CENTER FOR DRUG EVALUATION AND RESEARCH

APPLICATION NUMBER:
22-466

LABELING
HIGHLIGHTS OF PRESCRIBING INFORMATION

These highlights do not include all the information needed to use [Tradename] safely and effectively. See full prescribing information for [Tradename].

[Tradename] (articaine HCl and epinephrine) Injection, Intraoral Submucosal Injection

Articaine hydrochloride 4% and epinephrine 1:200,000
Articaine hydrochloride 4% and epinephrine 1:100,000

Initial U.S. Approval: 2000

INDICATIONS AND USAGE

[Tradename] is an amide local anesthetic containing a vasoconstrictor indicated for local, infiltrative, or conductive anesthesia in both simple and complex dental procedures (1).

DOSAGE AND ADMINISTRATION

For dental injection by submucosal infiltration and/or nerve block (2.1):
• For infiltration: 0.5 mL-2.5 mL (20 mg-100 mg articaine HCl) (2.1)
• For nerve block: 0.5 mL-3.4 mL (20 mg-136 mg articaine HCl) (2.1)
• For oral surgery: 1 mL-5.1 mL (40 mg-204 mg articaine HCl) (2.1)
• For most routine dental procedures, [Tradename] containing epinephrine 1:200,000 is preferred. However, when more pronounced homeostasis or improved visualization of the surgical field are required, [Tradename] containing epinephrine 1:100,000 may be used. (2.1)
• Dosages should be reduced in pediatric patients, elderly patients, and patients with cardiac or liver disease. (2.1)

Maximum recommended dosages (2.2):
- Adults: 7 mg/kg (0.175 mL/kg)
- Children 4-16 years and adults: 7 mg/kg (0.175 mL/kg), depending on the age, weight and magnitude of the operation.

Dosage Forms and Strengths

Injection (clear colorless solution), containing:
• Articaine hydrochloride 4% (40 mg/mL) and epinephrine 1:200,000 (as epinephrine bitartrate 0.009 mg/mL) (3)
• Articaine hydrochloride 4% (40 mg/mL) and epinephrine 1:100,000 (as epinephrine bitartrate 0.018 mg/mL) (3)

Dosage and Administration

Table 1 (below) summarizes the recommended volumes and concentrations of [Tradename] for various types of anesthetic procedures. The dosages suggested in this table are for normal healthy adults, administered by submucosal infiltration or nerve block.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>[Tradename] Injection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Volume (mL)</td>
</tr>
<tr>
<td>Infiltration</td>
<td>0.5 – 2.5</td>
</tr>
<tr>
<td>Nerve block</td>
<td>0.5 – 3.4</td>
</tr>
<tr>
<td>Oral surgery</td>
<td>1 – 5.1</td>
</tr>
</tbody>
</table>

The recommended doses serve only as a guide to the amount of anesthetic required for most routine procedures. The actual volumes to be used depend...
on a number of factors such as type and extent of surgical procedure, depth of anesthesia, degree of muscular relaxation, and condition of the patient. In all cases, the smallest dose that will produce the desired result should be given.

The onset of anesthesia and the duration of anesthesia are proportional to the volume and concentration (i.e., total dose) of local anesthetic used. Caution should be exercised when employing large volumes because the incidence of side effects may be dose-related.

For most routine dental procedures, [Tradename] containing epinephrine 1:200,000 is preferred. However, when more pronounced hemostasis or improved visualization of the surgical field are required, [Tradename] containing epinephrine 1:100,000 may be used.

2.2 Maximum Recommended Dosages

- **Adults:** For normal healthy adults, the maximum dose of [Tradename] administered by submucosal infiltration and/or nerve block should not exceed 7 mg/kg (0.175 mL/kg) of articaine HCl.
- **Pediatric Patients Ages 4 to 16 Years:** The quantity of [Tradename] in children ages 4 to 16 years of age to be injected should be determined by the age and weight of the child and the magnitude of the operation. The maximum dose of [Tradename] should not exceed 7 mg/kg (0.175 mL/kg) of articaine HCl [see Use in Specific Populations (8.4)].
- **Safety and effectiveness of [Tradename] in pediatric patients below the age of 4 years have not been established.**

2.3 Dosing in Special Populations

Dose reduction may be required in debilitated patients, acutely ill patients, elderly patients, and pediatric patients commensurate with their age and physical condition. No studies have been performed in patients with renal or liver dysfunction. Caution should be used in patients with severe liver disease. [see Warnings and Precautions (5.2), Use in Specific Populations (8.4, 8.5, and 8.6)].

3 DOSAGE FORMS AND STRENGTHS

Injection (clear colorless solution), containing:

- Articaine hydrochloride 4% and epinephrine 1:200,000 (as epinephrine bitartrate 0.009 mg/mL)
- Articaine hydrochloride 4% and epinephrine 1:100,000 (as epinephrine bitartrate 0.018 mg/mL)

4 CONTRAINDICATIONS

[Tradename] is contraindicated in patients who are hypersensitive to products containing sulfites. Products containing sulfites may cause allergic-type reactions including anaphylactic symptoms and life-threatening or less severe asthmatic episodes in certain susceptible people. Sulfite sensitivity is seen more frequently in asthmatic than in non-asthmatic people [see Warnings and Precautions (5.5)].

5 WARNINGS AND PRECAUTIONS

5.1 Accidental Intravascular Injection

Accidental intravascular injection of [Tradename] may be associated with convulsions, followed by central nervous system or cardiorespiratory depression and coma, progressing ultimately to respiratory arrest. Dental practitioners who employ local anesthetic agents including [Tradename] should be well versed in diagnosis and management of emergencies that may arise from their use. Resuscitative equipment, oxygen, and other resuscitative drugs should be available for immediate use. To avoid intravascular injection, aspiration should be performed before [Tradename] is injected. The needle must be repositioned until no return of blood can be elicited by aspiration. Note, however, that the absence of blood in the syringe does not guarantee that intravascular injection has been avoided.

Small doses of local anesthetics injected in dental blocks may produce adverse reactions similar to systemic toxicity seen with unintentional intravascular injections of larger doses. Confusion, convulsions, respiratory depression, and/or respiratory arrest, and cardiovascular stimulation or depression have been reported. These reactions may be due to intra-arterial injection of the local anesthetic with retrograde flow to the cerebral circulation. Patients receiving these blocks should be observed constantly. Resuscitative equipment and personnel for treating adverse reactions should be immediately available. Dosage recommendations should not be exceeded [see Dosage and Administration (2.1)].

5.2 Systemic Toxicity

This includes toxicity arising from accidental intravascular injection of [Tradename] discussed in Section 5.1, as well as that related to higher systemic concentrations of local anesthetics or epinephrine [see Warnings and Precautions (5.3)]. Systemic absorption of local anesthetics including [Tradename] can produce effects on the central nervous and cardiovascular systems.

At blood concentrations achieved with therapeutic doses of [Tradename], changes in cardiac conduction, excitability, refractoriness, contractility, and peripheral vascular resistance are minimal. However, toxic blood concentrations of [Tradename] can depress cardiac conduction and excitability, which may lead to atrioventricular block, ventricular arrhythmias, and cardiac arrest, possibly resulting in fatalities. In addition, myocardial contractility is depressed and peripheral vasodilation occurs, leading to decreased cardiac output and arterial blood pressure. [Tradename] should also be used with caution in patients with heart block as well as those with impaired cardiovascular function since they may be less able to compensate for functional changes associated with the prolongation of A-V conduction produced by these drugs.

Restlessness, anxiety, tinnitus, dizziness, blurred vision, tremors, depression, or drowsiness may be early warning signs of central nervous system toxicity.

Careful and constant monitoring of cardiovascular and respiratory (adequacy of ventilation) vital signs and the patient’s state of consciousness should be performed after each local anesthetic injection of [Tradename]. Repeated doses of [Tradename] may cause significant increases in blood levels because of possible accumulation of the drug or its metabolites. The lowest dosage that results in effective anesthesia should be used to decrease the risk of high plasma levels and serious adverse effects. Tolerance to elevated blood levels varies with the status of the patient. Resuscitative equipment, oxygen, and other resuscitative drugs should be available for immediate use. Precautions for epinephrine administration, discussed in Section 5.3 should be observed.

Debilitated patients, elderly patients, acutely ill patients, and pediatric patients should be given reduced doses commensurate with their age and physical condition [see Dosage and Administration (2.1, 2.3)]. No studies have been performed in patients with liver dysfunction, and caution should be used in patients with severe hepatic disease.

5.3 Vasocostricor Toxicity

[Tradename] contains epinephrine, a vasocostricor that can cause local or systemic toxicity and should be used cautiously. Local toxicity may include ischemic injury or necrosis, which may be related to vascular spasm. [Tradename] should be used with caution in patients during or following the administration of potent general anesthetic agents, since cardiac arrhythmias may occur under such conditions. Patients with peripheral vascular disease and those with hypertensive vascular disease may exhibit exaggerated vasocostricor response.

The American Heart Association has made the following recommendation regarding the use of local anesthetics with vasocostricors in patients with ischemic heart disease: “Vasocostricor agents should be used in local anesthesia solutions during dental practice only when it is clear that the procedure will be shortened or the analgesia rendered more profound. When a vasocostricor is indicated, extreme care should be taken to avoid intravascular injection. The minimum possible amount of vasocostricor should be used.” (Kaplan, 1986).

It is essential to aspirate before any injection to avoid administration of the drug into the blood stream.

5.4 Methemoglobinemia

[Tradename], like other local anesthetic solutions containing a vasoconstrictor, can cause methemoglobinemia, particularly in conjunction with methemoglobin-inducing agents. [Tradename] should not be used in patients with congenital or idiopathic methemoglobinemia, and in patients who are receiving treatment with methemoglobin-inducing agents since they are more susceptible to drug-induced methemoglobinemia.

Signs and symptoms of methemoglobinemia may be delayed some hours after exposure. Initial signs and symptoms of methemoglobinemia include slate grey cyanosis seen in buccal mucous membranes, lips and nail beds. In severe cases, symptoms may include central cyanosis, headache, lethargy, dizziness, fatigue, syncope, dyspnea, CNS depression, seizures, dysrythmia and shock. Methemoglobinemia should be considered if central cyanosis unresponsive to oxygen therapy occurs, especially if methemoglobin-inducing agents have been used. Calculated oxygen saturation and pulse oximetry are inaccurate in
the setting of methemoglobinemia. The diagnosis can be confirmed by an elevated methemoglobin level of at least 10% is present. The development of methemoglobinemia is dose-related.

**Management of methemoglobinemia:** If methemoglobinemia does not respond to administration of oxygen, clinically significant symptoms of methemoglobinemia should be treated with administration of a slow intravenous injection (over 5 minutes) of methylene blue at a dosage of 1-2 mg/kg body weight.

5.5 Anaphylaxis and Allergic-Type Reactions

[Tradename] contains sodium metabisulfite, a sulfite that may cause allergic-type reactions including anaphylactic symptoms and life-threatening or less severe asthmatic episodes in certain susceptible people. The overall prevalence of sulfite sensitivity in the general population is unknown. Sulfite sensitivity is seen more frequently in asthmatic than in non-asthmatic people.

6 ADVERSE REACTIONS

Reactions to articaine are characteristic of those associated with other amide local anesthetics. Adverse reactions to this group of drugs may also result from excessive plasma levels (which may be due to overdosage, unintentional intravascular injection, or slow metabolic degradation), injection technique, volume of injection, or hypersensitivity or they may be idiosyncratic.

### 6.1 Clinical Studies Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed cannot be directly compared to rates in other clinical trials and may not reflect the rates observed in practice.

The reported adverse events are derived from clinical trials in the United States and the United Kingdom with a similar product containing articaine and epinephrine. Table 2 displays the adverse events reported in clinical trials where 882 individuals were exposed to articaine containing epinephrine 1:100,000. Table 3 displays the adverse events reported in clinical trials where 182 individuals were exposed to articaine containing epinephrine 1:200,000 and 179 individuals were exposed to articaine containing epinephrine 1:200,000.

**Adverse reactions observed in at least 1% of patients:**

<table>
<thead>
<tr>
<th>Body System/Reaction</th>
<th>articaine containing epinephrine 1:100,000 (N=882) Incidence</th>
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<tr>
<td>Body as a whole</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Face edema</td>
<td>13 (1%)</td>
<td></td>
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</tr>
<tr>
<td>Headache</td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>114 (13%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nervous system</td>
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<td></td>
<td></td>
</tr>
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<tr>
<td>Any adverse event</td>
<td>33 (18%)</td>
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<td>Headache</td>
<td>11 (6.1%)</td>
</tr>
<tr>
<td>Positive blood</td>
<td>5 (1.6%)</td>
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<tr>
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### 5.5 Anaphylaxis and Allergic-Type Reactions

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### 6.2 Postmarketing Experience

The following adverse reactions have been identified during postapproval use of articaine hydrochloride with epinephrine. Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a casual relationship to drug exposure.

Persistent paresthesias of the lips, tongue, and oral tissues have been reported with use of articaine hydrochloride, with slow, incomplete, or no recovery. These postmarketing events have been reported chiefly following nerve blocks in the mandible and have involved the trigeminal nerve and its branches.

Hypoesthesia has been reported with use of articaine, especially in pediatric age groups, which is usually reversible. Prolonged numbness can result in soft tissue injuries such as that of the lips and tongue in these age groups.

Ischemic injury and necrosis has been described following use of articaine with epinephrine and has been postulated to be due to vascular spasm of terminal arterial branches.

Paralysis of ocular muscles has been reported, especially after posterior, superior alveolar injections of articaine during dental anesthesia. Symptoms include diplopia, mydriasis, ptosis and difficulty in abduction of the affected eye. These symptoms have been described as developing immediately after injection of the anesthetic solution and persisting one minute to several hours, with generally complete recovery.

7 DRUG INTERACTIONS

The administration of local anesthetic solutions containing epinephrine to patients receiving monoamine oxidase inhibitors, nonselective beta-adrenergic antagonists or tricyclic antidepressants may produce severe, prolonged hypertension. Phenothiazines and butyrophenones may reduce or reverse the pressor effect of epinephrine. Concurrent use of these agents should generally
be avoided. In situations when concurrent therapy is necessary, careful patient monitoring is essential [see Warnings and Precautions (5.1)].

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Teratogenic Effects—Pregnancy Category C.

There are no adequate and well-controlled studies in pregnant women with articaine with epinephrine. Articaine hydrochloride and epinephrine (1:100,000) has been shown to increase fetal deaths and skeletal variations in rabbits when given in doses approximately 4 times the maximum recommended human dose (MRHD). [Tradename] should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

In embryo-fetal toxicity studies in rabbits, 80 mg/kg, subcutaneously (approximately 4 times the MRHD based on body surface area) caused fetal death and increased fetal skeletal variations, but these effects may be attributable to severe maternal toxicity, including seizures, observed at this dose. In contrast, no embryo-fetal toxicities were observed when articaine and epinephrine (1:100,000) was administered subcutaneously throughout organogenesis at doses up to 40 mg/kg in rabbits and 80 mg/kg in rats (approximately 2 times the MRHD based on body surface area).

In pre- and postnatal developmental studies subcutaneous administration of articaine hydrochloride to pregnant rats throughout gestation and lactation, at a dose of 80 mg/kg (approximately 2 times the MRHD based on body surface area) increased the number of stillbirths and adversely affected passive avoidance, a measure of learning, in pups. This dose also produced severe maternal toxicity in some animals. A dose of 40 mg/kg (approximately equal to the MRHD on a mg/m² basis) did not produce these effects. A similar study using articaine and epinephrine (1:100,000) rather than articaine hydrochloride alone produced maternal toxicity, but no effects on offspring.

8.3 Nursing Mothers

It is not known whether [Tradename] is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when [Tradename] is administered to a nursing woman. When using [Tradename], nursing mothers may choose to pump and discard breast milk for approximately 4 hours (based on plasma half-life) following an injection of [Tradename] (to minimize infant ingestion) and then resume breastfeeding.

8.4 Pediatric Use

Safety and effectiveness of articaine HCl 4% with epinephrine 1:200,000 and 1:100,000 in pediatric patients below the age of 4 years have not been established.

Safety and effectiveness was established in clinical trials with 61 pediatric patients between the ages of 4 and 16 years administered another product containing articaine hydrochloride 4% and epinephrine 1:100,000 injections. Fifty-one of these patients received doses from 0.76 mg/kg to 5.65 mg/kg (0.9 mL to 5.1 mL) of articaine HCl for simple dental procedures and 10 patients received doses between 0.37 mg/kg and 7.48 mg/kg (0.7 mL to 3.9 mL) of articaine HCl for complex dental procedures. Approximately 13% of these pediatric patients required additional injections of anesthetic for complete anesthesia. Safety of doses greater than 7 kg/m² (0.175 mL/kg) of articaine HCl in pediatric patients has not been established. Dosages in pediatric patients should be reduced, commensurate with age, body weight, and physical condition [see Dosage and Administration (2.2)].

8.5 Geriatric Use

In clinical trials, 54 patients between the ages of 65 and 75 years, and 11 patients 75 years and over received another product containing articaine and epinephrine 1:100,000. Among all patients between 65 and 75 years, doses from 0.43 mg/kg to 4.76 mg/kg (0.9 mL to 11.9 mL) of articaine HCl were administered safely to 35 patients for simple procedures and doses from 1.05 mg/kg to 4.27 mg/kg (1.3 mL to 6.8 mL) of articaine HCl were administered safely to 19 patients for complex procedures. Among the 11 patients ≥ 75 years old, doses from 0.78 mg/kg to 4.76 mg/kg (1.3 mL to 11.9 mL) of articaine HCl were administered safely to 7 patients for simple procedures and doses of 1.12 mg/kg to 2.17 mg/kg (1.3 mL to 5.1 mL) of articaine HCl were safely administered to 4 patients for complex procedures.

Approximately 6% of patients between the ages of 65 and 75 years and none of the 11 patients 75 years of age or older required additional injections of anesthetic for complete anesthesia compared with 11% of patients between 17 and 65 years old who required additional injections.

No overall differences in safety or effectiveness were observed between elderly subjects and younger subjects, and other reported clinical experience has not identified differences in responses between the elderly and younger patients, but greater sensitivity of some older individuals cannot be ruled out.

8.6 Renal/Heaptic Insufficiency

No studies have been performed with articaine hydrochloride 4% and epinephrine 1:200,000 injection or articaine hydrochloride 4% and epinephrine 1:100,000 injection in patients with renal or hepatic dysfunction [see Warnings and Precautions (5.2)].

10 OVERDOSAGE

Acute emergencies from local anesthetics are generally related to high plasma levels encountered during therapeutic use of local anesthetics or to unintended subarachnoid injection of local anesthetic solution [see Warnings and Precautions (5.1, 5.2)].

The first consideration is prevention, best accomplished by careful and constant monitoring of cardiovascular and respiratory vital signs and the patient’s state of consciousness after each local anesthetic injection. At the first sign of change, oxygen should be administered.

For additional information about overdose treatment, call a poison control center (1-800-222-1222).

11 DESCRIPTION

[Tradename] injection is a sterile, aqueous solution that contains articaine HCl 4% (40 mg/mL) and epinephrine bitartrate in an epinephrine 1:200,000 or epinephrine 1:100,000 strength. Articaine HCl is an amino amide local anesthetic, chemically designated as 4-methyl-3-[2-(propylamino)-propionamido]-2-thiophene-carboxylic acid, methyl ester hydrochloride and is a racemic mixture. Articaine HCl has a molecular weight of 320.84 and the following structural formula:

\[
\text{O} \quad \text{H} \quad \text{N} \quad \text{C}_3\text{H}_7\text{N}_2\text{O}_5\text{S} + \text{HCl}
\]

Articaine HCl has a partition coefficient in n-octanol/Sorensen buffer (pH 7.35) of 17 and a pKa of 7.8.

Epinephrine bitartrate, (+)-1-(3,4-dihydroxyphenyl)-2-methylanino-ethanol (+) tartrate (1:1) salt, is a vasoconstrictor that is added to articaine HCl in a concentration of 1:200,000 or 1:100,000 (expressed as free base). It has a molecular weight of 333.3 and the following structural formula:

\[
\text{HO} \quad \text{NHCH}_3 \quad \text{OH} \quad \text{C}_6\text{H}_4\text{N}=\text{O} \quad \text{C}_2\text{H}_5\text{OH} \quad \text{C}_6\text{H}_4\text{NO}_2 \quad \text{C}_6\text{H}_5\text{ON}
\]

[Tradename] contains articaine HCl (40 mg/mL), epinephrine (1:200,000 or 1:100,000) (as epinephrine bitartrate) sodium chloride (1.0 mg/mL), sodium metabisulfite (0.5 mg/mL), and water for injection. The product is formulated with a 10% overage of epinephrine. The pH is adjusted to 3.6 with hydrochloric acid.

12 CLINICAL PHARMACOLOGY

12.1 Mechanism of Action
Articaine HCl is an amide local anesthetic. Local anesthetics block the generation and conduction of nerve impulses, presumably by increasing the threshold for electrical excitation in the nerve, by slowing the propagation of the nerve impulse and by reducing the rate of rise of the action potential. In general, the progression of anesthesia is related to the diameter, myelination, and conduction velocity of the affected nerve fibers. Epinephrine is a vasoconstrictor added to articaine HCl to slow absorption into the general circulation and thus prolong maintenance of an active tissue concentration.

12.2 Pharmacodynamics

Clinically, the order of loss of nerve function is as follows: (1) pain; (2) temperature; (3) touch; (4) proprioception; and (5) skeletal muscle tone. The onset of anesthesia has been shown to be within 1 to 9 minutes of injection of [Tradename]. Complete anesthesia lasts approximately 1 hour for infiltrations and up to approximately 2 hours for nerve block.

Administration of [Tradename] results in a 3- to 5-fold increase in plasma and up to approximately 2 hours for nerve block.

Approximately 60% to 80% of articaine HCl is bound to human serum albumin and γ-globulins at 37°C in vitro. Articaine HCl is metabolized by plasma carboxylesterase to its primary metabolite, articainic acid, which is inactive. In vitro studies show that the human liver microsome P450 isoenzyme system metabolizes approximately 5% to 10% of available articaine with nearly quantitative conversion to articainic acid.

Excretion: At the dose of 476 mg of articaine, the elimination half-life was 43.8 minutes and 44.4 minutes for articaine solution containing epinephrine 1:200,000, and articaine reaches peak blood concentration about 25 minutes after a single dose injection and 48 minutes after three doses. Peak plasma levels of articaine achieved after 68 mg and 204 mg doses are 385 ng/mL and 900 ng/mL, respectively. Following intraoral administration of a near maximum dose of 476 mg, articaine reaches peak blood concentrations of 2037 ng/mL and 2145 ng/mL for articaine solution containing epinephrine 1:100,000 and 1:200,000, respectively, approximately 22 minutes post-dose.

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