Exploring Local Anesthesia and Pain Control for the Dental Professional

Dr. Sean G. Boynes
Director of Dental Medicine
CareSouth Carolina
Clinical Application of Reversal

OraVerse™
(Phentolamine Mesylate) Injection
0.4 mg/1.7 mL

For Intraoral Submucosal Injection Only.
Usual Dosage; See Package Insert.
Contents: 10 Cartridges
Rx Only
Phentolamine Mesylate - OraVerse®

- Proposed Mechanism of Action
  - Increase vasodilation
  - Increase elimination and clearance
  - Decrease soft tissue effects of local anesthetic deposition
Positive Benefit / Risk

- OraVerse significantly accelerated time to return to normal sensation and function

- Within one hour of injection, 51% of patients undergoing mandibular procedures and 58% patients undergoing maxillary procedures had recovered normal function
  - Only 20% of patients receiving no injection reached this level of normal function
Clinical Benefit
## Local Anesthesia Complication Study

<table>
<thead>
<tr>
<th>Complication</th>
<th>Occurrences (n=49)</th>
<th>Overall Occurrence Rate (n=923)</th>
<th>Anesthetic Reported Most Often</th>
<th>Mean Amount of Anesthetic Deposited per Report</th>
<th>Mean Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Inflicted Injury - Lip Bite</td>
<td>18</td>
<td>1.95%</td>
<td>LIDO (11)</td>
<td>0.98 SD±0.56</td>
<td>7.77 SD±2.66</td>
</tr>
<tr>
<td>Self-Inflicted Injury - Cheek Bite</td>
<td>8</td>
<td>0.87%</td>
<td>ART200 (4)</td>
<td>1.40 SD±0.81</td>
<td>5.25 SD±0.89</td>
</tr>
<tr>
<td>Self-Inflicted Injury - Tongue Bite</td>
<td>2</td>
<td>0.22%</td>
<td>LIDO (1) ART200 (1)</td>
<td>0.75 SD±0.45</td>
<td>7.50 SD±3.53</td>
</tr>
<tr>
<td>Re-administration / Inadequate Anesthesia</td>
<td>11</td>
<td>1.19%</td>
<td>LIDO (10)</td>
<td>2.05 SD±1.36</td>
<td>9.36 SD±2.29</td>
</tr>
<tr>
<td>Trismus</td>
<td>3</td>
<td>0.32%</td>
<td>LIDO (3)</td>
<td>1.00 SD±0.25</td>
<td>13.3 SD±2.31</td>
</tr>
<tr>
<td>Pain at Injection Site</td>
<td>3</td>
<td>0.32%</td>
<td>LIDO (3)</td>
<td>0.83 SD±0.28</td>
<td>11.0 SD±1.00</td>
</tr>
<tr>
<td>Prolonged Anesthesia</td>
<td>1</td>
<td>0.11%</td>
<td>LIDO</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Undesired Nerve Block</td>
<td>1</td>
<td>0.11%</td>
<td>ART200</td>
<td>0.75 SD±0.11</td>
<td>8</td>
</tr>
<tr>
<td>Hematoma</td>
<td>1</td>
<td>0.11%</td>
<td>LIDO &amp; ART200</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Bleeding Related to Anesthesia Administration</td>
<td>1</td>
<td>0.11%</td>
<td>LIDO</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

Evaluation of phentolamine (PM)

- The complication rate with the group administered PM is 2.6%, 10 reports.
  - It should be noted that 6 additional complication reports with the PM group are associated with the re-administration of anesthetic/inadequate anesthesia prior to PM administration.

- The incidence of complications for the group administered phentolamine mesylate (2.6%) is lower than that seen with the overall study population (5.3%) and the group not administered PM (6.1%).
LA Complication Study

**Variables**
- Phentolamine administration
- Obesity
- ADHD
- Administration of a IANB injection

Data collected from the standardized form reveals IANB injections to be a variable to complication incidence ($P < 0.05$, CI 95%), appearing in 22 of the 49 reports (44.9%).
Evaluation of Local Anesthesia Complications in Special Needs Population

- Evaluated 172 consecutive dental care visits with local anesthetic administration
- Complication rate is 8.1%
  - All Complications are mild or moderate

Boynes SG, Riley AE, Milbee S. Evaluating complications during intraoral administration of local anesthetics in a rural, portable special needs dental clinic. Spec Care Dentist [In press]
# LA Anesthesia SpNeeds Evaluation

<table>
<thead>
<tr>
<th>Complication</th>
<th>Occurrences (n=14)</th>
<th>Overall Occurrence Rate (n=172)</th>
<th>Primary Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Inflicted Injury - Lip Bite</td>
<td>5</td>
<td>2.9%</td>
<td>IDD (4) Autism Spectrum (1)</td>
</tr>
<tr>
<td>Self Inflicted Injury – Cheek Bite</td>
<td>2</td>
<td>1.2%</td>
<td>IDD (2)</td>
</tr>
<tr>
<td>Self Inflicted Injury – Tongue Bite</td>
<td>1</td>
<td>0.6%</td>
<td>IDD (1)</td>
</tr>
<tr>
<td>Re-administration / Inadequate Anesthesia</td>
<td>3</td>
<td>1.7%</td>
<td>IDD (3)</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>2</td>
<td>1.2%</td>
<td>Down Syndrome (2)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
<td>0.6%</td>
<td>Down Syndrome (1)</td>
</tr>
</tbody>
</table>
LA SP Needs Evaluation

- Variables
  - Obesity
  - Administration of IANB injection
    - IANB injections a true variable to complication incidence ($p < .05$, CI95%); appearing in 13 of the 14 reports.
Decreasing Complications

- Large decrease in last year
- ??? What is the decrease????
  - Teacher involvement with sticker marking
  - OraVerse for obese/overweight; ADHD; previous history of self-inflicted soft tissue injury; and any patient with multiple “self-tests” prior to discharge
  - Elimination of the IANB as standard for routine mandibular procedures
The IANB Injection (Is it Passé?)

- Highest failure rates of any injection technique
  - Reported at high as 81%
  - One out of five dental patients require additional injection to achieve adequate anesthesia


Malamed SF. Is the mandibular block passe? J Am Dent Assoc 2011; 142:3:3S-7S.

Malamed SF. Handbook of Local Anesthesia, 5 ed. Elsevier Mosby, 2004
The IANB Injection (Is it Passé?)

- Reasons for high failure rates
  - Thickness of the cortical plate of bone in adults
  - Thickness of the soft tissue at the injection site leading to increased needle deflection
  - The difficulty of locating the inferior alveolar nerve
  - The possibility of accessory innervation
The IANB Injection (Is it Passé?)

- More often associated with complications than other injections
  - Toxicity
  - Neuropathy/Paresthesia
  - Localized complications
The IANB Injection (Is it Passé?)

- **Toxicity**
  - The majority of toxicity reports involve the administration of mandibular block injection
    - Inadvertent intravascular injection
    - Failure rates lead to re-administration
The IANB Injection (Is it Passé?)

- **Neuropathy**
  - When involving local anesthetic administration
  - Usually involves the lingual nerve following IANB injection
  - Product warnings for Articaine specifically state mandibular injections
The IANB Injection (Is it Passé?)

- Complication Rate
  - CSC Study – IANB involved in 59.2% of all complications with pediatric administration
  - CSC Study – IANB involved in 92% of all complications with special needs administration
  - Textbooks relate IANB to the majority of complications (body of text)
    - Jastak/Yagiela
    - Malamed
    - Bassett/DiMarco
IANB and Anemia?

- New reports of anemic areas presenting after IANB injection

- The precise cause of this complication is unknown; however, it may be derived from:
  - anastomosis of the maxillary artery,
  - rapid injection of local anesthetic solution,
  - misdirection of needle, and/or
  - spread of solution

- “Henceforth, dentists should consider the possibility of anemia after IANB administration…”

Alternatives to IANB Injection

- Mandibular Infiltration
- **Akinosi**
- Gow-Gates
- PDL
- Japanese Anterior Approach
- "Modified Approach"
Akinosi Injection

- “Closed Mouth Technique”
- Permits mandibular anesthesia to be achieved in patients who have difficulty opening their mouths or are uncooperative
- The end point of the needle lies within the superior portion of the pterygomandibular space
- There is normally no point of bony contact during this injection
Akinosi Injection

- Anatomical Considerations Prior to Injection
  - Maxillary Second Molar
  - Maxillary Vestibule
  - Maxillary Mucogingival Junction
Akinosi Injection Technique
(“Adjunct Anatomy”)

- Maxillary Second Molar
  - Provides a measurement for the depth of injection
  - Because it is difficult to see the needle insertion, the depth can be estimated by the hub of the needle being adjacent (and above) the maxillary second molar
Akinosi Injection Technique
(“Adjunct Anatomy”)

- Maxillary Second Molar
Akinosi Injection

- **Maxillary Vestibule**
- Portion of the oral cavity that lies between the cheeks and the teeth and the gingiva or residual ridges
Akinosi Injection

- Apex of the Maxillary Vestibule - Vertical Crosshair
Akinosi Injection

- Mucogingival Junction - Horizontal Crosshair
- The area of the oral cavity where the gingiva forms a junction of overlap with the oral mucosa
Akinosi Injection
Akinosi Technique (Signs of Anesthesia)

- The pattern of sensory nerve anesthesia is similar to that of the Gow-Gates mandibular block.

Akinosi

IA/Lingual
Figure 1  Sites for anesthetic solution deposition
“Modified Approach”

- Current investigation
- Short needle
- Directional aiming plane from opposite incisor/canine
- Higher than Japanese model and traditional IA injection
  - Increased onset time
  - High patient satisfaction
  - Decreased complications
“Modified Approach”
“Modified Approach”
“Modified Approach”
“Modified Approach”
“Modified Approach”
**Figure 1** Sites for anesthetic solution deposition
A Quick Review of Local Anesthetic Pharmacology & Therapeutics
Desirable Properties

• Non-irritating to tissue.
• Non-allergenic.
• Completely reversible effects.
• Minimal systemic toxicity.
• Rapid onset and adequate duration.
• Effective as a topical.
• Selective to nocioception (pain sensation).
Cocaine

- CNS Stimulation –
  - Provides a sense of well-being, endurance and euphoria.
- High doses induce and potentiate convulsions.
- Cardiovascular stimulation with increases in blood pressure, heart rate and arrhythmias.
- Direct and indirect hyperpyrexia.
- Local anesthesia with limited indications.
  - Upper respiratory procedures
  - TAC for laceration repair
Procaine

- Brand name is Novocain

- Hydrolyzed to para-aminobenzoic acid and diethyl amino alcohol.
- Poor efficacy and profundity.
- Short durations--requires a vasoconstrictor.
- High incidence of allergy
Lidocaine

- Brand Name: Xylocaine® and Lignospan®
- Available in cartridges as
  2% lidocaine; 1:100,000 epinephrine
  2% lidocaine, 1:50,000 epinephrine
- Excellent onset times and profundity (when combined with a vasoconstrictor)
- “Gold standard” for comparison to other anesthetics.
Amide Anesthetics

- Metabolized by liver amidases
- Essentially lacking of severe allergenicity
- Excellent diffusion through tissues

<table>
<thead>
<tr>
<th>FORMULATIONS FOR DENTISTRY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LIDOCAINE</strong></td>
</tr>
<tr>
<td><strong>MEPIVACAINE</strong></td>
</tr>
<tr>
<td><strong>PRILOCAINE</strong></td>
</tr>
<tr>
<td><strong>ARTICAINE</strong></td>
</tr>
<tr>
<td><strong>BUPIVACAINE</strong></td>
</tr>
<tr>
<td><strong>ETIDOCAINE</strong></td>
</tr>
</tbody>
</table>
Prilocaine

- **Brand Name:** Citanest®
- **Preparations in dentistry are**
  - 4% prilocaine plain
  - 4% prilocaine; 1:200,000 epinephrine
- **Anesthetic characteristics similar to lidocaine with epinephrine.**
- **Metabolic product (toluidine) may be the cause of reports of methemoglobinemia**
Methemoglobinemia

- Methemoglobinemia: increased quantities of hemoglobin with iron oxidized to the ferric form ($\text{Fe}^{3+}$).
- High concentrations appear chocolate brown.
- Normal levels 0-2%, Cyanosis 10-30%, Lethargy and Respiratory distress 30-60%, Death >70%.
- Acquired: NADH cytochrome $b_5$ reductase deficiency
- Induced: nitrates, sulfonamides, benzocaine or prilocaine
- Prilocaine’s primary metabolite, ortho-toluidine, induces methemoglobinemia.
- Treatment: methylene blue 1-2 mg/kg i.v. infusion.
Prilocaine and Methemoglobin Levels

- Ninety children, 3–6 years of age, undergoing dental rehabilitation under general anesthesia: group 1, 4% prilocaine plain, group 2, 2% lidocaine with 1:100,000 epinephrine, group 3, no local anesthetic.

- Prilocaine, at 5 mg/kg in pediatric dental patients, resulted in significantly higher peak SpMET levels than lidocaine and no local anesthetic.

Mepivacaine

- Somewhat shorter duration of pulpal anesthesia than lidocaine/epi.
- Available in cartridges as:
  - 3% mepivacaine
  - 2% mepivacaine; 1:20,000 levonordefrin
- Minimal vasodilating properties.
Articaine

- Similar anesthetic characteristics as lidocaine/epi.
- Available in cartridges as:
  - 4% articaine, 1:100,000 epinephrine
  - 4% articaine, 1:200,000 epinephrine
- More effective for mandibular infiltration
Articaine

- The rapid elimination of articaine from the systemic circulation (20-40 min half-life) minimizes its toxicity and safely permits repeated injections during long appointments.

- Comparative clinical trials in dentistry have found the onset, duration and profundity of 4% articaine with 1:100,000 epinephrine to be similar to 2% lidocaine with 1:100,000 epinephrine.

- Slightly better infiltration properties through tissue.

- There is little to indicate a higher allergenicity for articaine compared to other amid anesthetics used in dentistry.

- There may be a slight increased risk of paresthesias associated with articaine and prilocaine: 1 in 500,000* injections (permanent paresthesia 1:1,200,000)
Bupivacaine

- Marketed as Marcaine® and Vivacaine®
- Provides prolonged duration of soft tissue anesthesia to delay the postoperative pain.
- 0.5% bupivacaine, 1:200,000 epinephrine.
- Onset time is longer than other drugs b/c of elevated pKa
- Long duration due to binding to tissue proteins (about 80%).
Fear and Anxiety
CSC Parent of Patient Anxiety Evaluation

- Analysis of parental factors and parent-child communication with pediatric patients referred for nitrous oxide administration in a rural community health center setting

Evaluating

- Anxiety levels
- Dental knowledge
- Parent dental treatment history
- Evaluation of communication process between parent and pediatric patient
Corah’s Anxiety Scale

- A series of questions relating to a dental visit
- Anxiety rating:
  - • 9 - 12 = moderate anxiety but have specific stressors that should be discussed and managed
  - • 13 - 14 = high anxiety
  - • 15 - 20 = severe anxiety (or phobia). May be manageable with the Dental Concerns Assessment but might require the help of a mental health therapist.
- All respondents (AR): **Moderate Anxiety**
- Parents of patients that required referral to moderate or deep sedation/general anesthesia (RP): **High Anxiety**
Dental Knowledge Score

- A series of five questions that gauge basic dental knowledge
  - Cavities and brushing
  - Restoration placement
  - Home oral hygiene
  - Timing of dental examination
  - Use of mouth rinse

- AR: 2.98 out of 5 (59.6%)
- RP: 1.90 out of 5 (38.0%)
Points of Measurement

- Discuss appointment with child
  - AR: Yes (85.7%)
  - RP: Yes (75.0%)
- Discuss parent’s dental visits in past
  - AR: Yes (60.0%)
  - RP: No (67.0%)
- Description of dental visit to child
  - (Positive experience) (Negative experience, negative experience but told them their appointment would be better, as a positive experience but told them about a difficult appointment I had)
- **Negative Connotation**
  - AR: 41.1%
  - RP: 61.5%
Parent Past Dental Experience

- Parent had a bad experience with dental care in the past
  - AR: 50.0%
  - RP: 75.0%

- Description of parent bad experience (141 total selections by 63 participants)
  - 1 - Dentist’s attitude, the way you were treated (24.1%)
  - 2 - Pain during procedure (21.3%)
  - 3 – I did not get numb and the dentist continued drilling anyway (20.6%)
  - 4 - Getting a shot (19.1%)
  - 5 – I was in the chair too long (6.4%)
Outcomes of Study

- Did not find a “magic” question that would produce more reliability with appointment scheduling
- Investigators surprised at percentage of negative reports/connotations relayed to patient
- Opted to go with scripting and patient communication & knowledge gain
Basic instruction to staff will include brief information on three verbal approaches to patient/parent fear.

- The permissive approach (provide relevant information regarding treatment to relieve uncertainty);
- The empathetic approach (share another person’s feelings);
- The personal approach (create the feeling that a personal relationship exists).
All three approaches should be used when generally communicating with a patient or parent; however, the **empathetic approach** has been found most effective with behavior and anxiety.


A sample pre-appointment scripting scenario for nitrous oxide appointment management relating to parent communication

Appointment Creation Phase

Provide nitrous oxide patient information instructions and conclude with the following:

...here are a couple of additional things you will need to know for your child’s appointment.

“As I am sure you already know, many children are afraid of the dentist. The reason for this ‘laughing gas’ appointment is to decrease the amount of nervousness your child will have. A lot of children, and their parents, need these services every year in order to decrease any perceived frightening events while at the dentist. It is so very important to discuss this upcoming appointment in a positive way and make sure not to accidentally use the appointment to threaten a child who may be misbehaving. Please make sure to only focus on the positives of the appointment and make sure the child understands that your previous experience was safe and fun.”

Pre-Operative Phase

Conclude with the following: “Please remember that in order for all of us to have a successful appointment, it is very beneficial to be positive about [STATE PATIENT’S FIRST NAME] appointment on [STATE DATE OF APPOINTMENT]. The more positive you are the more positive he/she will be.”

The Empathetic Approach

- These parents share fear of the dentist with their children
- These parents most likely had a previous bad experience at the dentist.
- Many people throughout the world have these same anxieties.
- Think about something you are very afraid of and think of that as the same as fearing dental care.
Ocular Complications Associated with Dental Anesthetic Administration
# Ocular Complications

<table>
<thead>
<tr>
<th>Symptom/Manifestation</th>
<th>Total Reports</th>
<th>Maxillary Injections</th>
<th>Mandibular Injections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ophthalmoplegia (Paralysis of Eye Muscles)</td>
<td>14</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Ptosis of the Eyelid</td>
<td>12</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Mydriasis</td>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Amaurosis (Blindness/Loss of Vision)</td>
<td>9</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Diplopia</td>
<td>7</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Diplopia by Lateral Rectus Palsy</td>
<td>8</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Diplopia by Medial Rectus Palsy</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Miosis</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Dizziness</td>
<td>6</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Blurred Vision</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Partial Paresis</td>
<td>1</td>
<td>1</td>
<td>0</td>
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<tr>
<td>Blanching</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Burning Sensation</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Horner Syndrome</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Nausea</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Tearing</td>
<td>1</td>
<td>0</td>
<td>1</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>81</strong></td>
<td><strong>42</strong></td>
<td><strong>39</strong></td>
</tr>
</tbody>
</table>
Mandibular Injection

Illustrated by: Christine Bettinger
Onset and Duration of Complications
### Local Anesthetics and Ocular Complications

#### Table 2
Analysis of the type of anesthetic used in 48 case reports of ocular complications with local anesthesia for dentistry

<table>
<thead>
<tr>
<th>Type of Anesthetic</th>
<th>Total</th>
<th>Maxillary Injections</th>
<th>Mandibular Injections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% Lidocaine with Adrenaline</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2% Lidocaine with 1:80,000 Adrenaline</td>
<td>6</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2% Lidocaine Plain</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2% Lidocaine with 1:100,000 Epinephrine</td>
<td>9</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>3% Mepivacaine Plain</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2% Mepivacaine with Vasoconstrictor</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>4% Articaine with 1:100,000 Epinephrine</td>
<td>15</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Procaine</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Procaine with 1:300,000 Adrenaline</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Butethamine hydrochloride with 1:100,000 Adrenaline</td>
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<tr>
<td>Unknown/Not Reported</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
Local Anesthetic Use in the Pregnant and Postpartum Patient
The new mother…

- The use of systemically absorbed drugs in the gravid and in the lactating patient is of concern to the dentist.
- The need for interventional dental treatment occurs in virtually all stages of life, and during pregnancy is no exception.
- Prior to ANY procedure a consultation with the patient’s PCP and OB/GYN is highly recommended.
Main concern is teratogenicity (the capability of an agent to initiate fetal malformation) and mutagenicity.

- Most drugs cross the placenta by simple diffusion; hence our concern for the possibility of their teratogenic effects.
- Although the embryo is within the predifferentiation period from 2 to 4 weeks it is resistant to teratogenic effects.
- The most risk occurs following this period, when organogenesis takes place, during the 4 to 10 weeks following the last menstrual period.

Because of the level of sensitivity of the embryo and fetus, it is generally recommended that any dental treatment be deferred until the first trimester is complete.
The First Trimester

- If emergent care is required in the first trimester, the negative consequences of allowing an active infection to progress untreated in a pregnant patient outweigh the risks of providing care.

- RELATIVE CONTRAINDICTION

- Local Anesthetic Selection
  - Controversy with the use of epinephrine
Second Trimester

- Teratogenicity risk in the second trimester is a diminishing concern.
  - After 8-10 weeks, major organogenesis has occurred.
- In order to avoid labor, supine hypotensive syndrome, and general discomfort it is often suggested that elective dental care should be done during the second trimester.
Third Trimester

- During the third trimester, there are many physiologic changes that make dental treatment more challenging.

  **Cardiovascular Changes**
  - The cardiac output of the gravid patient increases 30% to 50%, secondary to a 20% to 30% increase in heart rate as well as a 20% to 50% increase in stroke volume.

  **Pulmonary Changes**
  - If patients are allowed to significantly hyperventilate (such as in a stressful situation), it may be extrapolated from studies that this could decrease uterine artery flow and could cause a decrease in fetal oxygenation.
The Postpartum Period

- The postpartum period can be an overwhelming experience for the mother. Patients may have delayed their dental care and actively sought treatment soon after delivery.

- Drug excretion into breast milk, along with the potential risks to the breast fed infant, is a common concern. Most drugs given to the mother are excreted into breast milk to some degree.
  - If a drug needs to be used that has significant effects on the newborn, an alteration of the mechanics of breastfeeding (stored breast milk) or formula may be substituted.
The American Academy of Pediatrics considers lidocaine to be safe and compatible for use in the breastfeeding mother.

Both the infant and fetus are able to metabolize lidocaine. Levels of lidocaine and its metabolite monoethylglycinexylidide (MEGX) in breast milk were examined in a prospective study following local anesthesia for dental procedures. undergoing dental treatment after local anesthesia using lidocaine without epinephrine.

It concluded that nursing mothers can continue breastfeeding safely.


In different articles, reported idiosyncratic reactions from other components of the local anesthetic (methylparaben or sulfite) suggested the use of local anesthetics without epinephrine to avoid these additional components.

The Postpartum Period

- HOWEVER, some obstetricians disagree with these findings therefore:
- One recommendation is for the breast feeding mother to discontinued direct feeding and/or pumping for 24 hours following the dental appointment in which local anesthetics are used.
Additional Considerations

- Best to avoid agents associated with methemoglobinemia such as: (tetracaine, benzocaine, and prilocaine)
  - In methemoglobinemia, hemoglobin iron atoms are oxidized to a ferric state and cannot carry oxygen to the same degree as normal.
  - If severe, maternal anoxia is potentially lethal to the fetus as well as the mother.
FDA Pregnancy Risk Factor

- **Category A**
  - Controlled studies in pregnant women fail to demonstrate a risk to the fetus in the first trimester with no evidence of risk later in trimesters.

- **Category B**
  - Either animal reproduction studies have not demonstrated a fetal risk, but there are no controlled studies in pregnant women OR animal studies have shown an adverse effect not confirmed in human studies

- **Category C**
  - Either studies in animals have revealed adverse effects and there are no controlled studies in women OR studies in women and animals are not available. Must weigh risks versus benefits

- **Category D**
  - There is positive evidence of human fetal risk

- **Category X**
  - Studies in animal or humans have demonstrated fetal abnormalities or there is evidence of significant risk based on human experience
# Local Anesthetics in Pregnancy

<table>
<thead>
<tr>
<th>Agent</th>
<th>Use in Pregnancy</th>
<th>Use in Nursing</th>
<th>Possible Side Effects</th>
<th>FDA Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lidocaine</td>
<td>Yes</td>
<td>Yes</td>
<td>Possible sulfite interaction with epinephrine</td>
<td>B</td>
</tr>
<tr>
<td>Articaine</td>
<td>With Caution</td>
<td>With Caution</td>
<td>Not reported</td>
<td>C</td>
</tr>
<tr>
<td>Mepivacaine</td>
<td>With Caution</td>
<td>With Caution</td>
<td>Fetal bradycarida</td>
<td>C</td>
</tr>
<tr>
<td>Prilocaine</td>
<td>Yes</td>
<td>With Caution</td>
<td>Methemoglobin-inemia</td>
<td>B</td>
</tr>
</tbody>
</table>
Summary and Recommendations

- Avoidance of treatment in first 10 weeks
- Strict adherence to good local anesthetic technique. Aspiration and avoidance of intravascular injection is paramount.
- Lidocaine is the anesthetic most studied and least associated with medical complications. Other amide or hybrid anesthetics can also be sued safely, albeit with slightly higher risk of adverse outcomes.
- Vital signs should be monitored during dental care

Pediatric Local Anesthesia Administration
Characteristics

- Administering local anesthesia for children is not complicated but it does require specific technical and verbal skills.
- In children, local anesthetic techniques, similar to other techniques in dentistry, are more demanding from a communication standpoint.
- In order to achieve optimum success, the process of local anesthesia must be a harmonious blend of skilled delivery and skilled communication.
Drug Toxicity and Agent Selection

- Overall, dose-dependent toxicity reactions in dentistry are most frequently reported in children.

- Several possible theories as to why excess dosing occurs with this population include:
  - The disproportion of orofacial anatomy to a child’s body weight (larger head compared to body) that may require larger volumes of anesthetic to achieve effect;
  - Failed anesthesia leading to multiple injections; the inadequacy of pain assessment scales due to some patients perceiving the numb feeling as pain;
  - Lack of or improper calculation of maximum recommended dose;
  - Improper administration procedures.
Drug Toxicity and Agent Selection

- Mepivacaine without epinephrine seems to be associated with a higher number of local anesthetic toxicity reports compared to other agents. (Virts, 1999).

- This may be due to the lack of a vasoconstrictor, which can create an environment for increased systemic absorption.

- Pharmacokinetic evaluation has revealed that anesthetic blood levels of 3% mepivacaine without epinephrine peak at a more rapid rate as well as surpassing plasma levels of an equal amount of 2% Lidocaine with 1:100,000 epinephrine by nearly 3-fold following maxillary infiltration injection. (Goebel, Allen, Randall, 1978) (Goebel, Allen, Randall, 1980) (Moore & Hersh, 2010).


Drug Toxicity and Agent Selection

- The frequent use of 3% mepivacaine plain in pediatric dentistry is rooted in reports of mepivacaine having a shorter duration and thus reducing the occurrence of sometimes severe postanesthetic trauma.

- However, while the durations of pulpal anesthesia with mepivacaine without epinephrine are shorter than those of 2% lidocaine with 1:100,000 epinephrine, the duration of soft tissue anesthesia for these two agents has been reported to be nearly identical.

Childhood Obesity

- Obese children pose unique challenges when establishing appropriate doses for local anesthetic drugs.
- Obesity is recurring-ly reported as a complicating factor during dental care.
- There are no clear-cut, separately-stated guidelines for local anesthetic dosing in obese children.
  - Current medical research, however, has found that it is advisable to use the ideal body weight (IBW) when calculating doses of medicinal agents for patients considered to be obese.
Childhood Obesity

- IBW is a statistical formula that uses combinations of height, weight, gender, and/or frame size to determine the optimal weight that is associated with low mortality for the average person.

  - Tables and internet-based calculators however are easily found using common internet search engines.
    - In addition, most Smartphone carriers have several IBW phone apps available for download in their respective app stores.
Use of Articaine in Children

- Articaine package inserts state that its safety and efficacy have not been evaluated in subjects under the age of four, which has lead many providers to avoid articaine in this patient population.

- In general, articaine 4% with epinephrine 1:100,000 or 1:200,000 demonstrates an appropriate level of safety and efficacy for use during pediatric dental care.

- Onset time and duration of action are suitable for clinical use and comparable to other local anesthetic agents used in pediatric dentistry.

Use of Articaine in Children

- Articaine is believed by some to be more effective in its ability to diffuse through bone compared to other amide anesthetic solutions
  - May decrease the likelihood of needing additional injections while providing a dependable drug for mandibular infiltration, especially in adolescents.

- Use may decrease toxicity incidence due to drug metabolism

- Must address reports of neuropathy

Articaine Package Insert (2010).
Moore and Hersh. Dent Clin N AM (2010); 54:587


To Buffer or Not to Buffer

- Buffering is the addition of a chemical agent to a solution which increases its pH (to the body’s normal pH)
  - Decreases pain on injection
  - Possible catalytic effect of CO2
Buffering

**Decreases Pain on Injection**

- **Meta Analysis**
  - Review of 12 published abstracts: 609 observations for buffered local anesthetic and 615 for unbuffered local anesthetic.
  - Buffered local anesthetic resulted in a statistically lower weighted mean difference in visual analog scale compared with unbuffered local anesthetic.

- 63 publications, of these, 22 were human prospective randomized controlled trials directly assessing the pain of infiltration. Three papers were based on observations.
  - The evidence is that buffering with sodium bicarbonate significantly reduces the pain of local anesthetic injection.


Buffering - Catalytic Effect

- Sodium bicarbonate interacts with the hydrochloric acid to create water and CO₂
- CO₂ with lidocaine (HCL) potentiates the action of lidocaine
  - Depressed effect of axon by CO₂
  - Concentrate anesthetic inside nerve trunk
  - Changes the anesthetic charge inside nerve trunk

Some studies present faster onset times and decrease in pain on injection that are dentistry specific.\(^1\)\(^-\)\(^2\)

Some studies report no effect with buffering dental local anesthetics\(^3\)

**Evaluation of these publications Reveals a Large Variable**

- Variation in injection technique
  - Improvement with procaine
- Accuracy of injection

**ROLE OF CO2**


Administration of Buffering Agent

- OnPharma Buffering System
- The practitioner should choose a volume in a ratio of 10:1 (local anesthetic solution to sodium bicarbonate)

### 10:1 Anesthetic-to-Bicarbonate Solution Ratio

<table>
<thead>
<tr>
<th>Volume (mL), Lidocaine with Epinephrine (Container Type)</th>
<th>Volume (mL), 8.4% Sodium Bicarbonate Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8 mL (Cartridge)</td>
<td>0.18 mL</td>
</tr>
<tr>
<td>20 mL (Vial)</td>
<td>2.0 mL</td>
</tr>
<tr>
<td>30 mL (Vial)</td>
<td>3.0 mL</td>
</tr>
<tr>
<td>50 mL (Vial)</td>
<td>5.0 mL</td>
</tr>
</tbody>
</table>

*ONLY APPROVED FOR USE WITH LIDOCAINE*
Administration of Buffering Agent

- Must be used within first few minutes of buffering initiation
- Delay in administration causes a loss of CO2
  - Decrease in reliability of agent


New Study on Onset Time

Malamed et al. - 2013
- Onset from OnPharma
- N=20 with IANB injection [LIDOCAINE ONLY]
  - Self report and EPT
- 71% with pulpal effect in 2 min or less with buffering versus 12% without
- Average time to pulpal analgesia 6.37 minutes without buffering versus 1.51 minutes with buffering

Malamed et al. Faster onset and more comfortable injection with alkalinized 2% lidocaine with epinephrine 1:100,000. Compendium 2013; 34:10-20.
Any Questions???