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Articaine, Local Anesthetics, and Paresthesia

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PLEASE SHARE THIS VALUABLE INFORMATION WITH ALL DOCTORS, HYGIENISTS, AND ASSISTANTS IN THE OFFICE

Articaine –Recent Clinical Information

Articaine HCl with epinephrine 1:100,000 is the first U.S.-approved dental anesthetic in over 40 years. In April 2000, the Food and Drug Administration granted approval of articaine for sale and distribution as a 4% solution with epinephrine 1:100,000 under the brand name Septocaine. This U.S. approval follows a long history of articaine use in dentistry. Articaine was originally synthesized in Germany in 1969 and introduced for clinical use in 1976.[1] It soon became available throughout Europe and South America. In 1983 it was approved for sale in Canada and in 1998 in the United Kingdom.[2] Since its US approval, articaine has become rapidly accepted in the US because of the many anecdotal reports suggesting superior dental anesthetic properties of articaine, including less failure to achieve anesthesia, the ability to achieve more profound anesthesia, the success of buccal infiltration in the maxilla to achieve palatal anesthesia, and the success of mandibular infiltration to replace inferior alveolar block anesthesia.[3] Because of its reported superior clinical properties, the drug has captured a major portion of local anesthesia usage by dentists throughout the world.[3]

A relatively recent clinical report on articaine was reprinted in the *CRA Newsletter* in 2002. It outlined data and impressions collected by participating dentists during an evaluation of the product.[4] The purpose of the evaluation was to determine if clinicians could discern differences between articaine (Septocaine) and other anesthetics routinely used. In the evaluation, observations from 94 dentists on over 13,000 patients between 3 and 96 years of age, described some advantages of articaine.[4] A majority of the 94 dentists stated that anesthesia was more profound than that of "routinely used anesthetics," the onset of effects was faster, and there was greater success in their "difficult-to-anesthetize" patients. Other comments from a minority of the 94 dentists cited a reduction in the number of missed blocks, and that the effectiveness of articaine in mandibular infiltration facilitated treatment of the pediatric and apprehensive patient.

Other reports from the UK and Germany have indicated that articaine had an advantage of low toxicity due to rapid hydrolysis, rapid onset of surgical anesthesia, faster elimination time than lidocaine, better diffusion through soft tissue and bone than other anesthetics, and a lack of toxicity in healthy individuals after unintentional intravascular injection.[5, 6] Isen has suggested two advantages to the actions of articaine: it is safe to reinject more drug later in a procedure due to the relatively short half-life of articaine, and articaine better penetrates and diffuses through the nerve cell membrane due to its high lipid solubility.[3] Haas and Lennon recognized the fact that articaine is effective when used in mandibular infiltration and dentists may be using the anesthetic frequently for infiltration.[7]

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Another study, in Canada, reported the effectiveness of articaine in pediatric patients after mandibular infiltration.[8] In this study using 50 patients, articaine 4% with epinephrine 1:100,000 (Ultracaine DS-Forte) produced an appropriate deep anesthesia of posterior primary mandibular teeth using infiltration only. The agent was infiltrated over 60 seconds at each site using a dose of 1.2 mL at each single root. Each injection was preceded by topical benzocaine 20% on the mucobuccal fold corresponding to the teeth being treated. All operative procedures were performed using a rubber dam. A total of 9 stainless steel crowns were placed with no problems. No extractions were performed. It was the impressions of the study investigators that articaine was able to diffuse through bone onto the lingual side of each tooth. They also were under the impression that the higher lipid solubility of articaine compared to lidocaine, prilocaine, and bupivacaine could account for its higher diffusion. In this study, some of the patients received the articaine with epinephrine 1:200,000 formula, available in Canada.

In a recent report,[9] comments from clinicians on the use of articaine included the following. 1) Because articaine is rapidly inactivated in the plasma, articaine may be safer upon multiple injections than other anesthestics. 2) Because of infiltration in the mandibular arch being one of the options of using articaine, the dentist may proceed with less chance of tongue numbness and lip numbness. 3) The most important recommendation clinically for the use of articaine is that the dentist must be aware of the fact that articaine delivers nearly twice the concentration of active anesthetic to the patient and therefore the dentist can effectively use approximately one-half of the amount of articaine to achieve similar anesthetic delivery. 4) Due to its high lipid solubility, deposition of the anesthetic in the tissues may result in adverse effects occurring more frequently if the dentist is not cautious in using additional doses.

Paresthesia

A concern about articaine is the possibility of paresthesia associated with its use. Also, the concern about paresthesia as an adverse effect of any local anesthetic is a justified and serious one. Paresthesia is associated with the use of dental local anesthetics and this information is widely disseminated in printed drug information sources. The Drug Information for the Health Care Professional-USPDI, 2000 20th edition makes the general statement that local anesthetics "may cause numbness or tingling of lips or mouth, prolonged – may occur when an anesthetic is used for dental anesthesia."[10] It also states that "paresthesia (tingling or 'pins and needles' sensation) can occur with local anesthetics in general". It does not single out any individual product associated with this effect. The term paresthesia is broadly defined as numbness or tingling of lips or mouth, persistent anesthesia or a painful neuropathy known as dysesthesia. The ADA Guide to Dental Therapeutics 2nd edition[11] states that long-lasting or permanent paresthesia (rare) is an adverse effect of dental local anesthetics. The Guide does not single out any particular product causing this effect.

Table 1. Warnings of paresthesia from package inserts of dental anesthetics

Product	Manufacturer	Warning statement
Lidocaine 2.0% and epinephrine 1:100,000	Eastman Kodak	"This product has caused neurologic effects."[1]
Prilocaine 4.0% And epinephrine 1:200,000 (Citanest Forte)	Dentsply	"Swelling and persistent paresthesia of the lips and oral tissues may occur." [2]
Mepivacaine 3.0% (Carbocaine 3%)	Eastman Kodak	No mention of paresthesia as an adverse effect.[3]
Bupivacaine 0.5% And epinephrine 1:200,000 (Marcaine)	Eastman Kodak	No mention of paresthesia as an adverse effect.[4]
Articaine 4.0% And epinephrine 1:100,000 (Septocaine)	Septodont	Lists paresthesia as "an event that occurs at overall rates of less than 1.0%."[5]

[1] Lidocaine 2% and epinephrine 1:100,000, (Lidocaine hydrochloride and epinephrine injection, USP) [package insert]. New York: Eastman Kodak Company, Dental Products; 2003.

[2] Citanest Forte 4% injection with epinephrine 1:200,000 [package insert]. York, PA; Dentsply Pharmaceutical; 2003.

[3] Carbocaine 3.0% injection (mepivacaine hydrochloride injection, USP [package insert]. New York: Eastman Kodak Company, Dental products;2003.

[4] Marcaine 0.5% with epinephrine injection 1:200,000 (as bitartrate)(bupivacaine hydrochloride and epinephrine injection, USP [package insert]. New York: Eastmant Kodak Company, Dental Products; 2003.

[5] Septocaine (articaine hydrochloride 4.0% (40 mg/ml) with epinephrine 1:100,000 injection)[package insert]. New Castle, DE: Septodont; 2000.

The package inserts of individual dental anesthetics vary in terms of warnings of paresthesia. Inserts for lidocaine 2% and epinephrine 1:100,000, prilocaine 4% with epinephrine 1:200,000 (Citanest Forte Dental), and articaine 4.0% with epinephrine 1:100,000 (Septocaine) lists warnings of the possibility of paresthesia occurring with their use. The inserts for mepivacaine 3% (Carbocaine) and bupivacaine 0.5% with epinephrine 1:100,000 (Marcaine) contain no such warnings. Table 1 lists the dental anesthetics and the warnings statement in the package inserts.

The package insert for lidocaine states that the product has caused neurological effects.[12] It states that a number of factors may be related to adverse reactions associated with local

Table 2. Estimated incidences of paresthesia

Study	#Paresthesias/TotalCases	Conditions
Nickel (Ref #14)	46/4,987	30 surgical 16 unexplained
Pogrel/Thamby (Ref #18)	1/160,571	After LA injection
Pogrel/Thamby (Ref #18)	1/26,762	After LA injection
Miller/Haas (Ref #22)	1/765,000	After LA injection

anesthetics, including the anesthetic technique employed, the total dose administered, the particular drug used, the route of administration and the patient's physical condition.[12] The package insert for articaine (Septocaine) lists adverse events derived from clinical trials in the US and UK[13] Out of 1325 patients treated, 882 were exposed to articaine (Septocaine). Eleven of the 882 patients (1%) experienced paresthesia..Further, the package insert lists the term paresthesia under the heading of events occurring at over all rates of less than 1%. The insert also contains the wording "the patient should be informed in advance of the possibility of temporary loss of sensation and muscle function following infiltration and nerve block injections."[13]

Nickel[14] looked at the records of 4,987 dental surgical patients (exodontias) and noted 46 cases of paresthesias of the inferior alveolar and lingual nerves (Table 2). The 46 incidences out of 4,987 patients equated to 0.92% incidence of paresthesia for all exodontias. There were 44 cases out of 3071 patients for 3rd molar removal. This equated to a 1.4% incidence. Of the 46 total cases, 30 were explained as a result of surgery and 16 had no surgical explanation. Either mepivacaine 3% or lidocaine 2% with epinephrine 1:100,000 were used as the anesthetics in the procedures. In the 16 unexplained cases, there was no difference between the numbers after mepivacaine or lidocaine with epinephrine. There were 7 cases associated with the use of mepivacaine (0.32% incidence) and 9 cases associated with the use of lidocaine with epinephrine (0.32% incidence). The durations of paresthesia for the total group of 46 (both explained and unexplained) were as follows: 27 lasted from 0–1 month, 6 lasted 2–3 months, 2 lasted 4–6 months, 3 lasted 7–9 months, 2 lasted 10–12 months, and 2 lasted greater than 12 months. Four patients were lost to follow-up. According to Nickel, the incidences of paresthesia uncovered in his study compared well to the 1.3%–5.3% reported incidence of paresthesia following odontectomy of impacted mandibular third molars as reported by Wofford and Miller.[15]

Paresthesia and inferior alveolar nerve block

On rare occasions, an inferior alveolar nerve block can cause permanent alteration in sensation over the distribution of the lingual nerve, the inferior alveolar nerve, or both nerves.[16, 17] Pogrel and Thamby evaluated 83 individuals who had permanent nerve involvement after an inferior alveolar nerve block.[18] In those cases where the local anesthetic was known, 33 of 68 (49%) had received lidocaine 2% with epinephrine 1:100,000, 32 of 68 (47%) had received prilocaine 4% with epinephrine 1:200,000, and 3 of 68 (4%) had received mepivacaine 3%. Some patients received multiple agents. The lingual nerve was affected 79% of the time compared to the inferior alveolar nerve.[18] In terms of the frequency of use of local anesthetics, prilocaine 4% with epinephrine 1:200,000 was involved more frequently (32/68) than its nationwide rate of use would indicate since it is used only 13% of time nationwide.[18] This was compared to the 33/68 cases of lidocaine2% with epinephrine 1:100,000 which was used 62% of the time.[18]

Pogrel and Thamby[18] also attempted to estimate the incidence of nerve involvement after local anesthetic injection using the following method. First, current sales of local anesthetics for dentistry in the US were obtained from industry and reported to be 161 million carpules annually. Second, in their study, Pogrel and Thamby observed an average of 18.75 patients per year with paresthesia out of a population of 10.2 million people of Northern California. Third, at the time of their report Northern California contained 3.74 percent of the US population. Using these figures, and calculating that approximately half of all the local anesthetic carpules administered during the year were for inferior alveolar nerve blocks, this gave an estimated incidence of permanent nerve involvement of 1 incident for every 160,571 inferior alveolar nerve blocks (1:160,571) (Table 2). This estimate was revised through anecdotal reports from more patients who had similar nerve damage with the new revised estimate being 1 out of every 26,762 inferior alveolar blocks (1:26,762) (Table 2). This number was within a range of blocks that a full time dentist might give within a lifetime of treatment. The authors thus reasoned that each practitioner has a chance of having one patient during their career that will have permanent nerve involvement resulting from an inferior alveolar nerve block.

Pogrel and Thamby[18] went on to state that when a nerve is affected by a local anesthetic, between 85% and 94% resolve within an 8-week period. If recovery does not occur fairly quickly, about two-thirds of those go on to have permanent damage. The authors summarized their study by stating that inferior alveolar nerve blocks can cause occasional nerve damage. The mechanisms are unknown and there is no known prevention or treatment.[18]

Their study confirmed that only on rare occasions does an inferior alveolar nerve block cause permanent alteration in sensation of the lingual nerve, the inferior alveolar nerve or both, and that the lingual nerve was usually affected more often.

In a more recent report by Pogrel et al,[19] they cited the incidence of permanent nerve involvement after inferior alveolar nerve block to range between 1 case for every 26,000 blocks and 1 case for every 800,000 blocks. The first figure comes from the earlier report by Pogrel and Thamby,[18] and the second figure comes from a report by Haas and Lennon.[7]

Table 3. Estimated frequencies of local anesthetic-induced paresthesia cases from Haas and Lennon report (Ref #7)

Anesthetic	Observed cases in 1993	Reduced to cases per million
Bupivacaine	0	0
Lidocaine	0	0
Mepivacaine	0	0
Articaine	10	2.27 per million
Prilocaine	4	1.70 per million

Pogrel et al stated that permanent nerve involvement is rare and can result as a paresthesia, anesthesia, or dysesthesia of both the lingual and inferior alveolar nerves, with the lingual nerve affected in 70% of the cases.[19]

Paresthesia: local anesthetics and articaine

Haas has stated that prolonged anesthesia or paresthesia of the tongue and lip are recognized risks of dental surgery such as extractions and that they may also occur following nonsurgical dentistry.[20] Local anesthetics are associated with paresthesia in the non-surgical cases, and articaine and prilocaine were reported as more likely to be involved than other commonly used local anesthetics. Most reactions commonly affect the lingual nerve. Most episodes resolve within 8 weeks, but some become permanent.[20]

Haas and Lennon examined all reported cases of nonsurgically induced paresthesia over a 21-year period in Ontario.[7] These cases were recovered from the Professional Liability Program of Ontario, a voluntary reporting program by dentists covered by malpractice insurance. Over the 21 years, there were 304 cases of surgical paresthesia and 143 of nonsurgical paresthesia. Most of the cases involved the lower lip. The local anesthetics used in the 143 cases were articaine, 50 cases; prilocaine, 43 cases; lidocaine, 5 cases; mepivacaine, 4 cases. In 47 of the 143 cases, the local anesthetic was unknown. Also, on some occasions, different agents were jointly administered.[7]

The authors then examined the number of reported cases for the year 1993 and discovered 14 cases had been reported that year; 10 associated with articaine, 4 associated with prilocaine, and none for the other anesthetics **(Table 3)**.[7] All cases were associated with injections in the mandibular arch. In order to estimate the frequency of paresthesia cases one should expect to be associated with any local anesthetic, the authors obtained data on the number of injections given which generated the 14 reported cases. In 1993 in Ontario, there were 11,000,000 injections administered. Using the null hypothesis that the anesthetic had no effect on the incidence of paresthesia, the expected frequency derived from the 14 cases per 11,000,000 injections would be 1.2 cases per 1,000,000 injections for any of the anesthetics used. This was estimated from the distribution of use of the anesthetics used in Ontario for that year. These anesthetics were bupivacaine, lidocaine, mepivacaine, articaine, and prilocaine. The actual observed distribution in 1993, however, was 0 cases with bupivacaine, 0 with lidocaine, 0 with mepivacaine, 10 with articaine, and 4 with prilocaine. When reduced to cases per million injections, articaine was 2.27:1,000,000 and prilocaine was 1.7:1,000,000. A statistical analysis determined that the differences between the expected of 1.2 per million to the observed values for articaine (2.27 per million) and prilocaine (1.7 per million) were significant. The survey did not identify the specific commercial preparations or vasoconstrictor concentrations for any of the anesthetics. In another way of estimating the frequency of paresthesias from articaine and prilocaine from the Hass and Lennon report, Dower[21] adjusted the data to show one incidence for every 219,949 cartridges used for articaine and one incidence for ever 294,077 cartridges used for prilocaine.

In a subsequent survey by Haas and Lennon,[22] they examined 19 reports of paresthesia in Ontario for the year 1994. Ten cases were associated with prilocaine, 8 with articaine, and 1 with mepivacaine. There were no cases associated with lidocaine or bupivacaine for that year. Analysis of the 1994 data for all local anesthetics showed that the differences between the observed and expected frequencies of paresthesia were significant. The observed frequencies of paresthesia with prilocaine and articaine use were significantly greater when compared with the expected frequencies. When the 1994 data were combined with the 1993 data described above,[7] the significant differences for articaine and prilocaine remained. From an estimate of the total number of cartridges used, this projected to an incidence of 2.98 paresthesia cases per million injections of prilocaine and 2.05 cases per million injections of articaine.[22]

Miller and Haas[23] examined the period 1994 through 1998 of reports of nonsurgical neuropathies in Ontario by the same method described above by Haas and Lennon.[7] The incidence of local anesthetic-associated neuropathies was 1 in 765,000 injections (Table 2) which equated to 1.3 cases per million injections. When differences between observed and expected frequencies were compared, a significance was observed for the incidence of postinjection paresthesia associated with articaine and prilocaine, but not with other agents.[23]

The only prospective study uncovered by this author in a literature search on articaine and paresthesia was that reported by Malamed et al.[1] This was a "three identical single-dose, randomized, double-blind, parallel-group, active-controlled multicenter" study. The report essentially compared the safety of articaine to the safety of lidocaine. Data were collected from 27 clinical sites (19 in the US and eight in the UK) using 882 subjects treated with articaine 4% with epinephrine 1:100,000 and 443 subjects treated with lidocaine 2% with epinephrine 1:100,000. The average volumes given per subject were comparable between the two local anesthetics, and the doses given were those required to achieve adequate anesthesia. The volumes of articaine used were simple

procedure = 2.5 mL, complex procedure = 4.2 mL. The volumes of lidocaine used were simple procedure = 2.6 mL, complex procedure = 4.5 mL.

Among the adverse events reported by the patients after articaine were hypesthesia 7 cases out of 882 patients (0.79%) and paresthesia, 11/882 (1.25%). Those same events reported by patients after lidocaine were hypesthesia, 5/443 (1.13%) and paresthesia 2/443 (0.45%). From the primary investigators' observations, these events after articaine were hypesthesia 6/882 (0.68%) and paresthesia 8/882 (0.91%). After lidocaine they were hypesthesia 1/443 (0.22%) and paresthesia 2/443 (0.45%). Adverse events considered by the primary investigators after combining hypesthesia cases and paresthesia cases together were articaine 14/882 (1.6%) and lidocaine 3/443 (0.68%). During a telephone follow-up 24 hours and 7 days after the procedures, the investigators asked the subjects if they had any ongoing numbness or tingling of the mouth or face (paresthesia). The numbers of subjects reporting paresthesia 4 to 8 days after the treatment was 8/882 (1%) for articaine group and 5/443 (1%) for lidocaine group.

From this study,[1] there seemed to be very little difference between the incidences of the combined hypesthesia/paresthesia cases for articaine and lidocaine. Also, there appeared to be no difference in the incidence of paresthesia between articaine and lidocaine from 4 to 8 days after treatment.

Additional reports of articaine-induced paresthesia

In an attempt to assess additional cases and reports on paresthesia that may be directly attributed to articaine, this author used a literature search engine to survey the clinical literature going back to 1976.[24] One report of 2002 documented two cases of paresthesia associated with articaine use by 94 dentists on over 13,000 patients.[4] The articaine preparation was articaine 4% with epinephrine 1:100,000 (Septocaine). One case of paresthesia of the lateral border of the tongue was observed. This case lasted > 3.6 months, and resulted after placement of endosseous implants on tooth numbers 29 and 30. A second case of paresthesia of the left mandible was observed that lasted 36 hours after a block injection followed by X-Tip intraosseous injection for treatment of tooth #19 crown preparation on a patient with a long history of difficulty achieving anesthesia.

Table 4. Summary of articaine local anesthetics and paresthesia

1. General statements that paresthesia can be caused by any local anesthetic exists in the professional reference literature.
2. Specific package insert warnings of paresthesia exist for lidocaine, prilocaine, and articaine.
3. Paresthesia following nonsurgical dentistry is a rare event and has been reported for articaine, lidocaine, mepivacaine, and prilocaine.
4. Permanent nerve involvement is an extremely rare event associated with the use of local anesthetics in dentistry.
5. Retrospective analysis in Ontario showed that articaine and prilocaine were associated with slightly higher incidences of causing the rare event of paresthesia compared to local anesthetics in general.
6. A prospective study reported that articaine and lidocaine have similar incidences of association with paresthesia.
7. There is concern expressed in the literature by some dentists in the UK over the association of articaine and prilocaine with slightly higher incidences of paresthesia.

Also uncovered were some recent letters to the editor published in the *British Journal of Oral and Maxillofacial Surgery* , expressing concern in the UK over the potential for articaine to cause paresthesia. Van Eden and Patel wrote that four patients presented complaining of persistent and long-standing lingual paresthesia following an inferior dental block with articaine for routine dentistry.[5] The paresthesia persisted from 6 to 18 months in the group of four. A second letter[25] reminded readers that the Van Eden and Patel report[5] was not the first report of an association between articaine and long-standing altered sensation following intraoral injection, and cited the study by Haas and Lennon[7] that implicated articaine with a higher incidence of paresthesia compared to other anesthetics.

A third letter questioned the appropriateness of articaine as an alternative to lidocaine for local anesthesia for dental purposes.[26] The author stated that there had been an apparent increase in dysesthesia following regional nerve block injections associated with the use of articaine. No documentation or cases were described, however, by the author of the letter.[25] Finally, a report by Hawkins and Moore was uncovered in the search that emphasized both articaine and prilocaine were associated with slightly higher incidences of mandibular and lingual paresthesia compared to other local anesthetics.[27]

There have been no additional reports in the literature on articaine-induced paresthesia between 2002 and the time of this manuscript submission. It is interesting to note that the amount of articaine used in local anesthesia over this time is estimated to be substantial. For example, the number of boxes of 50 cartridges sold in one quarter of 2003 were 256,000, which according to the manufacturer, equated to 12,8000,000 injections of articaine.[28]

Table 4 summarizes the information presented in this paper. There is evidence that all local anesthetics are associated with paresthesia. Retrospective analyses showed that articaine and prilocaine were associated with slightly higher incidences of paresthesia. A prospective study showed similar incidences of paresthesias associated with articaine and lidocaine. There is a justified concern about the association of articaine and prilocaine with slightly higher incidences of paresthesia.

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Continuing Education Test Questions

Answer Sheet on Back Cover

1. Which local anesthetic preparation below is the most widely used anesthetic in dentistry?
a. Lidocaine 2% and epinephrine 1:100,000
b. Mepivacaine 3%
c. Articaine 4% and epinephrine 1:100,000
d. Bupivacaine 0.5% and epinephrine 1:200,000

2. Warnings on paresthesia and/or neurotoxicity appear in the package inserts for:
a. Lidocaine
b.Prilocaine
c. Articaine
d. All the above

3. Best describes the term dysesthesia
a. A painful neuropathy
b. Long-term numbness of oral tissues
c. Swelling of the jaw
d. Infection of the oral tissues

4. Best describes the term paresthesia
a. Naso-labial pruritis
b. Permanent swelling of oral tissues
c. Lack of anesthetic effect
d. Tingling or "pins and needles" sensation

5. According to the report by Nickel, the incidence of paresthesia in dental surgical patients was
a. <1%
b. 1–5%
c. 5–10%
d. >10%

6. Paresthesia has never been associated with the use of mepivacaine
a. Statement is true
b. Statement is false

7.According to the report by Nickel, the duration of the majority of paresthesias occurring in dental surgical patients was:
a. 0–1 month
b. 2–3 months
c. 4–6 months
d. > 6 months

8. In those cases in which the inferior alveolar nerve block technique caused permanent alteration in nerve sensation, the nerve affected in the majority of cases was the
a. Lingual nerve
b. Inferior alveolar nerve
c. Both the lingual and inferior alveolar nerves equally affected.

9.Articaine HCl with epinephrine 1:100,000 is the first US approved dental anesthetic in over ____ years.
a. 10
b. 100
c. 25
d. 40

10. Articaine is the only amide-type local anesthetic that is hydrolyzed in plasma by "plasma esterases".
a. Statement is true
b. Statement is false

11. The ability of articaine to diffuse into posterior primary mandibular teeth in pediatric patients has been attributed to its:
a. High water solubility
b. High lipid solubility
c. High protein binding
d. Rapid hydrolysis in tissues

12. One mL of a 4% solution of articaine contains how much more anesthetic than one ml of a 2% solution of lidocaine?
a. 4 times as much
b. Twice as much
c. 100 times as much
d. Both concentrations are equal

13. Best expresses the wording by the ADA Guide to Dental Therapeutics 2nd edition on paresthesia
a. Permanent paresthesia is a rare event
b. Permanent paresthesia is a common event
c. Paresthesia occurs in most dental patients receiving local anesthesia
d. Long-lasting or permanent paresthesia (rare) is an adverse effect of dental local anesthetics

14. The package insert for lidocaine 2% with 1:100,000 epinephrine states that "this product has caused neurological effects".
a. Statement is true
b. Statement is false

15. Which statement below best expresses the comments from the majority of dentists about articaine from the CRA review?
a. Articaine is my favorite local anesthetic
b. Articaine is as long acting as bupivacaine (Marcaine)
c. Articaine was more successful in the "difficult-to-anesthetize" patients
d. Articaine is available without vasoconstrictor

16. The Northern California study by Pogrel and Thamby, as reported in the Journal of the American Dental Association, estimated the incidence of permanent nerve involvement after a local anesthetic injection to be approximately:
a. One in every 10,000 injections
b. One in every million injections
c. One in every 160,000 injections
d. One in every 16,000 injections

17. The Northern California study by Pogrel and Thamby, as reported in the Journal of the American Dental Association, stated that most cases of an affected nerve after paresthesia resolve within an _____ week period
a. 8
b. 12
c. 52
d. 2

18. The Northern California study by Pogrel and Thamby, as reported in the Journal of the American Dental Association, reasoned that each practitioner has a chance of having how many patients in their career with permanent nerve involvement due to an inferior alveolar nerve block?
a. 1
b. 10
c. 100
d. 1000

19. The retrospective study by Haas and Lennon in Ontario observed a frequency of articaine-induced paresthesias in 1993 to be:
a. < one case per million injections
b. < two cases per million injections
c. < three cases per million injections
d. > 10 cases per million injections

20. The retrospective study by Haas and Lennon in Ontario projected a frequency of articaine-induced paresthesias in the years 1993 and 1994 combined to be:
a. < one case per million injections
b. < two cases per million injections
c. < three cases per million injections
d. > 10 cases per million injections

21. In the study by Malamed et al comparing adverse events after articiane and lidocaine, the incidence of paresthesia reported by patients after lidocaine was:
a. 0.45%
b. 1.25%
c. 2.50%
d. 10.0%

22. In the study by Malamed et al comparing adverse events after articiane and lidocaine, the incidence of paresthesia reported by patients after articaine was:
a. 0.45%
b. 1.25%
c. 2.50%
d. 10.0%

23. In the study by Miller and Haas, they reported an incidence of local anesthetic-induced neuropathies between 1994 and 1998 in Ontario to be:
a. One in 7 million injections
b. One in 10 million injections
c. One in 76,000 injections
d. One in 765,000 injections

24. In the study by Miller and Haas, when reduced to incidences per million injections they reported local anesthetic-induced neuropathies between 1994 and 1998 in Ontario to be:
a. 1.3 per million
b. 1.0 per million
c. 10 per million
d. 13 per million

Articaine, Local Anesthetics, and Paresthesia

Richard L. Wynn, Ph.D

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1.	A	B	C	D	13.	A	B	C	D
2.	A	B	C	D	14.	A	B		
3.	A	B	C	D	15.	A	B	C	D
4.	A	B	C	D	16.	A	B	C	D
5.	A	B	C	D	17.	A	B	C	D
6.	A	B			18.	A	B	C	D
7.	A	B	C	D	19.	A	B	C	D
8.	A	B	C		20.	A	B	C	D
9.	A	B	C	D	21.	A	B	C	D
10.	A	B			22.	A	B	C	D
11.	A	B	C	D	23.	A	B	C	D
12.	A	B	C	D	24.	A	B	C	D

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