Caudal Ropivacaine in Children Undergoing Ambulatory Orchiopexy. Biol Pharm Bull 2015; 38(7):1020-5.
109. Lundblad M, Marhofer D, Eksborg S, Lönnqvist PA. Dexmedetomidine as adjunct to ilioinguinal/iliohypogastric nerve blocks for pediatric inguinal hernia repair: An exploratory randomized controlled trial. Regional Anesthesia and Pain Medicine 2015; 40(5):e150.
110. Wang XD, Yang B, Fan LL, Guo N, Song HB. Application of dexmedetomidine combined with propofol intravenous anesthesia in laparoscopic day surgery in pediatric urology. Pakistan Journal of Medical Sciences 2022; 38(1):150-5.
111. Chauhan R, Luthra A, Sethi S, et al. A Prospective Randomized Controlled Trial Using Propofol or Dexmedetomidine for Conscious Sedation in Pediatric Patients Undergoing Sclerotherapy. J Pediatr Neurosci 2020; 15(4):379-85.
112. Das R, Das R, Jena M, Janka J, Mishra S. Procedural sedation in children for fractionated radiation treatment: Intranasal dexmedetomidine versus oral midazolam and ketamine. Indian Journal of Anaesthesia 2022; 66(10):687-93.
113. Chen X, Xin D, Xu G, Zhao J, Lv Q. The Efficacy and Safety of Remimazolam Tosilate Versus Dexmedetomidine in Outpatients Undergoing Flexible Bronchoscopy: A Prospective, Randomized, Blind, Non-Inferiority Trial. Frontiers in Pharmacology 2022; 13.
114. Gu W, Xu M, Lu H, Huang Q, Wu J. Nebulized dexmedetomidine-lidocaine inhalation as a premedication for flexible bronchoscopy: a randomized trial. J Thorac Dis 2019; 11(11):4663-70.
115. Ryu JH, Lee SW, Lee JH, et al. Randomized double-blind study of remifentanil and dexmedetomidine for flexible bronchoscopy. Br J Anaesth 2012; 108(3):503-11.
116. Groeben H, Mitzner W, Brown RH. Effects of the alpha2-adrenoceptor agonist dexmedetomidine on bronchoconstriction in dogs. Anesthesiology 2004; 100(2):359-63.
117. Mikami M, Zhang Y, Kim B, et al. Dexmedetomidine's inhibitory effects on acetylcholine release from cholinergic nerves in guinea pig trachea: a mechanism that accounts for its clinical benefit during airway irritation. BMC Anesthesiol 2017; 17(1):52.
118. Karanth H, Murali S, Koteshwar R, Shetty V, Adappa K. Comparative Study between Propofol and Dexmedetomidine for Conscious Sedation in Patients Undergoing Outpatient Colonoscopy. Anesth Essays Res 2018; 12(1):98-102.
119. Amri P, Nahrini S, Hajian-Tilaki K, et al. Analgesic Effect and Hemodynamic Changes Due to Dexmedetomidine Versus Fentanyl During Elective Colonoscopy: A Double-Blind Randomized Clinical Trial. Anesth Pain Med 2018; 8(6):e81077.
120. Dere K, Sucullu I, Budak ET, et al. A comparison of dexmedetomidine versus midazolam for sedation, pain and hemodynamic control, during colonoscopy under

conscious sedation. Eur J Anaesthesiol 2010; 27(7):648-52.
121. Eberl S, Preckel B, Bergman JJ, Van Dieren S, Hollmann MW. Satisfaction and safety using dexmedetomidine or propofol sedation during endoscopic oesophageal procedures. European Journal of Anaesthesiology 2016; 33(9):631-7.
122. Edokpolo LU, Mastriano DJ, Serafin J, et al. Discharge Readiness after Propofol with or without Dexmedetomidine for Colonoscopy: A Randomized Controlled Trial. Anesthesiology 2019; 131(2):279-86.
123. Liu W, Yu W, Yu H, Sheng M. Comparison of clinical efficacy and safety between dexmedetomidine and propofol among patients undergoing gastrointestinal endoscopy: a meta-analysis. J Int Med Res 2021; 49(7):3000605211032786.
124. Nishizawa T, Suzuki H, Hosoe N, et al. Dexmedetomidine vs propofol for gastrointestinal endoscopy: A meta-analysis. United European Gastroenterol J 2017; 5(7):1037-45.
125. Ramkiran S, Iyer SS, Dharmavaram S, et al. BIS targeted propofol sparing effects of dexmedetomidine versus ketamine in outpatient ERCP: A prospective randomised controlled trial. Journal of Clinical and Diagnostic Research 2015; 9(5):UC07-UC12.
126. Wu W, Chen Q, Zhang LC, Chen WH. Dexmedetomidine versus midazolam for sedation in upper gastrointestinal endoscopy. J Int Med Res 2014; 42(2):516-22.
127. Wu Y, Zhang Y, Hu X, et al. A comparison of propofol vs. dexmedetomidine for sedation, haemodynamic control and satisfaction, during esophagogastroduodenoscopy under conscious sedation. Journal of Clinical Pharmacy and Therapeutics 2015; 40(4):419-25.
128. Shteamer JW, Dedhia RC. Sedative choice in drug-induced sleep endoscopy: A neuropharmacology-based review. Laryngoscope 2017; 127(1):273-9.
129. Chen YT, Sun CK, Wu KY, et al. The Use of Propofol versus Dexmedetomidine for Patients Receiving Drug-Induced Sleep Endoscopy: A Meta-Analysis of Randomized Controlled Trials. J Clin Med 2021; 10(8).
130. Chang ET, Certal V, Song SA, et al. Dexmedetomidine versus propofol during drug-induced sleep endoscopy and sedation: a systematic review. Sleep Breath 2017; 21(3):727-35.
131. Sruthi S, Mandal B, Rohit MK, Puri GD. Dexmedetomidine versus ketofol sedation for outpatient diagnostic transesophageal echocardiography: A randomized controlled study. Ann Card Anaesth 2018; 21(2):143-50.
132. Scheinin H, Aantaa R, Anttila M, et al. Reversal of the sedative and sympatholytic effects of dexmedetomidine with a specific alpha2-adrenoceptor antagonist atipamezole: a pharmacodynamic and kinetic study in healthy volunteers. Anesthesiology 1998; 89(3):574-84.
133. Tomar GS, Singh F, Ganguly S, Gaur N. Is dexmedetomidine better than propofol and fentanyl combination in minor day care procedures? A prospective randomised double-blind study. Indian J Anaesth 2015; 59(6):359-64.
134. Wang HM, Shi XY, Qin XR, Zhou JL, Xia YF. Comparison of dexmedetomidine and propofol for conscious sedation in inguinal hernia repair: A prospective, randomized, controlled trial. J Int Med Res 2017; 45(2):533-9. (à mettre à la fin pour le tableau)
135. Kim NY, Kim SY, Yoon HJ, Kil HK. Effect of dexmedetomidine on sevoflurane requirements and emergence agitation in children undergoing ambulatory surgery. Yonsei Med J 2014; 55(1):209-15.
136. Lee-Archer PF, von Ungern-Sternberg BS, Reade M, et al. The effect of dexmedetomidine on postoperative behaviour change in children: a randomised controlled trial. Anaesthesia 2020; 75(11):1461-8.

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