ISSN: 2754-6667

Journal of Critical Care & Emergency Medicine

SCIENTIFIC Research and Community

Research Article

Open Access

Anesthetic Drugs: A Comprehensive Overview for Emergency Medicine

Merhavy ZI[1]*, Merhavy CE[1], Varkey TC[2] and Zeitler CM[3]

[1]Ross University School of Medicine – Barbados

[2]University of Arizona College of Medicine, Banner University Medical Center – Phoenix, AZ

[3]Department of Internal Medicine, Billings Clinic – Billings, MT

ABSTRACT

The purpose of this document is to provide a unique white paper on the use of different anesthetic drugs and the key clinical pearls for ensuring patient safety in humans. This paper is designed to be a convenient guide that can be placed in work rooms for residents and medical school trainees to improve their learning and to provide reminders about drug-drug interactions. Finally, it is designed to be a potential living document - the first of its kind within the field. Unlike other white papers, this could be added to and modified based on the current literature and amended as newer drugs are discovered and made available. This document is intended to become a 'go-to-guide' for clinical anesthetic drug use on humans that houses an in depth, yet condensed encyclopedia of the most pertinent, necessary information for emergency medicine health professionals.

***Corresponding author**

Zack Merhavy, Ross University School of Medicine – Bridgetown, Barbados.

Received: January 08, 2025; **Accepted:** January 15, 2025; **Published:** January 20, 2025

Keywords: Anesthesia Drugs, Drug-Drug Interactions, Dosage, Side Effects, Brand Names, Emergency Medicine, Critical Care, Reference Document

Introduction

The main focus of this paper is not to expand knowledge or summarizing pre-existing literature on the use of anesthetic drugs, but is to provide a white paper on the key clinical pearls for ensuring patient's safety. This paper is designed as a convenient guide that can be placed in work rooms for residents and medical school trainees to improve their education. Additionally, it is designed to exist as a reference tool for emergency medicine professionals on the move who may need to have quick reminders about pharmacological tips and interactions to be aware of. Finally, it is designed to be a potential living document - the first of its kind within the field. Unlike other white papers, this could be added to and modified based on the current literature and amended as newer drugs are discovered and available. Similar ideas have been proposed in other fields including neurology, but are seldom followed through on. This 'go-to-guide' for anesthetic drugs serves as a living document where further reviewers can be added as contributors as well as provide additional edits as the document as it continues to 'live and breathe' for the most pertinent information. Similar to that of a Wikipedia page, the intention of this document is to exist for the purpose of being modified and added to over time.

The rationale behind the need for this type of paper is the increasing difficulty in finding this information in one centralized location. Often times, the newest and most pertinent clinical information is restricted behind pay walls as a way to force the purchase a subscription to individual journals to gain access to the information. Additionally, this information may also be buried under small randomized control trials or lost in the never-ending list of novel studies that show minor benefits. The hope of the authorial team is to create a centralized document that gets updated and edited as necessary with the potential for growth and modification based on the information as it becomes available. This first, improves patient safety; second, ease in teaching and educating on the topic of the different and numerous anesthetic drugs is increased; and third, providers feel more comfortable with utilizing a more diverse array of medications to treat the specific individualized needs of the patients.

Local Injectable Anesthetics (6)

- **Articaine / Epinephrine:**

Articaine / Epinephrine Systemic – a combination anesthetic that works by blocking nerve signals in the body through the binding to sodium channels thereby reducing sodium influx and threshold cannot be met for neuronal firing [1-9].

Usage

Articaine/epinephrine is most commonly used as a numbing agent for the mouth during dental procedures by injection into the gum area.

Dosage

- For infiltration, 0.5-2.5ml or 20-100mg of articaine.
- For nerve blocking, 0.5-3.4ml or 20-136mg of articaine.
- For oral surgery, 1.0-5.1ml or 40-204mg of articaine.
- For most routine dental procedures, the preferred articaine-epinephrine ratio should be 1:200,000.

Major Interactions
More common interactants may include, but are not limited to antidepressants, antipsychotic medications, or an MAO inhibitor. Medication such as an articaine/epinephrine combination could potentially interact with many other drugs and cause dangerous side effects, or even death. A total list consisting of 38 major interactions and 191 moderate interactions should be reviewed fully before prescribing.

Side Effects
Common side effects of the articaine/epinephrine combination anesthetic include, but are not limited to tongue pain or swelling, headache, mild swelling in the face, shallow breathing, blurred vision, anxiety, bradycardia, confusion, numbness, or a tingling sensation.

Name Brands (6): Articadent, Orabloc, Septocaine, Ultacan, Ultacan Forte, and Zorcaine

- **Lidocaine:**

Lidocaine Systemic – group 1 antiarrythmics – an anesthetic that causes numbness to the specific area of the body where injected to reduce pain or discomfort by stabilizing the neuronal membrane by binding to and inhibiting voltage-gated sodium channels [10-14].

Usage
Injectable forms of lidocaine are often used as a numbing agent to aid in reducing pain or discomfort caused by invasive medical procedures. Additionally, this form of lidocaine is used to treat irregular heart rhythms that may signal a possible heart attack as well as acting as an epidural to reduce the discomforts of contractions during labor.

Dosage
- For adult patients in ventricular fibrillation, ventricular tachycardia, or cardiac arrhythmia, the initial dose should be 50-100mg IV over 2-3 minutes and may be repeated after 5 minutes if necessary, where 300mg in a 1-hour period is not exceeded.

- For adult patients needing anesthesia, the maximum individual dose should be 4mg/kg IV with 4.5mg/kg for infiltration, where the maximum total dose is 300mg.

Major Interactions
More common interactants may include, but are not limited to nefazodone, antibiotics, St John's wort, antiviral medicine to treat hepatitis or HIV/AIDS, seizure medications, tuberculosis medications, or heart or blood pressure medications. Medication such as lidocaine could potentially interact with many other drugs and cause dangerous side effects, or even death. A total list consisting of 14 major interactions and 149 moderate interactions should be reviewed fully before prescribing.

Side Effects
Some common side effects of lidocaine may include, but are not limited to shallow breathing, feeling faint, muscle stiffness, bradycardia, nausea, dizziness, anxiety, confusion, blue appearance of the skin, or vomiting.

Name Brands (3): DentiPatch, Xylocaine HCI, and Xylocaine-MPF

- **Tetracaine**

Tetracaine Systemic – a local anesthetic that works by reversibly binds voltage-gated sodium ion channels in neuronal cell membranes, preventing the initiation and conduction of nerve impulses [15-20].

Usage
Tetracaine is most often given as an epidural injection to produce numbness during labor, surgery, or other medical procedures.

Dosage
For adult patients, the maximum single dose should be 1-3mg/kg without a vasoconstrictor or 1.5mg/kg with a vasoconstrictor.

Major Interactions
- Bupivacaine liposome could potentially alter the release rate if exposed to another local anesthetic solution such as tetracaine. If injected into the same area around the same time, bupivacaine liposome could potentially cause a rapid release of the active medication and alter the safety and efficiency of each other. Additional use of local anesthetics should be generally avoided within 96 hours following administration of bupivacaine liposome.

- Sodium nitrite usage may increase an individual's risk of methemoglobinemia.
- Other medicines such as sulfa drugs may potentially cause adverse effects when used alongside tetracaine.

Side Effects
Some potential side effects of tetracaine may include, but are not limited to lightheadedness, headaches, shallow breathing, dizziness, chills, tingling sensations, blurred vision, tremors, nausea, ringing in the ears, or vomiting.

Name Brands (3): Pontocaine, Democaine, and Viractin

- **Ropivacaine**

Ropivacaine Systemic – an injectable anesthetic solution that binds to voltage-gated sodium ion channels in the neuronal membrane [21-27].

Usage
Ropivacaine is used as a local anesthetic for a spinal block, or an epidural, to provide anesthesia during a surgery or C-section, or to ease labor pains.

Dosage
- For lumbar epidural administration for surgery, the typical adult dose for a 0.5% concentrated solution should be 75-150mg, which should have a duration of 2-4 hours. For a 0.75% concentration, 113-188mg, which should have a duration of 3-5 hours. For a 1.0% concentration, 150-200mg, which should have a duration for 4-6 hours.

- If administering for a C-section in a typical adult, a 0.5% concentrated solution should be 100-150mg, which should have a duration of 2-4 hours. With a 0.75% concentration, 113-150mg, which should have a duration of 3-5 hours.

- When administered for a typical adult with labor pain, the initial dose should be 20-40mg of a 0.2% concentrated solution, which should last 0.5-1.5 hours, with a continuous infusion of 12-28mg/hr.

Major Interactions
- Bupivacaine liposome could potentially alter the release rate

if exposed to another sodium channel block. If injected into the same area around the same time, bupivacaine liposome could potentially cause a rapid release of the active medication and alter the safety and efficiency of each other. Additional use of local anesthetics should be generally avoided within 96 hours following administration of bupivacaine liposome.

- Sodium Channel blocker usage may increase an individual's risk of methemoglobinemia.

Side Effects
Potentially dangerous side effects may include, but are not limited to anxiousness, confusion, issues with speech or vision, ringing in the ears, metallic taste, seizures, bradycardia or tachycardia, problems with urination or sexual function, back pain, nausea, or vomiting.

Name Brands (4): Naropin, Naropin Polyamp, Naropin SDV, and Naropin Novaplus

- **Bupivacaine**

Bupivacaine Systemic – an injectable local anesthetic solution with many practical medical uses due to its ability to reversibly bind to specific sodium ion channels in the neuronal membrane, reducing the permeability of sodium ions and resulting in the loss of sensation [27-30].

Usage
Bupivacaine is given as an epidural injection into the spinal column to produce numbness during labor, surgery, or other certain medical or dental procedures.

Dosage
- In a typical adult patient for an epidural block, 75-150mg of a 0.75% concentrated solution should be given for a complete motor block; 50-100mg of a 0.5% solution for a moderate to complete motor block; and 25-50mg of a 0.25% solution for partial to moderate motor block.

- For epidural anesthesia, 0.5% and 0.75% solutions should be administered in 3-5ml increments.

- For epidural anesthesia in obstetrics, only 0.5% and 0.25% concentrations should be used, where the 0.5% solution should be administered in 3-5ml increments and not exceeding 50-100mg at any dosing interval.

Major Interactions
- Bupivacaine liposome could potentially alter the release rate if exposed to another local anesthetic solution such as bupivacaine. If injected into the same area around the same time, bupivacaine liposome could potentially cause a rapid release of the active medication and alter the safety and efficiency of each other. Additional use of local anesthetics should be generally avoided within 96 hours following administration of bupivacaine liposome.

- Prilocaine usage may increase an individual's risk of methemoglobinemia.

Side Effects
Potentially dangerous side effects may include, but are not limited to anxiousness, confusion, issues with speech or vision, ringing in the ears, metallic taste, seizures, bradycardia or tachycardia, problems with urination or sexual function, back pain, nausea, or vomiting.

Name Brands (5): Marcaine HCl, Marcaine Spinal, Sensorcaine, Sensorcaine-MPF, and Sensorcaine-MPF Spinal

- **Chloroprocaine**

Chloroprocaine Systemic – a fast-onset injectable local anesthetic solution to produce local anesthesia by infiltration and peripheral nerve block. This drug acts by increasing the threshold required for electrical excitation of nerves [31-35].

Usage
Chloroprocaine is used most commonly to establish adequate epidural anesthesia as well as for peripheral nerve block in a patient undergoing short ambulatory surgery that is not anticipated to produce significant postoperative pain.

Dosage
- For lumbar epidural anesthesia for C-section delivery in a typical adult patient should be a total dose of 15-25ml of a 3.0% preservative-free solution.
- For infiltration and peripheral nerve block:
- Digital without epinephrine should be 3-4ml of a 1.0% solution with a total dose of 30-40mg.
- Infraorbital should be 0.5-1.0ml of a 2.0% solution with a total dose of 10-20mg.
- Mandibular should be 2-3ml of a 2.0% solution for a total dose of 40-60mg.
- Paracervical should be 3ml per each of four sites of a 1.0% solution with a total dose of up to 120mg.
- Pudendal should be 10ml for each side of a 2.0% solution with a total dose of 400mg.

Major Interactions
- Chloroprocaine could potentially alter the release rate if exposed to another sodium channel blockers. If injected into the same area around the same time, bupivacaine liposome could potentially cause a rapid release of the active medication and alter the safety and efficiency of each other. Additional use of local anesthetics should be generally avoided within 96 hours following administration of bupivacaine liposome.

- Nitrite usage may increase an individual's risk of methemoglobinemia.

Side Effects
Dangerous side effects of chloroprocaine may include, but are not limited to hyperhidrosis, severe anxiety, lightheadedness, confusion, headaches, change in speech, tremors, dizziness, blurred vision, seizures, bradycardia or tachycardia, chest pain, leaking of urine or stool, back pain, or sexual dysfunction.

Name Brands (2): Nesacaine and Nesacaine-MPF

Summary

Drug Name	Adult Dosing	Major Interactants	Major Side Effects
Articaine / Epinephrine Systemic	Infiltration, 20-100mg. Nerve blocking, 20-136mg. Oral surgery, 40-204mg.	• Antidepressants • Antipsychotics • MAO inhibitor	• Tongue pain • Swelling of the face • Bradycardia
Bupivacaine Systemic	75-150mg of a 0.75% concentrated solution for a complete motor block; 50-100mg of a 0.5% solution for a moderate to complete motor block; and 25-50mg of a 0.25% solution for partial to moderate motor block.	• Bupivacaine liposome • Prilocaine	• Seizures • Ringing in the ears • Metallic taste • Urination problems • Sexual dysfunction • Nausea/vomiting • Back pain
Bupivacaine Systemic	Total dose, 15-25ml of a 3.0% preservative-free solution.	• Bupivacaine liposome • Nitrites	• Seizures • Tremors • Hyperhidrosis
Lidocaine Systemic	Induction, 50-100mg IV over 2-3 minutes and may be Repeated after 5 mins.	• Nefazodone • Antibiotics • Antivirals for hepatitis or HIV/AIDS • St John's wort • Seizure medications • Tuberculosis medications • Heart/blood pressure medications	• Shallow breathing • Bradycardia • Nausea/vomiting • Blue appearance of the skin • Anxiety • Muscle stiffness • Confusion • Dizziness • Feeling faint
Ropivacaine Systemic	0.5% concentrated solution, 75-150mg. 0.75% solution, 113-188mg. 1.0% solution, 150-200mg.	• Bupivacaine liposome • Sodium channel blockers	• Urination problems • Sexual dysfunction • Ringing in the ears • Nausea/vomiting • Back pain • Seizures • Metallic taste
Tetracaine Systemic	Max single dose, 1-3mg/kg w/o a vasoconstrictor; 1.5mg/kg with a vasoconstrictor.	• Bupivacaine liposome • Sodium nitrite • Sulfa drugs	• Ringing in the ears • Tremors • Nausea/vomiting • Shallow breathing

Conclusion

The purpose of this paper is to provide a clear and easy means to navigate a document on the use of different anesthetic drugs and the key clinical pearls for ensuring patient safety. Through gathering this key information into a singular document, this paper can be utilized as a convenient guide in work rooms for residents and medical school trainees. This paper is designed around the idea that the practice of medicine and the understanding of how to utilize the currently available medications should be easy to access, therefore, it is simply a summary of what is known at the time of writing. With this in mind, the paper was designed to be a potential living document - which could be added to and modified based on the current literature and amended as newer drugs are discovered and available. This would allow for further reviewers and/or authors to be added as contributors in the future as more is learned about the utilization of these drugs.

References

1. De Morais HH A, De Santana Santos T, Da Costa Araújo FA, Vajgel A, De Holanda Vasconcellos RJ (2012) Hemodynamic changes comparing lidocaine HCl with epinephrine and articaine HCl with epinephrine. Journal of Craniofacial Surgery 23: 1703-1708.
2. Oertel R, Rahn R, Kirch W (1997) Clinical pharmacokinetics of articaine. Clinical pharmacokinetics 33: 417-425.
3. Malamed SF, GAGNON S, Leblanc D (2000) Efficacy of articaine: a new amide local anesthetic. The Journal of the American Dental Association 131: 635-642.
4. Moore PA, Boynes SG, Hersh EV, DeRossi SS, Sollecito TP, et al. (2006) The anesthetic efficacy of 4 percent articaine 1: 200,000 epinephrine: two controlled clinical trials. The Journal of the American Dental Association 137: 1572-1581.
5. Santos CF, Modena KC, Giglio FP, Sakai VT, Calvo AM, et al. (2007) Epinephrine concentration (1: 100,000 or 1: 200,000) does not affect the clinical efficacy of 4% articaine for lower third molar removal: a double-blind, randomized, crossover study. Journal of oral and maxillofacial surgery 65: 2445-2452.
6. Kämmerer PW, Krämer N Esch, J, Pfau H, Uhlemann U, et al. (2013). Epinephrine-reduced articaine solution (1: 400,000) in paediatric dentistry: a multicentre non-interventional clinical trial. European Archives of Paediatric Dentistry 14: 89-95.
7. Wahl MJ, Schmitt MM, Overton DA (2006) Injection pain of prilocaine plain, mepivacaine plain, articaine with epinephrine, and lidocaine with epinephrine. General dentistry 54: 168-171.
8. Paxton K, Thome DE (2010) Efficacy of articaine formulations: quantitative reviews. Dental Clinics 54: 643-653.
9. Snoeck M (2012) Articaine: a review of its use for local and regional anesthesia. Local and regional anesthesia 5: 23-33.
10. Ejlersen E, Andersen HB, Eliasen K, Mogensen T (1992) A comparison between preincisional and postincisional lidocaine infiltration and postoperative pain. Anesthesia and analgesia 74: 495-498.
11. King SY, Davis FM, Wells JE, Murchison DJ, Pryor PJ (1992) Lidocaine for the prevention of pain due to injection

of propofol. Anesthesia and analgesia 74: 246-249.
12. Mao J, Chen LL (2000) Systemic lidocaine for neuropathic pain relief. Pain 87: 7-17.
13. Boyes RN, Scott DB, Jebson PJ, Godman MJ, Julian DG (1971) Pharmacokinetics of lidocaine in man. Clinical Pharmacology & Therapeutics 12: 105-116.
14. National Center for Biotechnology Information (2021) PubChem Compound Summary for CID 3676, Lidocaine https://pubchem.ncbi.nlm.nih.gov/compound/Lidocaine.
15. Moore DC (1980) Spinal anesthesia: bupivacaine compared with tetracaine. Anesthesia and analgesia 59: 743-750.
16. Boedeker BH, Lojeski EW, Kline MD, Haynes DH (1994) Ultra-Long-Duration Local Anesthesia Produced by Injection of Lecithin-Coated Tetracaine Microcrystals. The Journal of Clinical Pharmacology 34: 699-702.
17. Fernandes SA, Cabeça LF, Marsaioli AJ, De Paula E (2007) Investigation of tetracaine complexation with beta-cyclodextrins and p-sulphonic acid calix [6] arenes by nOe and PGSE NMR. Journal of Inclusion Phenomena and Macrocyclic Chemistry 57: 395-401.
18. Stringer CM, Maani CV (2025) Tetracaine. StatPearls https://pubmed.ncbi.nlm.nih.gov/30571058/.
19. Goto F, Ishizaki K, Yoshikawa D, Obata H, Arii H, Terada M (1999) The long lasting effects of peripheral nerve blocks for trigeminal neuralgia using a high concentration of tetracaine dissolved in bupivacaine. Pain 79: 101-103.
20. National Center for Biotechnology Information (2021) PubChem Compound Summary for CID 5411, Tetracaine https://pubchem.ncbi.nlm.nih.gov/compound/Tetracaine.
21. National Center for Biotechnology Information (2021) PubChem Compound Summary for CID 175805, Ropivacaine https://pubchem.ncbi.nlm.nih.gov/compound/Ropivacaine.
22. National Center for Biotechnology Information (2021) PubChem Compound Summary for CID 8612, Chloroprocaine https://pubchem.ncbi.nlm.nih.gov/compound/Chloroprocaine.
23. McClellan KJ, Faulds D (2000) Ropivacaine. Drugs 60: 1065-1093.
24. Markham A, Faulds D (1996) Ropivacaine. Drugs 52: 429-449.
25. Simpson D, Curran MP, Oldfield V, Keating GM (2005) Ropivacaine. Drugs 65: 2675-2717.
26. Hansen TG (2004) Ropivacaine: a pharmacological review. Expert review of neurotherapeutics 4: 781-791.
27. National Center for Biotechnology Information (2021) PubChem Compound Summary for CID 2474, Bupivacaine. https://pubchem.ncbi.nlm.nih.gov/compound/Bupivacaine.
28. Kuthiala G, Chaudhary G (2011) Ropivacaine: A review of its pharmacology and clinical use. Indian journal of anaesthesia 55: 104.
29. Moore DC, Bridenbaugh LD, Thompson GE, Balfour RI, Horton WG (1978) Bupivacaine: a review of 11,080 cases. Anesthesia and Analgesia 57: 42-53.
30. Tong YCI, Kaye AD, Urman RD (2014) Liposomal bupivacaine and clinical outcomes. Best Practice & Research Clinical Anaesthesiology 28: 15-27.
31. Babst CR, Gilling BN (1978) Bupivacaine: a review. Anesthesia progress 25: 87.
32. Hejtmanek MR, Pollock JE (2011) Chloroprocaine for spinal anesthesia: a retrospective analysis. Acta Anaesthesiologica Scandinavica 55: 267-272.
33. Abboud TK, Kim KC, Noueihed R, Kuhnert BR, DerMardirossian N, et al. (1983) Epidural bupivacaine, chloroprocaine, or lidocaine for cesarean section-maternal and neonatal effects. Anesthesia and analgesia 62: 914-919.
34. O'Brien JE, Abbey V, Hinsvark O, Perel J, Finster M (1979) Metabolism and measurement of chloroprocaine, an ester-type local anesthetic. Journal of pharmaceutical sciences 68: 75-78.
35. Tonder S, Maani CV (2025) Chloroprocaine. https://pubmed.ncbi.nlm.nih.gov/30422496/.