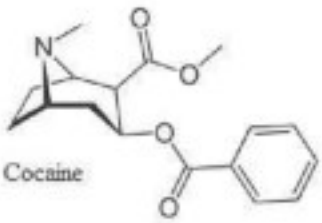
- Physical trauma
- Low temperature
- Anoxia
- Neurolytic agents
- Chemical agents

Cocaine

- Derived from *Erythroxylum coca*
- Used in Peru from 6th century
- Used by Incas for ritual trephenations and the Aztecs prior to human sacrifice
- 1855 - First isolated by Gadake
- 1859 - Albert Nieman purified and named substance cocaine
- 1880's Merck's largest product
- 1885 – Sold by Parke-Davis: "supply the place of food, make the coward brave, the silent eloquent and ... render the sufferer insensitive to pain."
- 1886 – Included in Coca-Cola's original formula
- 1903 – eliminated from Coca-Cola
- 1914 –Harrsion Narcotics Act (USA) outlawed use

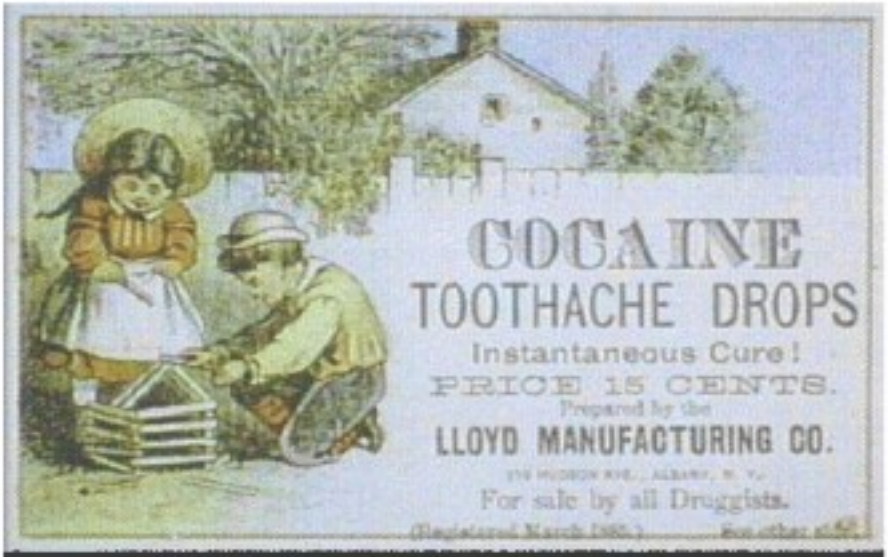


Cocaine

Cocaine

Cocaine and Coca-Cola

Cocaine and Toothaches



1885 Advertisement for Cocaine Toothache Drops

Fundamentals of impulse

Generation &transmission

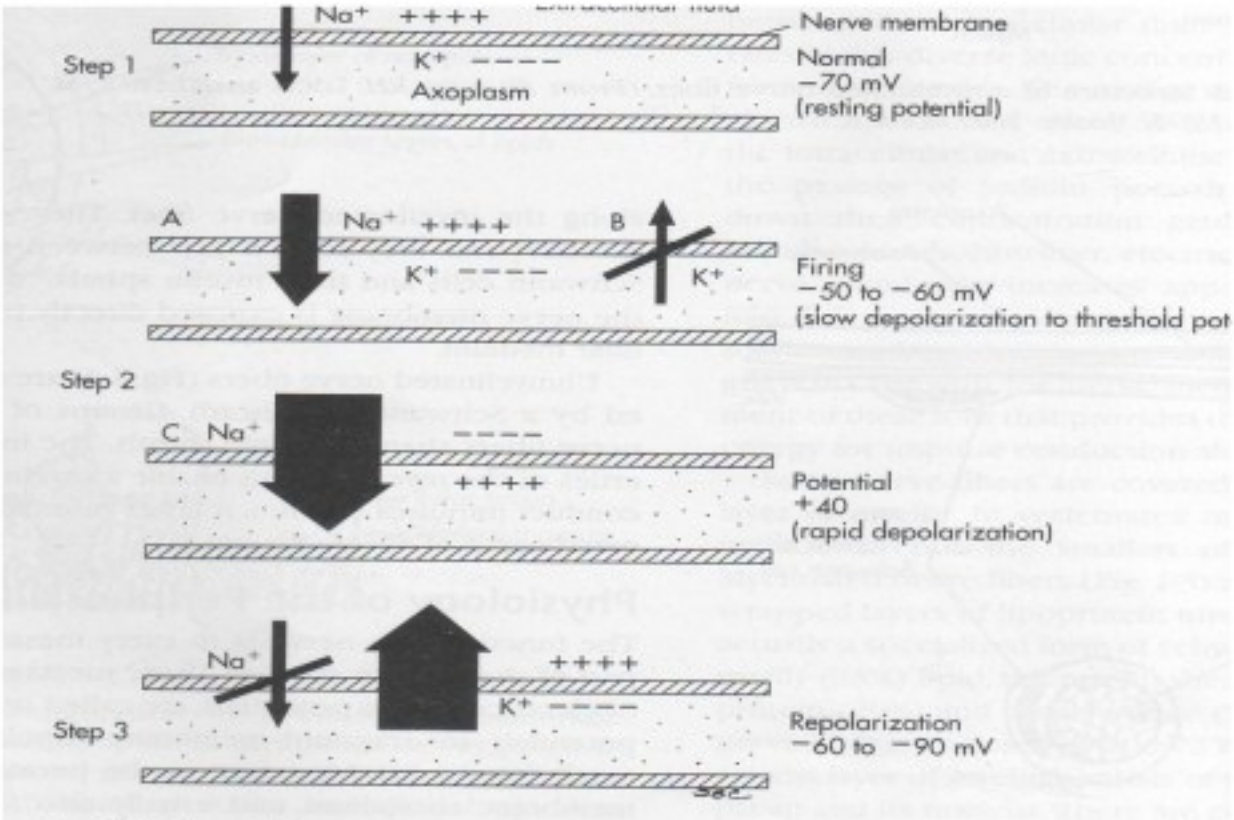


Fig. 1-5 *Step 1,* Resting potential. *Step 2, A* and *B,* Slow depolarization to threshol
2, C, Rapid depolarization. *Step 3,* Repolarization.

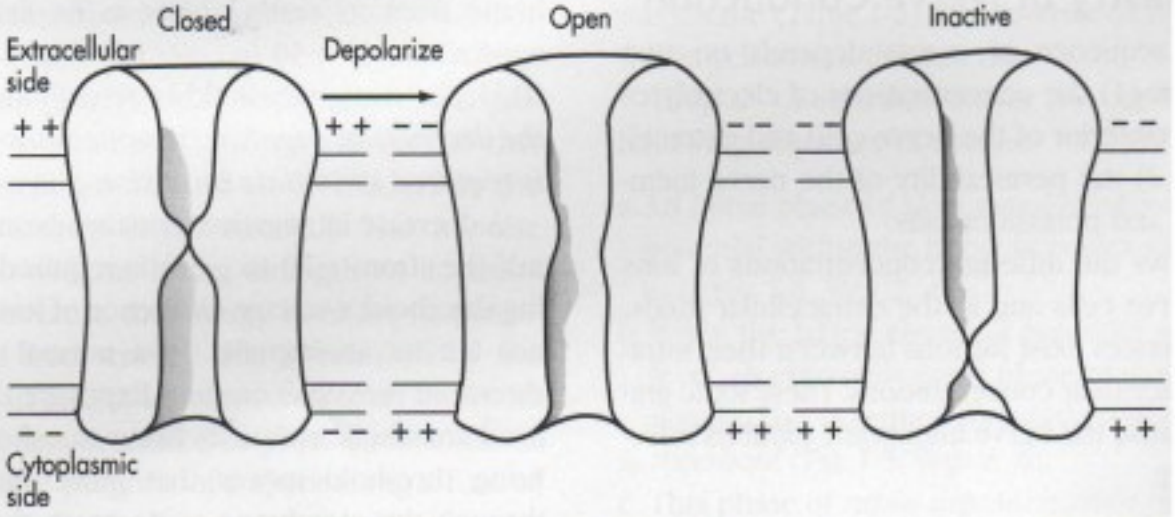


Fig. 1-6 Sodium channel transition stages. Depolarization reverses resting membrane potential from interior negative *(left)* to interior positive *(center)*. The channel proteins undergo corresponding conformational changes from resting state (closed) to ion-conducting state (open). State changes continue from open *(center)* to inactive *(right)*, where channel configuration assumes a different—but still impermeable—state. With repolarization the inactivated refractory channel reverts to the initial resting configuration *(left)*, ready for the next sequence. *(From Siegelbaum SA, Koester F:* Ion channels. *In Kandel ER, editor:* Principles of neural science, *ed 3, Norwalk, Conn, 1991, Appleton-Lange.)*

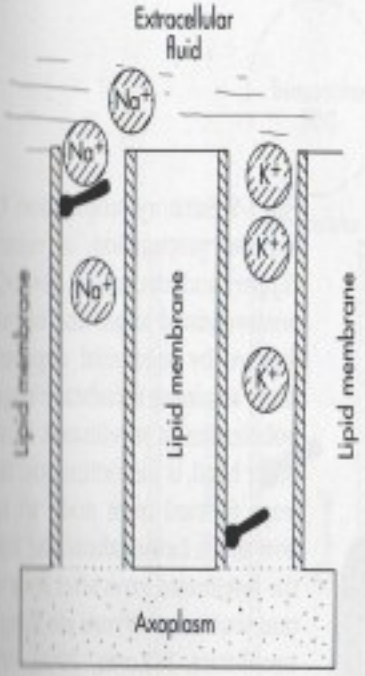


Fig. 1-7 Membrane channels are partially occluded; the nerve is at rest. Hydrated sodium ions *(Na+)* are too large to pass through channels, although potassium ions *(K+)* can pass through unimpeded.

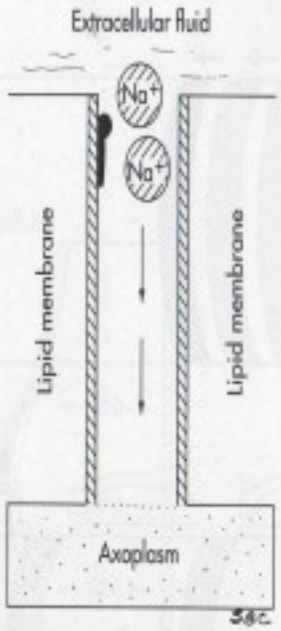


Fig. 1-8 Membrane channels are open; depolarization occurs. Hydrated sodium ions *(Na+)* now pass unimpeded through the sodium channel.

Where do local anesthetic work

Mechanism

- Sodium Channel
  - At least 9 types are known
    - Named Na_V from 1.1 to 1.9
  - Different neurons have different types
  - Some subtypes are exclusive to sensory neurons (low threshold types)
  - True differential blockade may be possible

Mechanism - Nerves

- At resting potential
  - Axonoplasm is negative (around -70mV)
  - Membrane is freely permeable to K+ and Cl-
  - Membrane is only slightly permeable to Na+

Mechanism - Nerves

- Nerve excitation causes
  - Increase in the permeability of the membrane to Na+
  - The rapid influx of Na+ to the interior of the nerve cell causes the axonoplasm to become more positive
  - The firing threshold is reached (-50 to -60mV)
  - An action potential is created

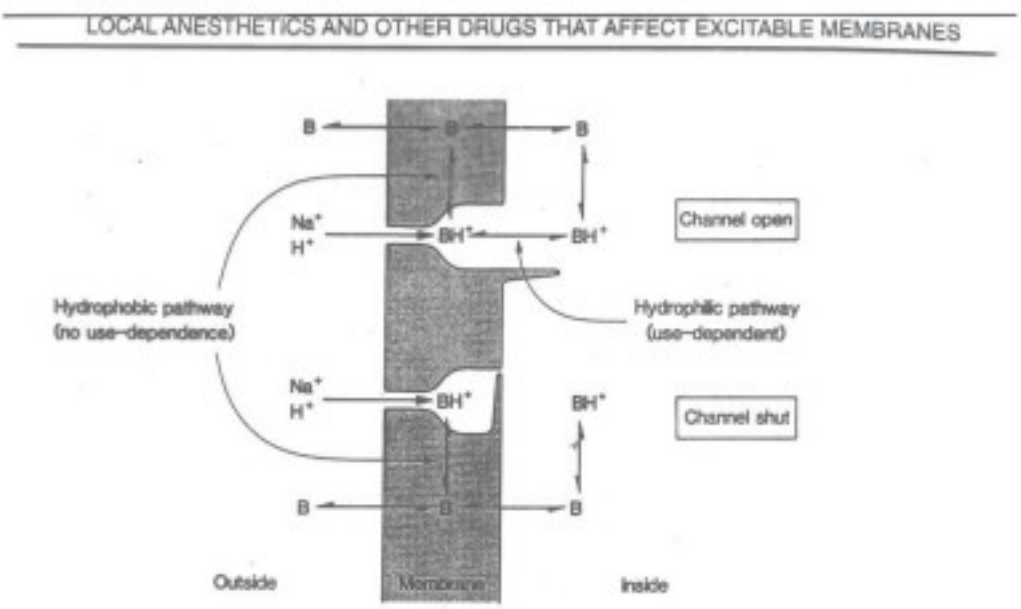
Mechanism - Nerves

- Repolarization
  - At the end of the action potential, the electric potential is positive (+40mV)
  - The nerve membrane becomes impermeable to Na+
  - There is an efflux of K+ and there is a return to normal resting potential

Mechanism

- Prevent transmission of nerve impulses
- Stabilization of closed inactivated Na^+ Channels
  - Specific local anesthetic receptor site?
  - Inside of cell (internal or H gate)
  - LA must first attach Na^+ Channel in active open state
  - Prevents conversion to rested closed and eventually open active states
- Prevents Na^+ permeability from increasing slowing the rate of depolarization and preventing the threshold potential from being reached
- No action potential is propagated
- No alteration of resting potential occurs

Mechanism



Mechanism

- Frequency Dependent Blockade
  - Degree of blockade is increased each time a channel opens
  - Channel access is only available during the open activated state
  - Increase blockade is found in faster firing neurons
- Degree of blockade is a property of nerve anatomy and firing rate
- Other drugs that affect neuronal firing rate may affect degree of LA blockade (anticonvulsants, barbiturates)

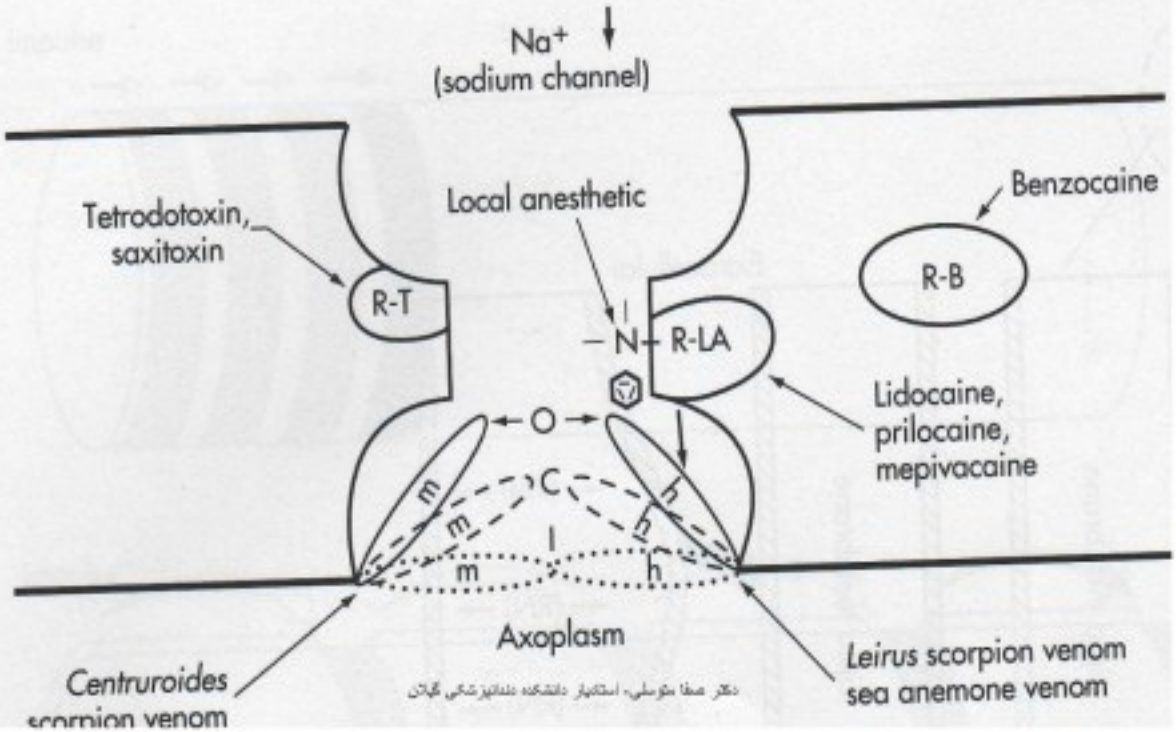
Differential Conduction Blockade

- B-fibers are affected at the lowest concentrations
- Small C-fibers
- C-fibers and small and medium A-fibers
- Result
  - Loss of pain and temperature
  - Touch, propioception and motor preserved
- High concentrations all can be blocked

Order of Blockade

1. pain
2. cold
3. warmth
4. touch
5. deep pressure
6. motor

- Recovery is in reverse



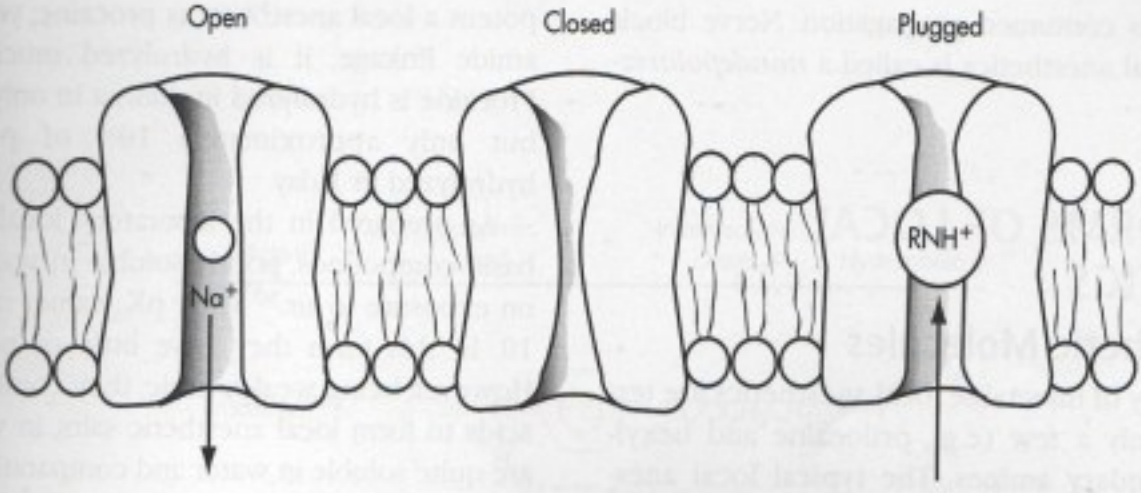


Fig. 1-12 Channel entry. On the left is an open channel, inward permeant to sodium ion. The center channel is in the resting closed configuration; though impermeant to sodium ion here, the channel remains voltage-responsive. The channel on the right, though in open configuration, is impermeant because it has local anesthetic cation bound to the gating receptor site. Note that local anesthetic enters the channel from the axoplasmic (lower) side; the channel filter precludes direct entry via the external mouth. Local anesthetic renders the membrane impermeant to sodium ion; hence inexcitable by local action currents. *(From de Jong RH:* Local anesthetics, *St Louis, 1994, Mosby-Year Book.)*

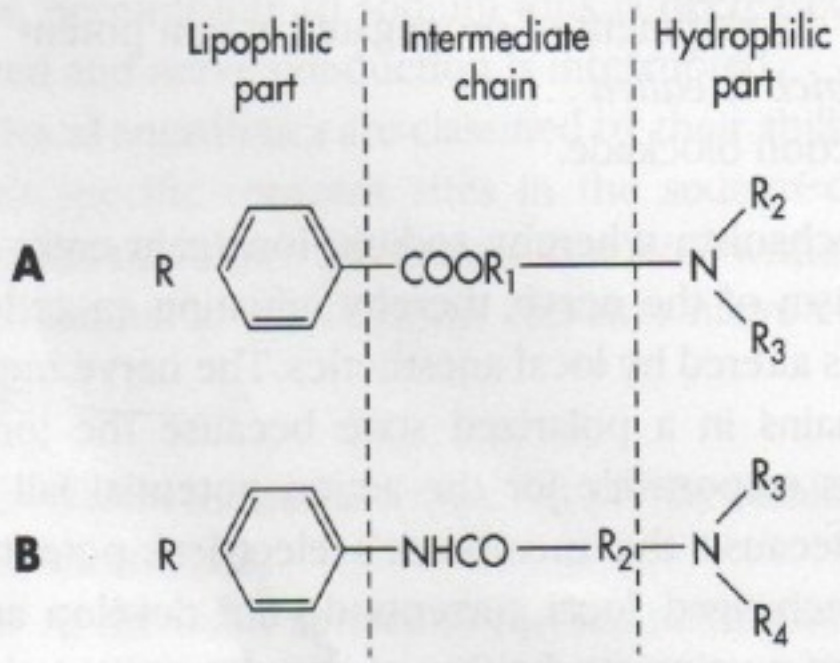
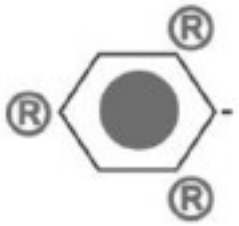


Fig. 1-13 Typical local anesthetic. **A,** Ester type. **B,** Amide type.

Structure

Aromatic Ring

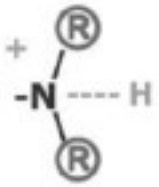


Intermediate Linkage

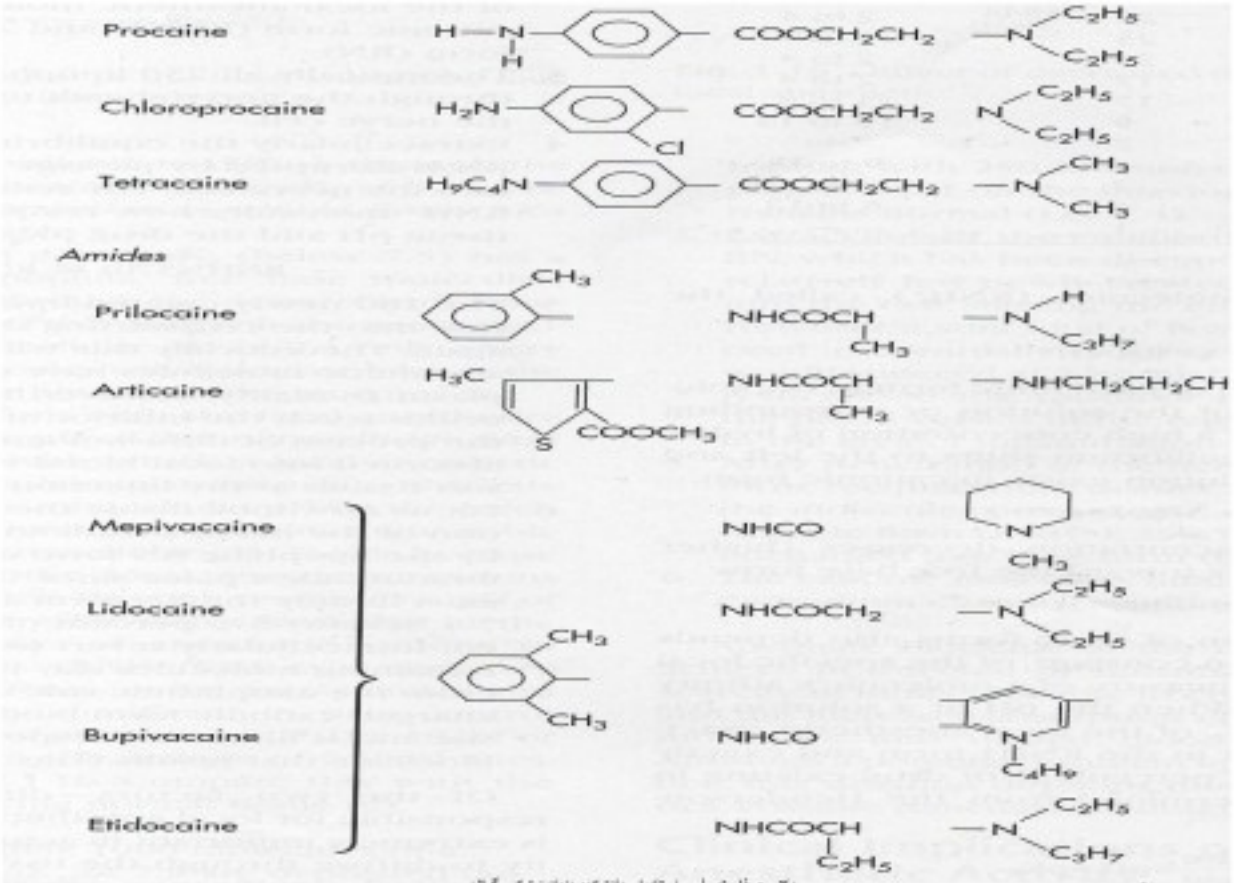
Ester
-C-O-C-

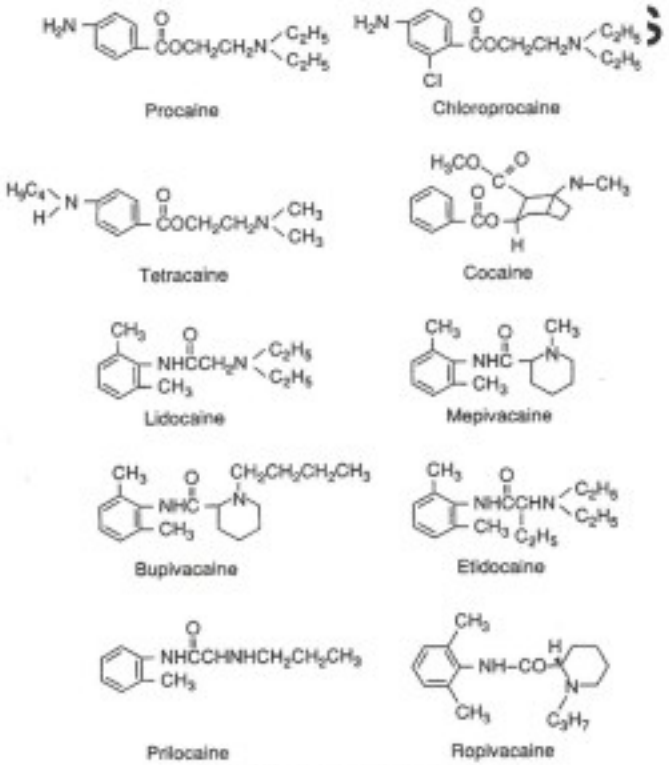
Amide
-NH-C-C-

Terminal Amine



- Aromatic Ring – fat soluble (hydrophobic)
- Terminal Amine – water soluble (hydrophillic)
- Ampophoteric character





Dissociation of local anesthetics

Structure

- Sold as solutions of base hydrochloride salts in water
- Only the free base form of the drug can cross a membrane
- The preparations of LA's are acidic and very little free base is found in preparations at pH <5
- "Crack" is the free base of cocaine hydrochloride

TABLE 1-4 Dissociation Constants (pK_a) of Local Anesthetics

Agent	pK_a	Percent base (RN) at pH 7.4	Approximate onset of action (min)
Benzocaine	3.5	100	—
Mepivacaine	7.7	33	2 to 4
Lidocaine	7.8	29	2 to 4
Articaine	7.8	29	2 to 4
Etidocaine	7.9	25	2 to 4
Prilocaine	7.9	25	2 to 4
Ropivacaine	8.1	17	2 to 4
Bupivacaine	8.1	17	5 to 8
Tetracaine	8.4	9	10 to 15
Cocaine	8.6	7	—
Propoxycaine	8.9	4	9 to 14
Procaine	9.1	2	14 to 18
Chloroprocaine	8.7	6	6 to 12
Procainamide	9.3	1	—

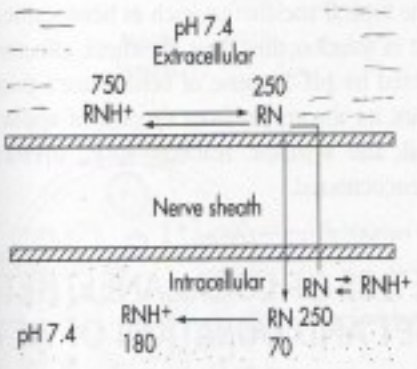


Fig. 1-15 Mechanism of action of the local anesthetic molecule. Anesthetic pK_a of 7.9; tissue pH of 7.4.

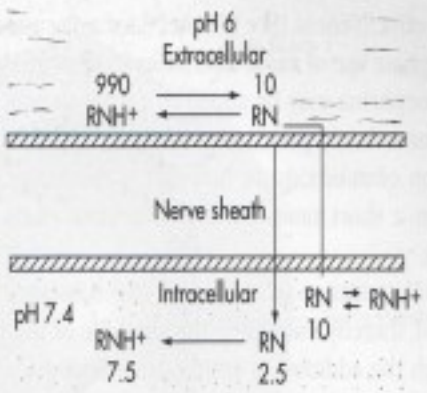
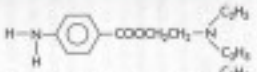
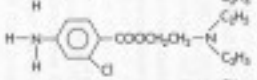
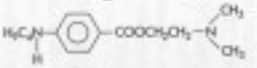
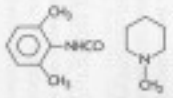
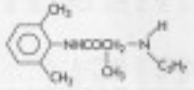
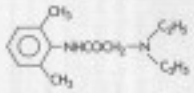
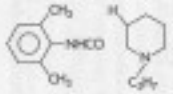
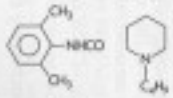
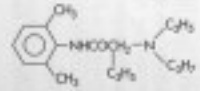


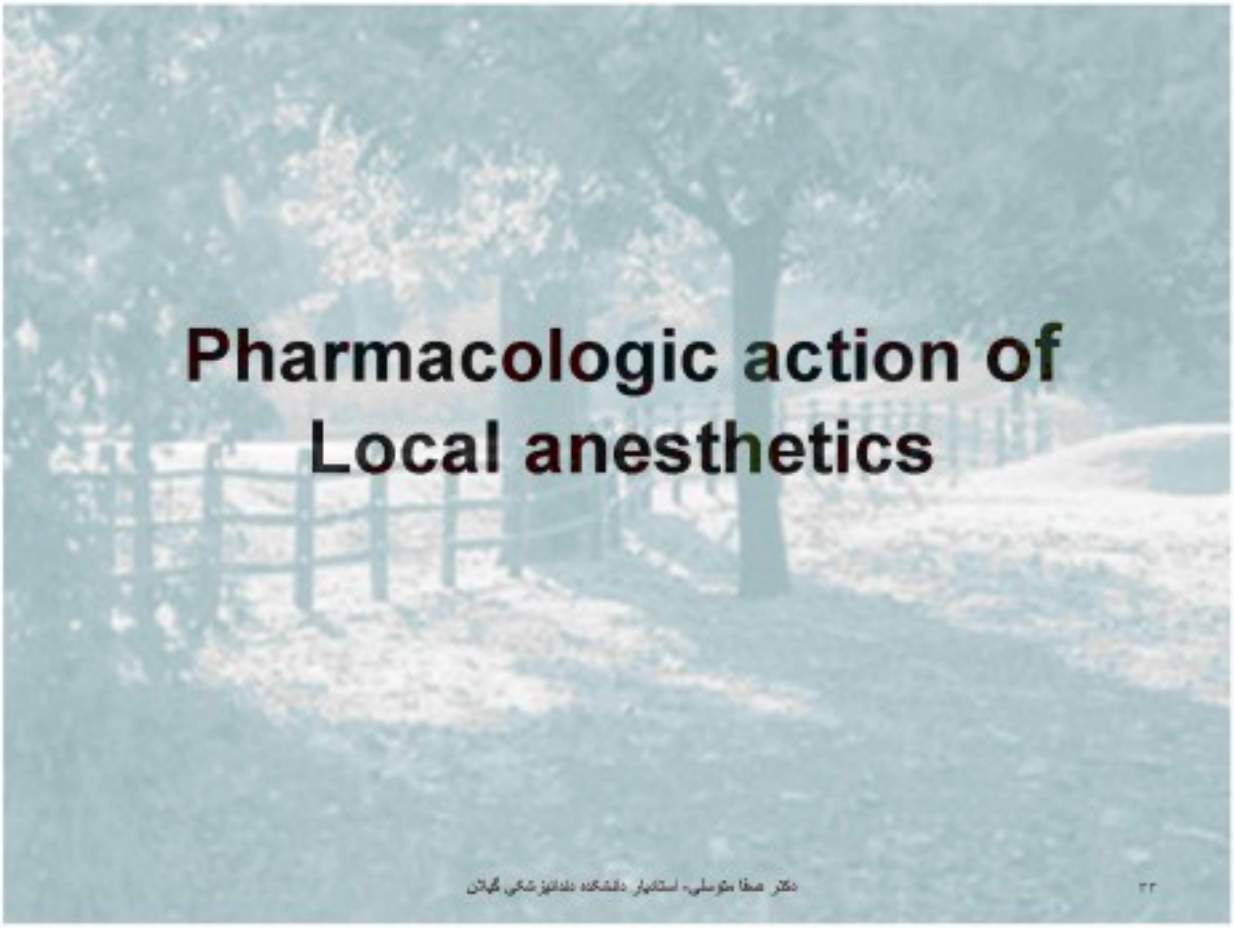
Fig. 1-16 Effect of decreased tissue pH on the actions of a local anesthetic.

Agent	Aromatic lipophilic	Intermediate chain	Amine hydrophilic	Molecular weight (base)	pK_a (36°C)	Onset	Approx. lipid solubility	Usual effective concentration %	Protein binding	Duration
Esters										
Procaine				236	8.9	Slow	1.0	2 to 4	5	Short
Chloroprocaine				271	9.1	Fast	NA	NA	NA	Short
Tetracaine				264	8.4	Slow	80	0.15	85	Long
Amides										
Mepivacaine				246	7.7	Fast	1.0	2 to 3	75	Moderate
Prilocaine				220	7.8	Fast	1.5	4	55	Moderate
Lidocaine				234	7.8	Fast	4.0	2	65	Moderate
Ropivacaine				274	8.1	Moderate	NA	NA	NA	Long
Bupivacaine				288	8.1	Moderate	30	0.5 to 0.75	95	Long
Etidocaine				276	7.9	Fast	140	0.5 to 1.5	94	Long

Modified from Rogers MC, et al, editors: *Principles and practice of anesthesiology*. St Louis, 1993, Mosby-Year Book.
NA, Not available.

NO ONE CAN MAKE YOU INFERIOR WITHOUT YOUR CONSENT

هیچ کس نمیتواند شما را تحقیر کند مگر اینکه خود بخواهید



absorption

- Oral
- Topical
- Parentral:
- s/c , i/m, i/v

metabolism

- Esters
- amids

excretion

Urine (mainly)

Systemic effect of local anesthetics

- CNS
- cardiovascular

Anticonvulsive blood level of lidocaine

• Anticonvulsive level	0/5 to 4
• Preseizure sign & symptoms	4/5 to 7
• Tonic-clonic seizure	>7/5

Clinical action of individual drugs

procaine

- Type : ester
- Potency : 1
- Toxicity :1
- PKa:9/1
- Vasodilating effect :severe
- Onset of action:6-10 min
- Half life :0/1hour
- Effective dental concentration:2%-4%

propoxicaine

- Type : ester
- Potency : 7-8
- Toxicity :7-8
- PKa:NA
- Vasodilating effect :moderat_ severe
- Onset of action:2-3 min
- Half life :NA
- Effective dental concentration:0/4%

lidocaine

- Type : amid
- Potency : 2
- Toxicity :2
- PKa:7/9
- Vasodilating effect :moderate_ severe(less than procain)
- Onset of action:2-3 min
- Half life :1/6
- Effective dental concentration:2%

mepivacaine

- Type : amid
- Potency : 2
- Toxicity :1/5-2
- PKa:7/9
- Vasodilating effect :mild
- Onset of action:1/5 -2
- Half life :1/9
- Effective dental concentration:2%-3%

prilocaine

- Type : amid
- Potency : 2
- Toxicity :1
- Vasodilating effect :mild -moderate
- Onset of action:2-4min
- Half life :1/9
- PKa;7/9
- Effective dental concentration:4%

Articaine

- Type : amid
- Potency : 2
- Toxicity :1-2
- Vasodilating effect :moderate-severe
- Onset of action:2-3min
- Half life :1/25
- PKa;7/8
- Effective dental concentration:4%
- Possibility of methemoglobinemia
- Contraindicated in sulfur-drug allergic

Bupivacaine

- Type : amid
- Potency : 4 times that of lidocaine
- Toxicity :Potency : 4 times that of lidocaine

- Vasodilating effect :.>lidocaine&prilocaine
- Onset of action:6-10min
- Half life :2/7hour
- PKa;8/1
- Effective dental concentration:0/5%

Etidocaine

- Type : amid
- Potency : 4 times that of lidocaine
- Toxicity :Potency :2- 4 times that of lidocaine

- Vasodilating effect :.>lidocaine&prilocaine
- Onset of action:1/5-3min
- Half life :2/6hour
- PKa;7/7
- Effective dental concentration:1/5%

Anesthetic for topical administration

- Benzocaine
- Butacaine sulfate
- Cocaine hydrochloride
- Dyclonine hydrochloride
- Lidocaine
- tetracaine

Amides and Esters

Esters	Potency	Onset	Duration (min)
Procaine	1	Slow	45-60
Chloroprocaine	4	Rapid	30-45
Tetracaine	16	Slow	60-180
Amides			
Lidocaine	1	Rapid	60-120
Etidocaine	4	Slow	240-480
Prilocaine	1	Slow	60-120
Mepivicaine	1	Slow	90-180
Bupivicaine	4	Slow	240-480
Levobupivicaine	4	Slow	240-480
Ropivicaine	4	Slow	240-480

Amides and Esters

Esters	Onset	pK	Non-Ionized Fraction pH 7.4 (%)	Lipid Solubility
Procaine	Slow	8.9	3	0.6
Chloroprocaine	Rapid	8.7	5	
Tetracaine	Slow	8.5	7	80
Amides				
Lidocaine	Rapid	7.9	25	2.9
Etidocaine	Slow	7.7	33	141
Prilocaine	Slow	7.9	24	0.9
Mepivicaine	Slow	7.6	39	1
Bupivicaine	Slow	8.1	17	28
Levobupivicaine	Slow	8.1	17	28
Ropivicaine	Slow	8.1	17	

FACTORS IN SELECTION OF LOCAL ANESTHETIC

1. Length of time that pain control is required
2. Potential for discomfort in the posttreatment period
3. Possibility of self-mutilation in the postoperative period
4. Requirement for hemostasis during treatment
5. Medical status of the patient

ندگی زیباست ای زیبا پسند

ده اندیشان به زیبائی رسند

Pharmacology of vasoconstrictors

TABLE 3-1 Effect of Vasoconstrictor (Epinephrine 1:200,000) on Peak Local Anesthetic Level in Blood

Local anesthetic	Dose (mg)	Peak level (μg/ml) Without vasoconstrictor	With vasoconstrictor
Mepivacaine	500	4.7	3
Lidocaine	400	4.3	3
Prilocaine	400	2.8	2.6
Etidocaine	300	1.4	1.3

Activity of Vasoconstrictors

Drug	α_1	α_2	β_1	β_2
Epinephrine	+++	+++	+++	+++
Norepinephrine	++	++	++	+
Levonordefrin	+	++	++	+

From Jastak JT, Yagiela JA, Donaldson D: *Local anesthesia of the oral cavity*, Philadelphia, 1995, WB Saunders.

Relative potency of drugs is indicated as follows: +++ = high, ++ = intermediate, and + = low.

TABLE 3-3 Systemic Effects of Sympathomimetic Amines

Effector organ or function	Epinephrine	Norepinephrine
Cardiovascular system		
Heart rate	+	—
Stroke volume	++	++
Cardiac output	+++	0, —
Arrhythmias	++++	++++
Coronary blood flow	++	++
Blood pressure		
Systolic arterial	+++	+++
Mean arterial	+	++
Diastolic arterial	+, 0, —	++
Peripheral circulation		
Total peripheral resistance	—	++
Cerebral blood flow	+	0, —
Cutaneous blood flow	—	—
Splanchnic blood flow	+++	0, +
Respiratory system		
Bronchodilation	+++	0
Genitourinary system		
Renal blood flow	—	—
Skeletal muscle		
Muscle blood flow	+++	0, —
Metabolic effects		
Oxygen consumption	++	0, +
Blood glucose	+++	0, +
Blood lactic acid	+++	0, +

AMERICAN SOCIETY OF ANESTHESIOLOGISTS PHYSICAL STATUS CLASSIFICATION

I	Normal healthy individual
II	Patient with mild to moderate systemic disease
III	Patient with severe systemic disease that limits activity but is not incapacitating
IV	Patient with severe systemic disease that limits activity and is a constant threat to life
V	Moribund patient not expected to survive 24 hours with or without an operation
VI	Clinically dead patient being maintained for harvesting of organs

vasoconstrictors

- Catecholamine (epinephrine,norepinephrine,levonordefrine,isoprotrenol,dopamin)
- Noncatecholamine(amphetamin,ephedrine,metoxamine,phenilephrin)

Direct acting drugs

- Epinephrine/Norepinephrine
- Levonordefrin
- Isoproterenol
- Dopamin
- Methoxamine
- phenylephrine

Indirect acting drugs

- Tyramine
- Amphetamine
- Methamphetamine
- hydroxyamphetamine

Mixed acting

- Metaraminol
- ephedrine

Clinical application of epinephrine

- Management of acute allergic reaction
- Management of bronchospasm
- Treatment of cardiac arrest
- To produce mydriasis
- As a vasoconstrictor,for hemostasis,to decrease absorption into the cardiovascular system&to increase the duration of action

epinephrine

- Mode of action(beta=alpha)
- Systemic actions (myocardium,blood pressure,vasculature,respiratorysystem, CNS,metabolism)
- Termination of action &elimination

Side effect & overdose

- Fear & anxiety
- Tension & restlessness
- Throbbing headache,dizziness,tremor
- Weakness,pallor,respiratory difficulty
- palpitation

norepinephrine

- Mode of action (mainly on alpha receptors 90%)
- Potency;1/4 of epinephrine,cocentration 1:30,000
- Systemic actions(myocardium,heart rate, blood pressure
- Vasculature
- Respiratory system
- CNS
- metabolism

Clinical application

- As a vasoconstrictor
- Management of hypotension

levonordefrine

- Mode of action(mainly alpha receptor 75%,25%betha)
- Potency;15% of epinephrine
- Systemic effect ;same as epinephrine but to a lesser extent
- Clinical concentration:1:20,000

phenylephrine

- Mode of action;95%alpha
- Potency ;5% of epinephrine but longer duration,1:2500
- Little inottrpic & chronotropic effect on heart
- Increased systolic & diastolic pressure
- Decrease heart rate by barroreceptor reflex
- Tachyphylaxis with chronic use

Clinical application

- As a vasoconstrictor in L.A solution
- Management of hypotension
- As a nasal decongestant
- In ophtalmic solution for mydriasis

felypressine

- Source;synthetic analogue of vasopressin
- Mode of action;direct stimulant of vascular smooth muscle(venous>artery)
- Availability in dentistry(0.03iu/ml)
- MRD in patient significant cardiovascular impairment 0.27iu

Selection of a vasoconstrictor

- Length of dental procedure
- Requirement for hemostasis
- Medical statues of patient

TABLE 1-7 Factors Affecting Local Anesthetic Action

Factor	Action affected	Description
pK_a	Onset	Lower pK_a = More rapid onset of action, more RN mole through nerve sheath; thus onset time is decreased
Lipid solubility	Anesthetic potency	Increased lipid solubility = Increased potency (example: 140)
		Etidocaine produces conduction blockade at very low c procaine poorly suppresses nerve conduction, even a
Protein binding	Duration	Increased protein binding allows anesthetic cations (RN attached to proteins located at receptor sites; thus du increased
Nonnervous tissue diffusibility	Onset	Increased diffusibility = Decreased time of onset
Vasodilator activity	Anesthetic potency and duration	Greater vasodilator activity = Increased blood flow to r anesthetic molecules from injection site; thus decrea decreased duration

From Cohen S, Burns RC: Pathways of the pulp, ed 6, St Louis, 1994, Mosby-Year Book.

NO PAIN ,NO GAIN

بابرده رنج گنج میسر نمیشود

The syringe

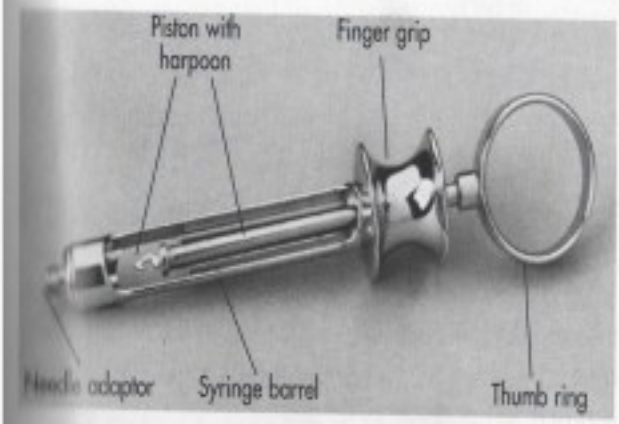


Fig. 5-1 Breech-loading, metallic, cartridge-type syringe.

Fig. 5-3 Articaine syringe, which is loaded from the top rather than from the side.

Type of syringe

- Nondisposable
  a.breech-loading,metallic,aspirating
  b.breech-loading,plastic,aspirating
  c.breech- loading,metallic,self aspirating
  d.pressure
  e.jet injector
- Disposable
- Safety syringe

Jet injector

Fig. 5-11 Jet injector.

The needle parts

- Bevel
- Shank
- Hub
- Syringe penetrating end

Inserted in Hydrocolloid Tubes to Their Hubs

Needle type	Length (mm, tip to hub)	Maximum tip deflection (mm, ± SD)
25-Gauge long (conventional)	35	7.1 ± 0.81*
27-Gauge long (conventional)	36	8.4 ± 1.2*
27-Gauge short (conventional)	26	4.6 ± 0.97†
28-Gauge long (nondeflecting)	31	1.1 ± 0.82
28-Gauge short (nondeflecting)	22	0.8 ± 0.91

Data modified from Jeske AH, Boshart BF: Deflection of conventional versus non-deflecting dental needles in vitro, *Anesth Prog* 32:62-64, 1985.

*A statistically significant difference from the nondeflecting long needle ($p < 0.01$); n = 10 needles in each group.

†A statistically significant difference from the nondeflecting short

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Key points to be considered

- Gauge of needle
- Length of needle
- Conventional / nondeflecting needle

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دندانپزشکی گیلان

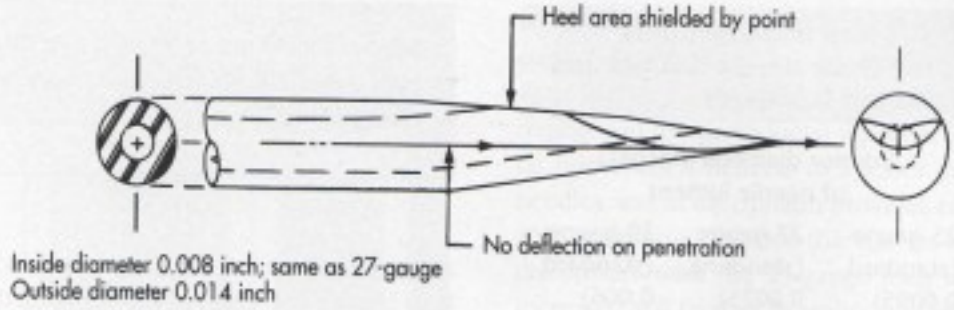
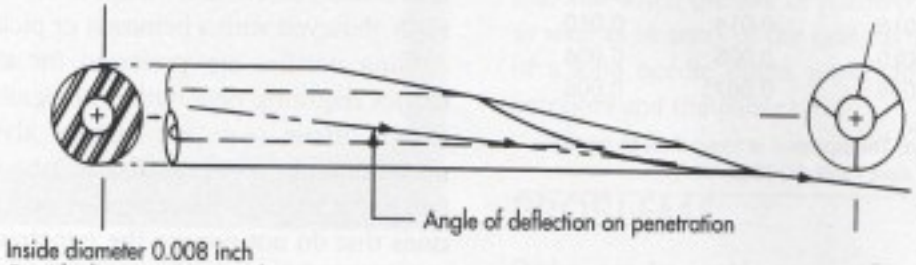


Fig. 6-3 The tip of a nondeflecting needle is located in the center of the shaft, thereby minimizing deflection as the needle penetrates soft tissues.



27-gauge needle with standard point

Fig. 6-4 Conventional dental needle. The needle tip lies at the lower edge of the needle shaft, thereby producing deflection as the needle passes through soft tissue.

The cartridge

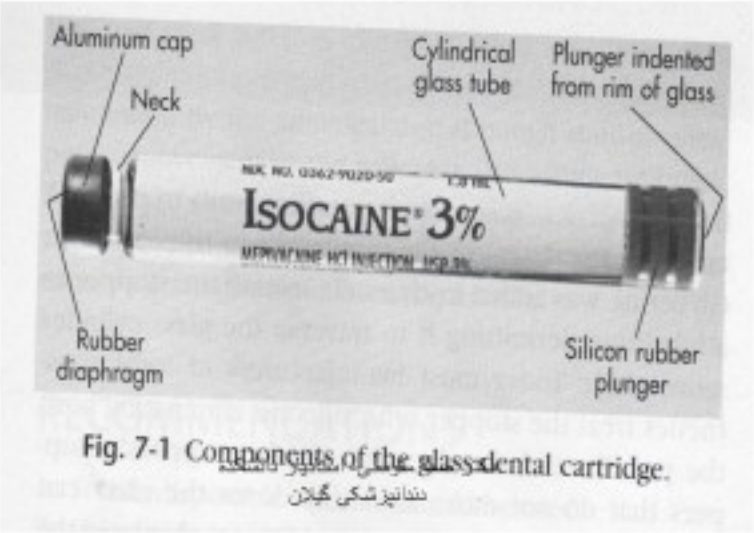


Fig. 7-1 Components of the glass dental cartridge.

Cartridge contents

- Local anesthetic drug
- Vasopressor drug
- Preservative (bisulfite sodium)
- Sodium chloride
- Distilled water

TABLE 7-1 Calculation of Milligrams per Cartridge

Percent solution		Milligrams per milliliter		Volume of cartridge		Milligrams per cartridge
0.25	=	2.5	×	1.8	=	4.5
0.40	=	4.0	×	1.8	=	7.2
0.50	=	5.0	×	1.8	=	9.0
1.0	=	10.0	×	1.8	=	18.0
1.5	=	15.0	×	1.8	=	27.0
2.0	=	20.0	×	1.8	=	36.0
3.0	=	30.0	×	1.8	=	54.0
4.0	=	40.0	×	1.8	=	72.0

problems

- Bubble in the cartridge
- Extruded stopper
- Burning on injection
- Sticky stopper
- Corroded cap
- Leakage during injection
- Broken cartridge
- Rust on the cap

Bubble in the cartridge

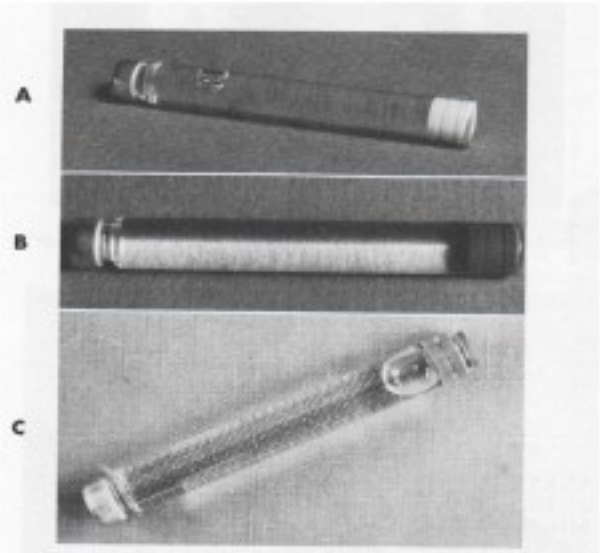


Fig. 7-10 Normal cartridge with a small bubble, **A**, or no bubble, **B**. Notice that the rubber stopper is indented from the glass rim. **C**, Local anesthetic cartridge with an extruded stopper and large bubble caused by freezing.

Skepticism is beginning of faith

شکاکیت سر آغاز ایمان است

BASIC INJECTION TECHNIQUE

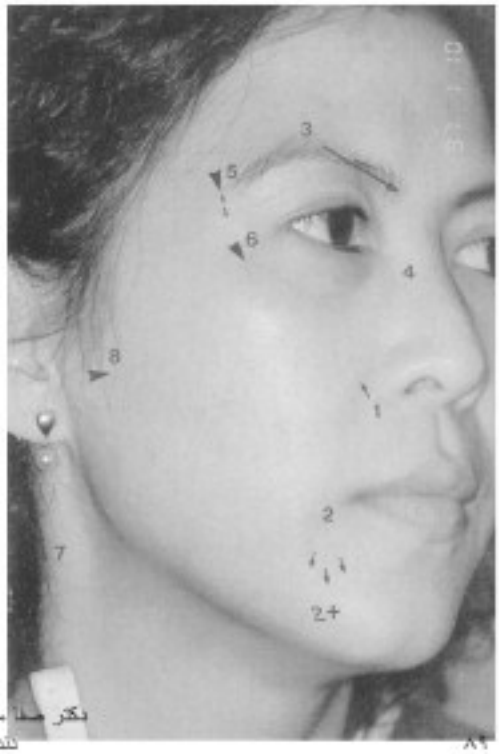
Local Anesthesia

1. Local infiltration
   - type of injection that anesthetizes a small area (one or two teeth and asscociated areas)
   - anesthesia deposited at nerve terminals

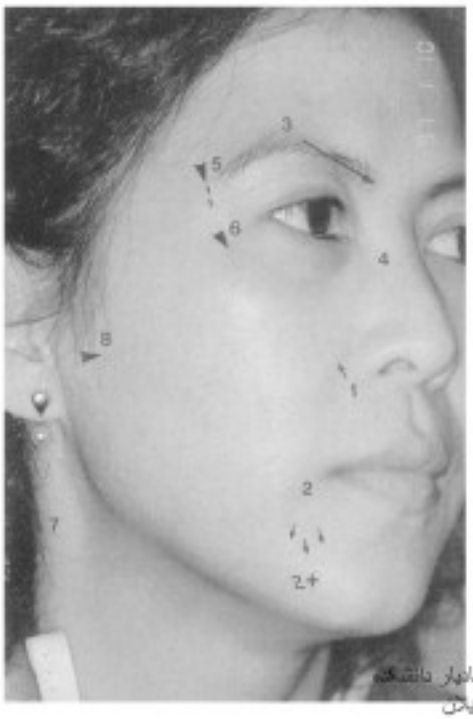
2. Nerve block
   - type of injection that anesthetizes a larger area
   - anesthesia deposited near larger nerve trunks

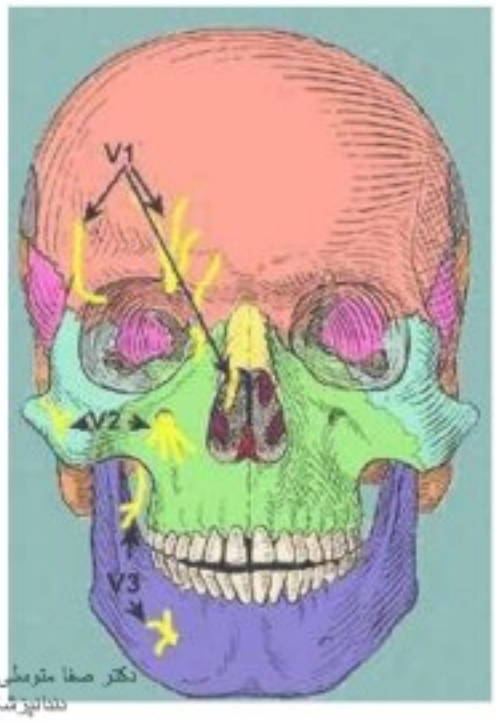
Local/ Regional Blocks

- 1 Infraorbital
- 2 Mental and Mental Plus
- 3 Supraorbital/ supratrochlear infratrochlear
- 4 Dorsal Nasal Nerve
- 5 Zygomaticotemporal
- 6 Zygomaticofacial
- 7 Great auricular
- 8 V3 block



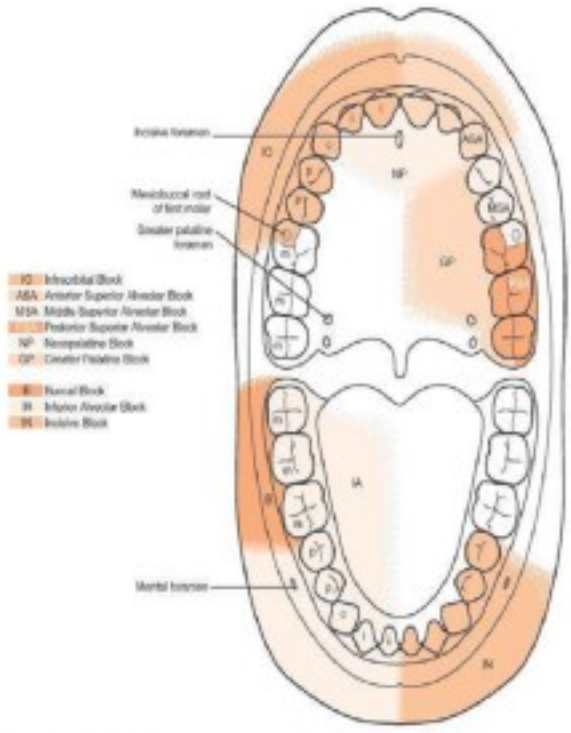
Anatomy





Types of Nerve Anesthesia

- **Maxillary**
  - A. posterior superior alveolar block
  - B. middle superior alveolar block
  - C. anterior superior alveolar block
  - D. greater palatine block
  - E. infraorbital block
  - F. nasopalatine block
- **Mandibular**
  - A. inferior alveolar block
  - B. buccal block
  - C. mental block
  - D. incisive block
  - E. Gow-Gates mandibular nerve block



Local anesthetic blocks of oral tissues. (Figure 9-1)

Considerations

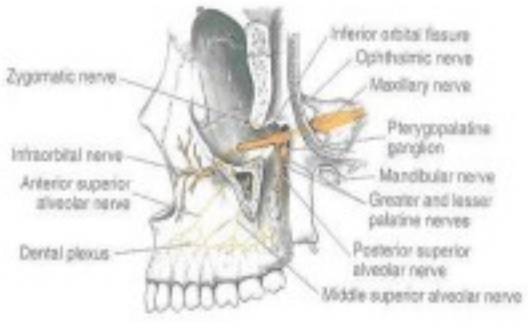
- dental procedures can usually commence after 3 – 5 minutes
- failure requires re-administration using another method
- never re-administer using the same method
- keep in mind the total # of injections and the dosages
- never inject into an area with an abcess, or other type of abnormality

Maxillary Nerve Anesthesia

- **Chart 9-1**
- **pulpal anesthesia:** through anesthesia of each nerve's dental branches as they extend into the pulp tissue (via the apical foramen)
- **periodontal:** through the interdental and interradicular branches
- **palatal:** soft and hard tissues of the palatal periodontium (e.g. gingiva, periodontal ligaments, alveolar bone)
- **PSA block:** recommended for maxillary molar teeth and associated buccal tissues in ONE quadrant
- **MSA block:** recommended for maxillary premolars and associated buccal tissues
- **ASA block:** recommended for maxillary canine and the incisors in ONE quadrant
- **greater palatine block:** recommended for palatal tissues distal to the maxillary canine in ONE quadrant
- **nasopalatine block:** recommended for palatal tissues between the right and left maxillary canines

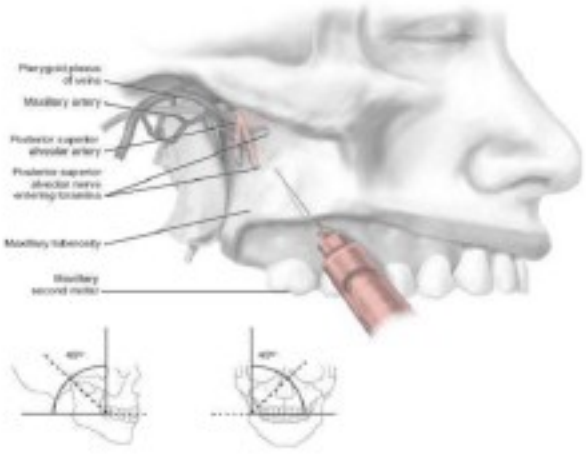
PSA Nerve Block

- **figures 9-2 through 9-7**
- pulpal anesthesia of the maxillary 3rd, 2nd and 1st molars
  - required for procedures involving two or more molars
  - sometimes anesthesia of the 1st molar also required block of the MSA nerve
- associated buccal periodonteum overlying these molars
  - including the associated buccal gingiva, periodontal ligament and alveolar bone
  - useful for periodontal work on this area



PSA Nerve Block

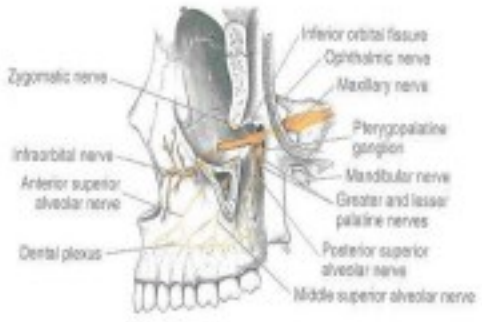
- target: PSA nerve
  - as it enters the maxillar through the PSA foramen on the maxilla's infratemporal service – **Figure 9-2 & 9-3**
  - into the tissues of the mucobuccal fold at the apex of the 2nd maxillary molar (**figures 9-4 and 9-5**)
  - mandible is extended toward the side of the injection, pull the tissues at the injection site until taut
  - needle is inserted distal and medial to the tooth and maxilla
  - depth varies from 10 to 16 mm depending on age of patient
- no overt symptoms (e.g. no lip or tongue involvement)
- can damage the pterygoid plexus and maxillary artery



Correct insertion for PSA block. (Figure 9-7)

MSA Nerve Block

- limited clinical usefulness
- can be used to extend the infraorbital block distal to the maxillary canine
- can be indicated for work on maxillary pre-molars and mesiobuccal root of 1st molar (**Figure 9-8**)
- if the MSA is absent – area is innervated by the ASA
- blocks the pulp tissue of the 1st and 2nd maxillary premolars and possibly the 1st molar + associated buccal tissues and alveolar bone
- useful for periodontal work in this area
- to block the palatine tissues in this area – may require a greater palatine block

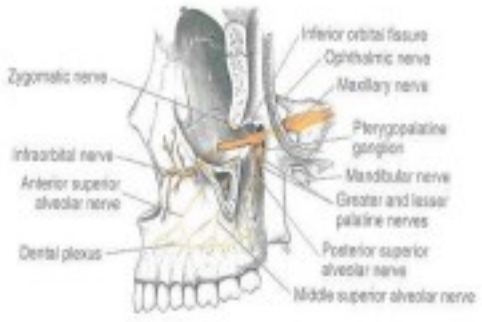


MSA Block

- target area: MSA nerve at the apex of the maxillary 2nd premolar (**figures 9-8 and 9-9**)
  - mandible extended towards injection site
  - stretch the upper lip to tighten the injection site
  - needle is inserted into the mucobuccal fold
  - tip is located well above the apex of the 2nd premolar
    - **figure 9-11**
- harmless tingling or numbness of the upper lip
- overinsertion is rare

ASA Block

- **figures 9-12 through 9-14**
- can be considered a local infiltration
- used in conjunction with an MSA block
- the ASA nerve can cross the midline of the maxilla onto the opposite side!
- used in procedures involving the maxillary canines and incisors and their associated facial tissues
  - pulpal and facial tissues involved – restorative and periodontal work
- blocks the pulp tissue + the gingiva, periodontal ligaments and alveolar bone in that area

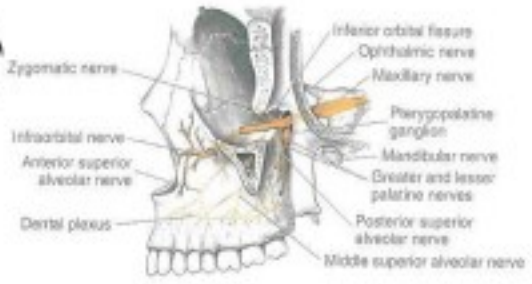


ASA Block

- target: ASA nerve at the apex of the maxillary canine – **figures 9-12 & 9-13**
- at the mucobuccal fold at the apex of the maxillary canine – **figure 9-13**
- harmless tingling or numbness of the upper lip
- overinsertion is rare

Infraorbital Nerve Block

- **figures 9-15 through 9-17**
- anesthetizes both the MSA and ASA
- used for anesthesia of the maxillary premolars, canine and incisors
- indicated when more than one premolar or anterior teeth
  - pulpal tissues – for restorative work
  - facial tissues – for periodontal work
- also numbs the gingiva, periodontal ligaments and alveolar bone in that area
- the maxillary central incisor may also be innervated by the nasopalatine nerve branches



IO Block

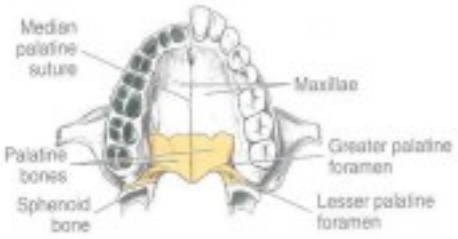
- target: union of the ASA and MSA with the IO nerve after the IO enters the IO foramen – **figure 9-15**
- also anesthesizes the lower eyelid, side of nose and upper lip
- IO foramen is gently palpated along the IO rim
  - move slightly down about 10mm until you feel the depression of the IO foramen – **figure 9-16**
  - locate the tissues at the mucobuccal fold at the apex of the 1st premolar
    - place one finger at the IO foramen and the other on the injection site – figure 9-17
    - locate the IO foramen, retract the upper lip and pull the tissues taut
    - the needle is inserted parallel to the long axis of the tooth to avoid hitting the bone
- harmless tingling or numbness of the upper lip, side of nose and eyelid

Greater Palatine Block

- **figures 9-19 through 9-21**
- used in restorative procedures that involve more than two maxillary posterior teeth or palatal tissues distal to the canine
- also used in periodontal work – since it blocks the associated lingual tissues
- anesthetizes the posterior portion of the hard palate – from the 1st premolar to the molars and medially to the palate midline
- does NOT provide pulpal anesthesia – may also need to use ASA, PSA, MSA or IO blocks
- may also need to be combined with nasopalatine block

Greater Palatine Block

- target: GP nerve as it enters the GP foramen
  - located at the junction of the maxillary alveolar process and the hard palate – at the maxillary 2nd or 3rd molar – **figure 9-19**
- palpate the GP foramen – midway between the median palatine raphe and lingual gingival margin of the molar tooth – **figure 9-21**
- can reduce discomfort by applying pressure to the site before and during the injection
  - produces a dull ache to block pain impulses
  - also slow deposition of anesthesia will also help
- needle is inserted at a 90 degree angle to the palate – **figure 9-22**



Nasopalatine Block

- **figure 9-23 through 9-26**
- **useful** for anesthesia of the bilateral portion of the hard palate
  - from the mesial of the right maxillary 1st premolar to the mesial of the left 1st premolar
- for palatal soft tissue anesthesia
  - periodontal treatment
- required for two or more anterior maxillary teeth
- for restorative procedures or extraction of the anterior maxillary teeth – may need an ASA or MSA block also
- blocks both right and left nerves

Nasopalatine Block

- target: both right and left nerves as they enter the incisive foramen from the mucosa of the anterior hard palate – **figure 9-23 & 9-25**
  - posterior to the incisive papilla
- injection site is lateral to the incisive papilla – **figure 9-26**
- head turned to the left or right
- inserted at a 45 degree angle about 6-10 mm – gently contact the maxillary bone and withdraw about 1mm before administering
- can reduce discomfort by applying pressure to the site before and during the injection
  - produces a dull ache to block pain impulses
  - also slow deposition of anesthesia will also help
- can anesthetize the labial tissues between the central incisors prior to palatal block
  - can block some branches of the nasopalatine prior to injection

Techniques of Mandibular Anesthesia

Mandibular Anesthesia

Lower success rate than Maxillary anesthesia - approx. 80-85 %

Related to bone density

Less access to nerve trunks

Mandibular Nerve Blocks

Inferior alveolar

Mental - Incisive

Buccal

Lingual

Gow-Gates

Akinosi

Mandibular Anesthesia

Most commonly performed technique

Has highest failure rate (15-20%)

Success depends on depositing solution within 1 mm of nerve trunk

Inferior Alveolar Nerve Block

Not a complete mandibular nerve block.

Requires supplemental buccal nerve block

May require infiltration of incisors or mesial root of first molar

Inferior Alveolar Nerve Block

Nerves anesthetized

- Inferior Alveolar
- Mental
- Incisive
- Lingual

Inferior Alveolar Nerve Block

Areas Anesthetized

- Mandibular teeth to midline
- Body of mandible, inferior ramus
- Buccal mucosa anterior to mental foramen
- Anterior 2/3 tongue & floor of mouth
- Lingual soft tissue and periosteum

Inferior Alveolar Nerve Block

Indications

Multiple mandibular teeth

Buccal anterior soft tissue

Lingual anesthesia

Inferior Alveolar Nerve Block

Contraindications

Infection/inflammation at injection site

Patients at risk for self injury (eg. children)

Inferior Alveolar Nerve Block

10%-15% positive aspiration

Inferior Alveolar Nerve Block

Alternatives

Mental nerve block

Incisive nerve block

Anterior infiltration

Inferior Alveolar Nerve Block

Alternatives (cont.)

Periodontal ligament injection (PDL)

Gow-Gates

Akinosi

Intraseptal

Inferior Alveolar Nerve Block

Technique

Apply topical

Area of insertion:

medial ramus, mid-coronoid notch,

level with occlusal plane (1 cm above),

3/4 posterior from coronoid notch to pterygomandibular raphe

advance to bone (20-25 mm)

Inferior Alveolar Nerve Block

Target Area

Inferior alveolar nerve, near mandibular foramen

Landmarks

Coronoid notch

Pterygomandibular raphe

Occlusal plane of mandibular posteriors

Inferior Alveolar Nerve Block

Precautions

Do not inject if bone not contacted

Avoid forceful bone contact

Inferior Alveolar Nerve Block

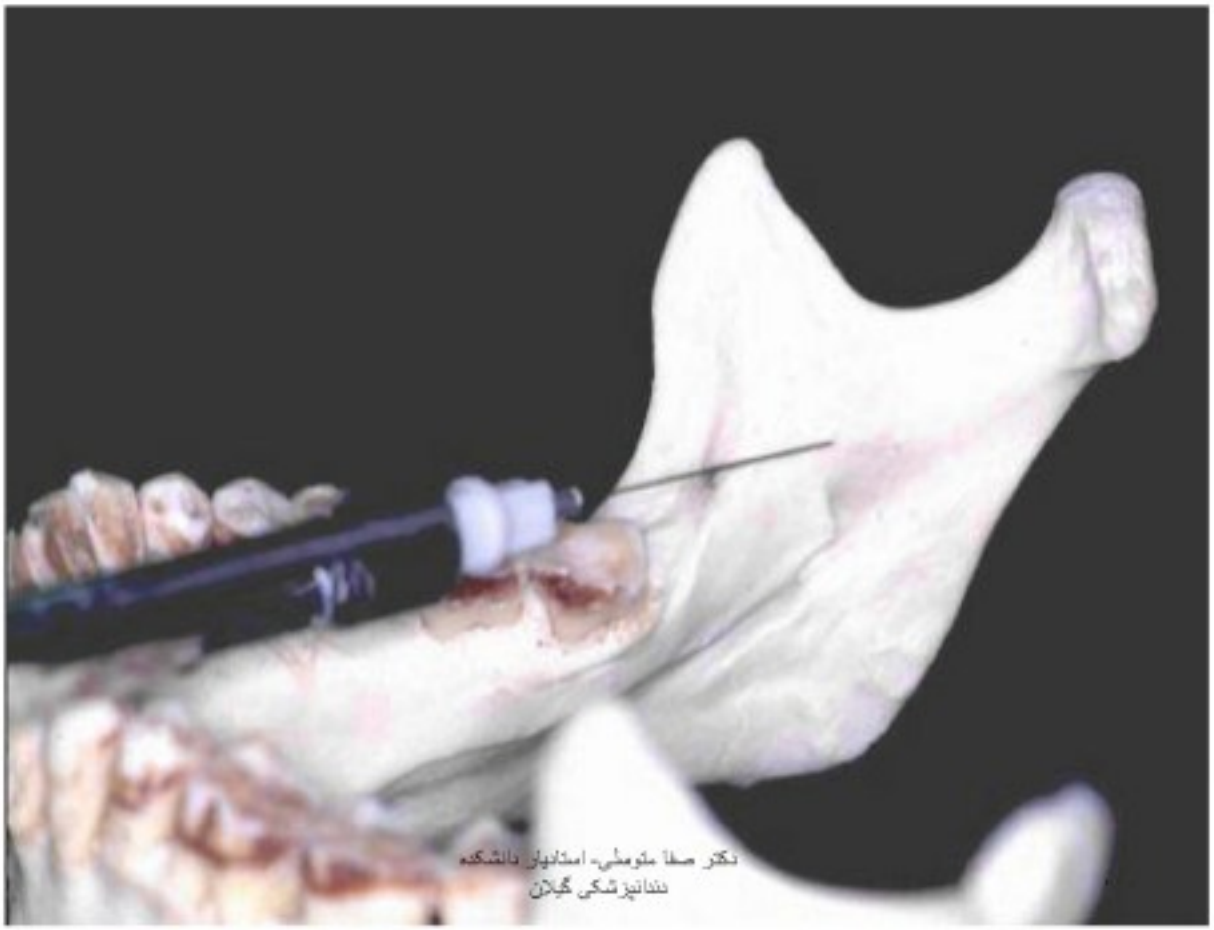
Failure of Anesthesia

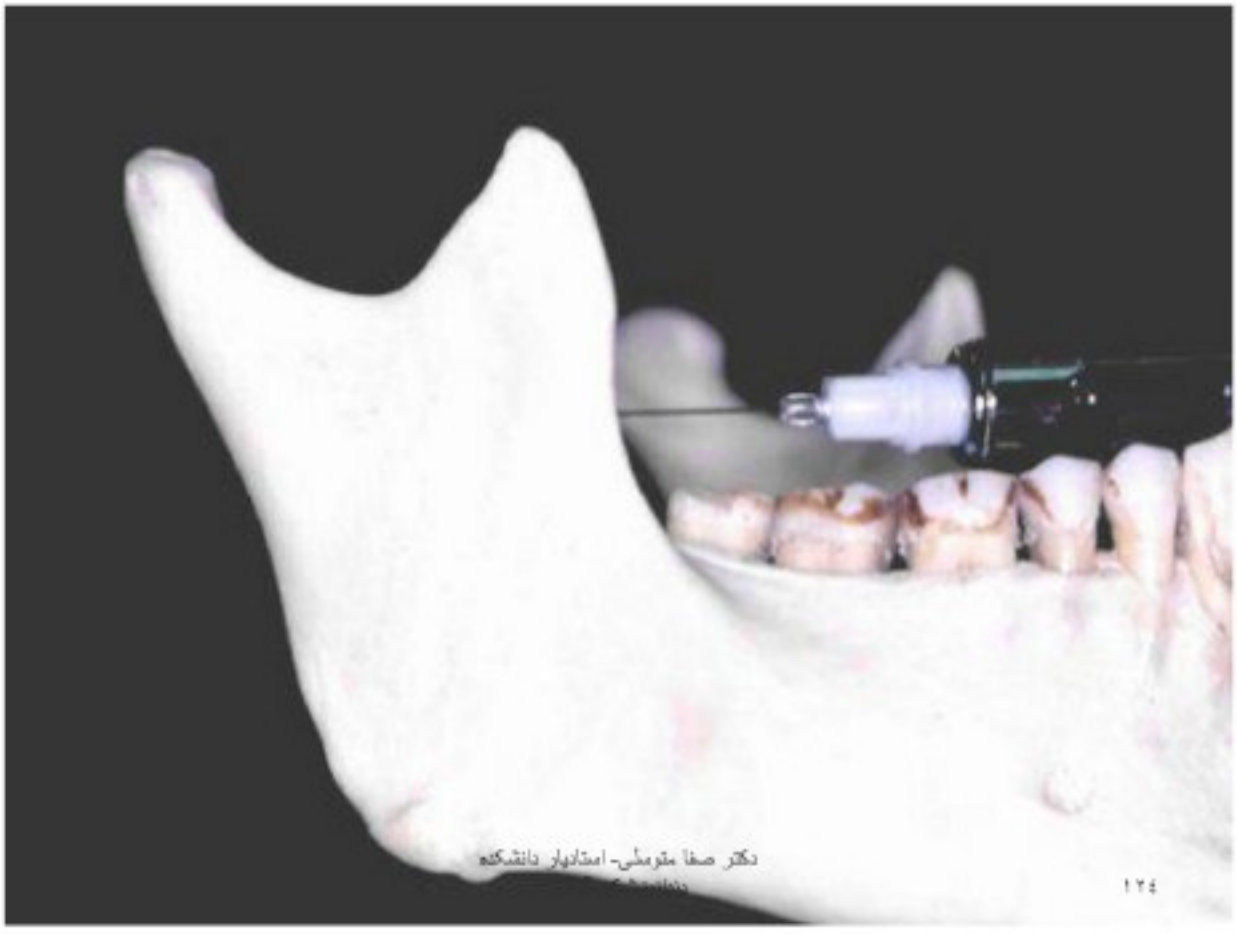
- Injection too low
- Injection too anterior
- Accessory innervation
  - -Mylohyoid nerve
  - -contralateral Incisive nerve innervation

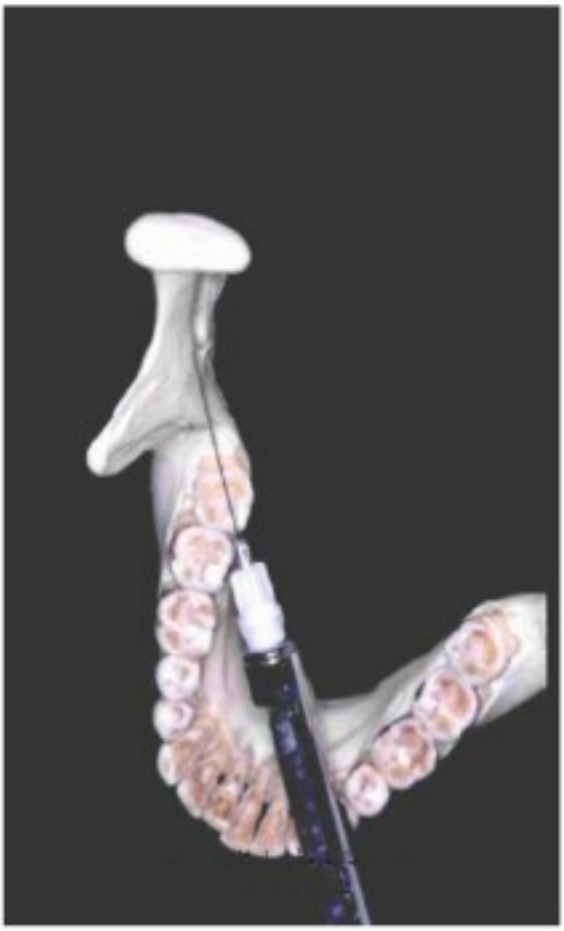
Inferior Alveolar Nerve Block

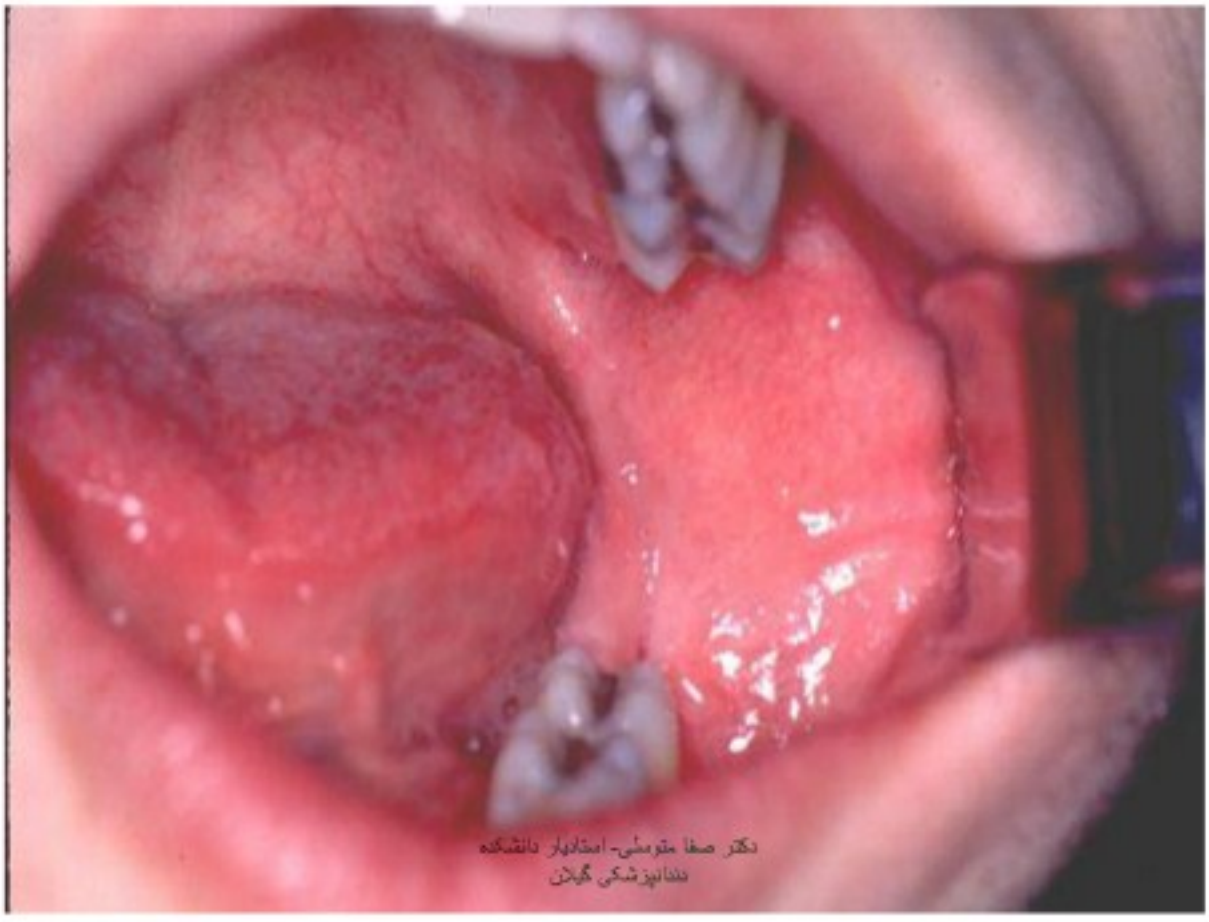
Complications

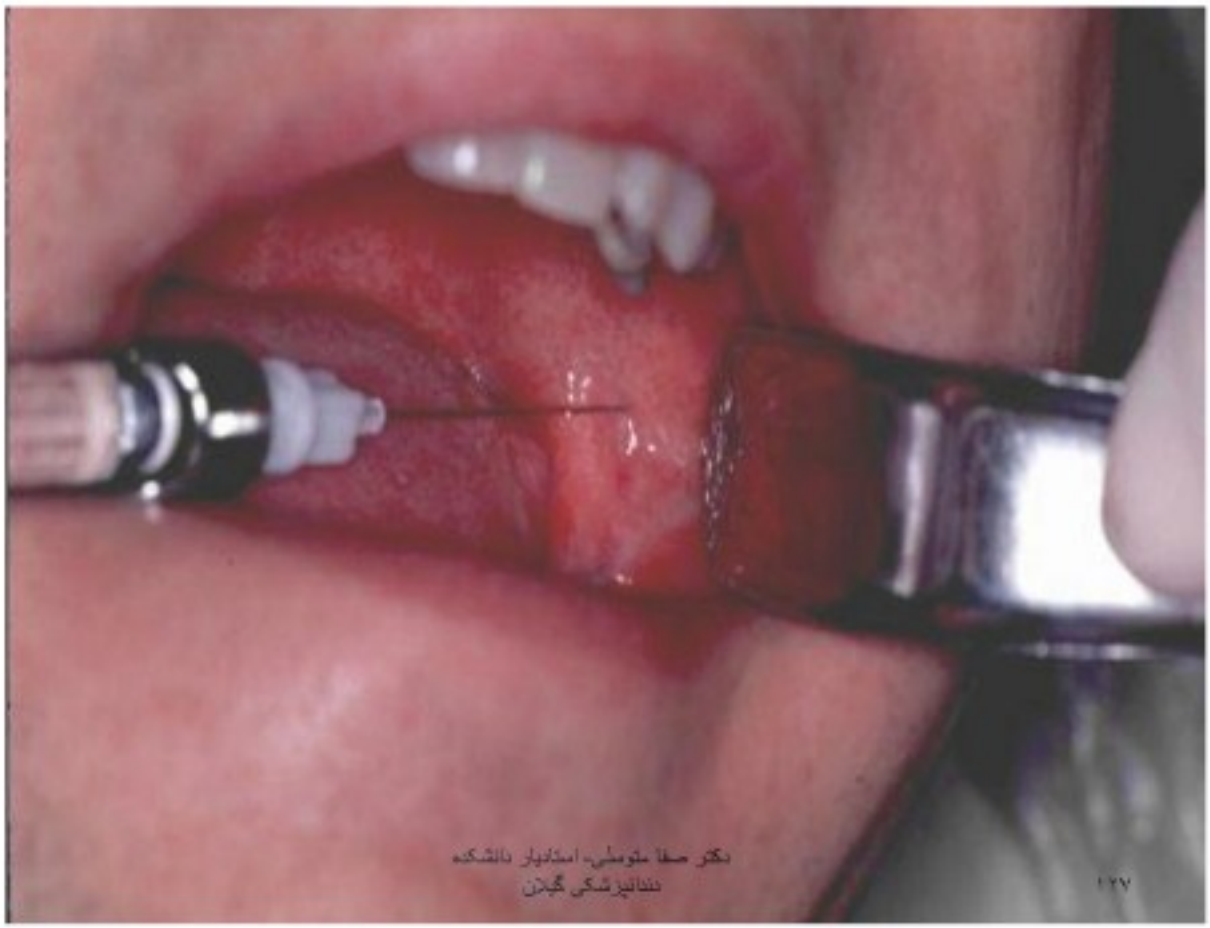
- Hematoma
- Trismus
- Facial paralysis

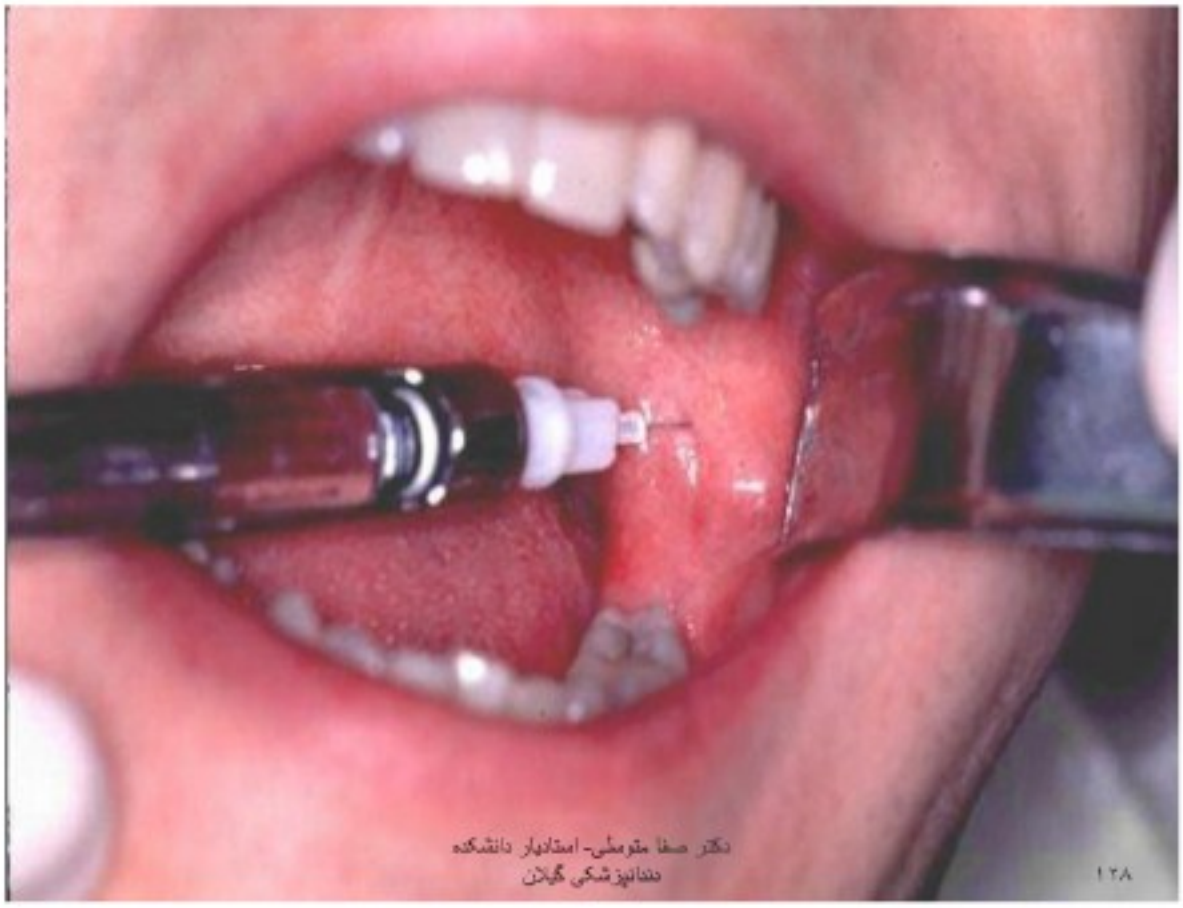










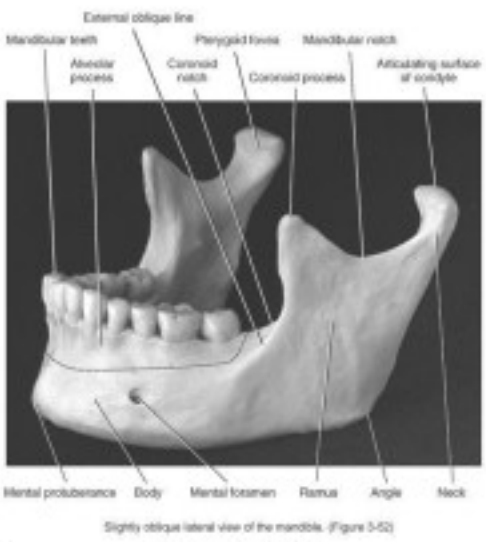


Buccal Block

- **figures 9-36 and 9-37**
- for buccal periodonteum of mandibular molars, gingiva, periodontal ligament and alveolar bone
- for restorative and periodontal work
- buccal nerve is readily located on the surface of the tissue and not within bone

Buccal block

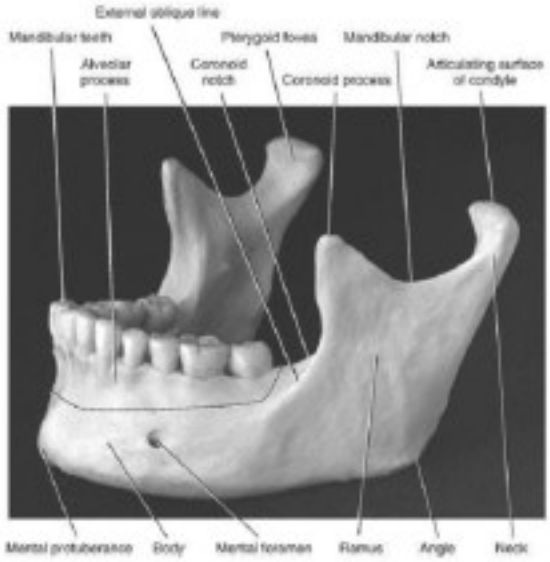
- target: buccal nerve as it passes over the anterior border of the ramus through the buccinator – **figure 9-36**
- injection site is the buccal tissues distal and buccal to the most distal molar – on the anterior border of the ramus as it meets the body – **figure 9-37**
- pull the buccal tissue tight and advance the needle until you feel bone – only about 1 to 2mm **figure 9-38**
  - patient-inflicted trauma – lip biting etc...



Slightly oblique lateral view of the mandible. (Figure 3-52)

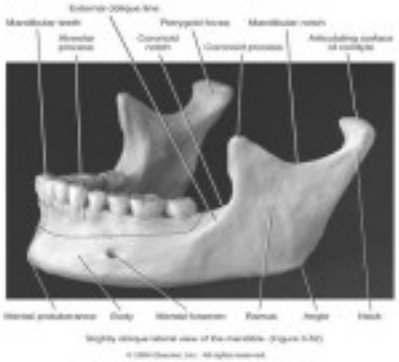
Mental Block

- **figures 9-39 through 9-41**
- for facial periodonteum of mandibular premolars and anterior teeth on one side
- for restorative work – incisive block should be considered instead

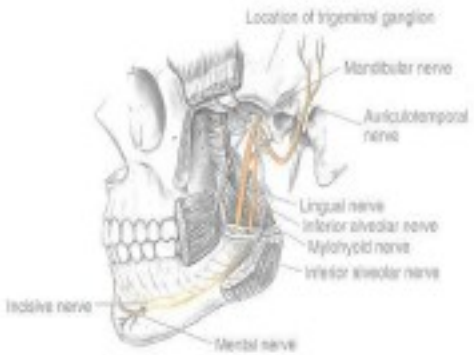


Slightly oblique lateral view of the mandible. (Figure 9-52)

Mental Block



- target site: mental nerve before it enters the mental foramen where it joins with the incisive nerve to form the IA nerve – **figure 9-39**
- palpate the foramen between the apices of the 1st and 2nd premolars
  - palpate it intraorally – find the mucobuccal fold between the apices of the 1st and 2nd premolars – **figure 9-42**
  - in adults, the foramen faces posterosuperiorly
  - may be anterior or posterior
  - can be found using radiographs
- insertion site is the mucobuccal fold tissue directly over or slight anterior to the foramen site
- avoid contact with the mandible with the needle
- depth is 5 to 6mm
- no need to enter the foramen

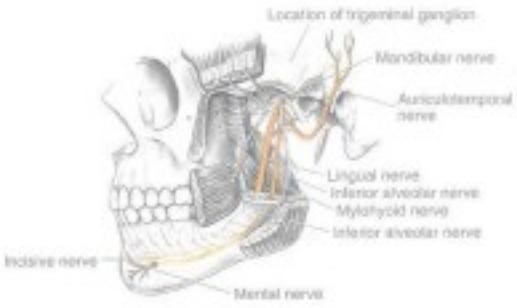


Incisive Block

- for pulp and facial tissues of the teeth anterior to the mental foramen
  - same as the mental block except pulpal anesthesia is provided also
- restorative and periodontal work
- IA block indicated for extractions – no lingual anesthesia with an incisive block
- target: mental foramen – **figure 9-43**

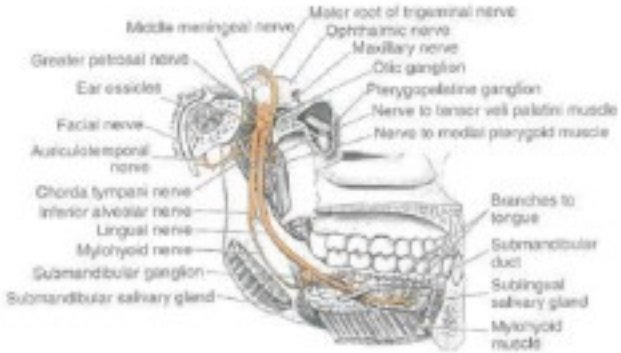
Incisive Block

- injection site: **figure 9-44**
  - same as for the mental block
  - directly over or anterior to the mental foramen
  - in the mucobuccal fold at the apices of the 1st and 2nd premolars
  - pull the buccal tissues laterally
  - more anesthesia is used for this block when compared to the mental block
  - pressure is applied during the injection – forces for anesthetic solution into the foramen and block the deeper incisive nerve
  - the increased injection solution may balloon the facial tissues



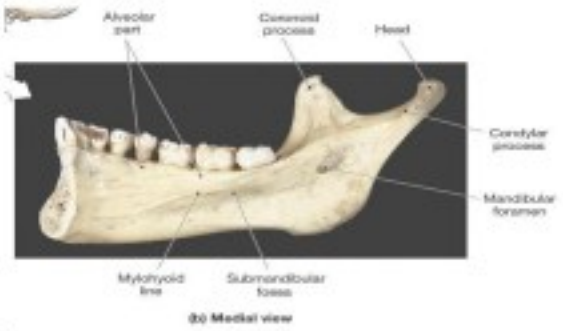
Gow-Gates

- **figures 9-45 through 9-50**
- blocks the IA, mental, incisive, lingual, mylohyoid, auriculotemporal and buccal nerves – **figure 9-28 and 9-45**
- used for quadrant dentistry
- buccal and lingual soft tissue from most distal molar to the midline
- greater success than an IA block



Gow-Gates

- target site: anteromedial border of the mandibular condylar neck – **figure 9-46**
- just inferior to the insertion of the lateral pterygoid muscle
- injection site is intraoral
- locate the intertragic notch and labial commisure extraorally
  - draw a line from the tragus/intertragic notch to the labial commisure – **figure 9-47**
  - place your thumb on the condyle (just in front of the tragus when the mouth is open)
  - pull buccal tissue away
  - place the needle inferior to the mesiolingual cusp of the MAXILLARY 2nd molar
  - the needle penetrates distal to the maxillary 2nd molar
  - see the video

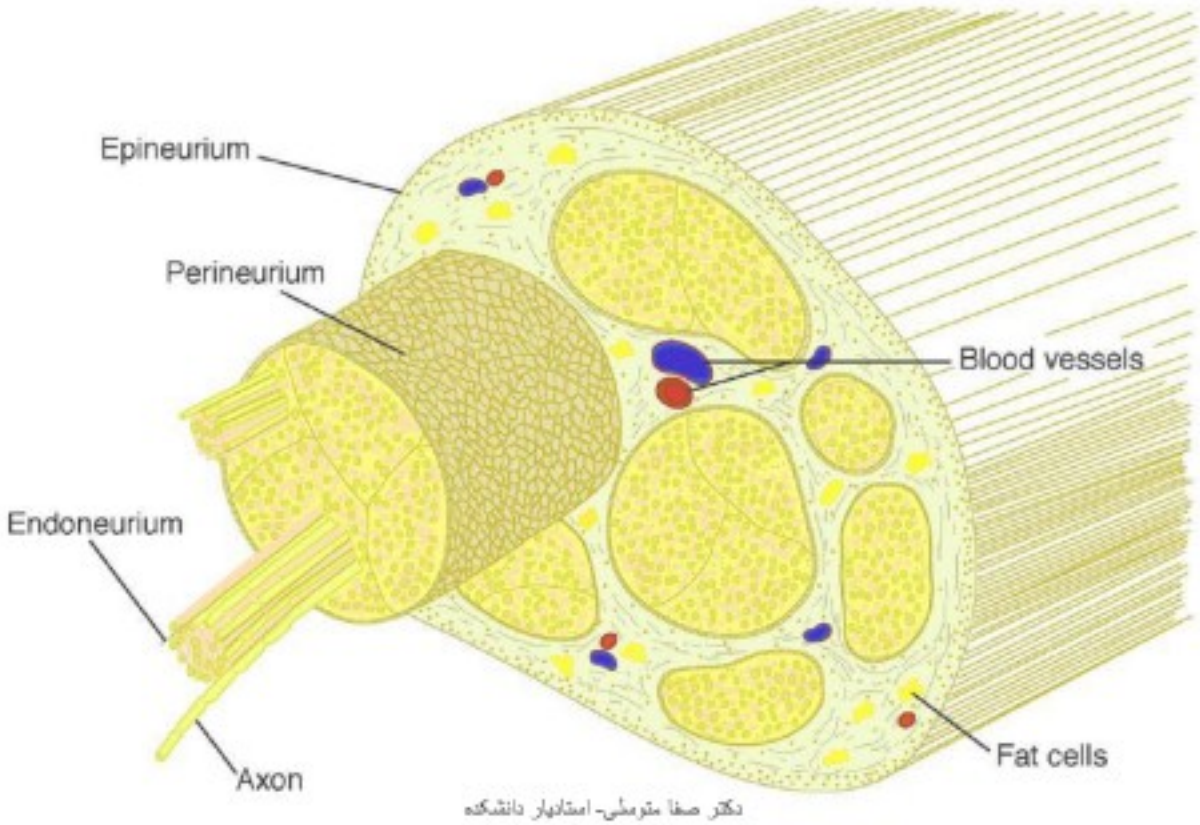


Factors to be considered

- Use a sterilized sharp needle
- Check the flow of local anesthetic solution
- Determine whether or not to warm the anesthetic solution
- Position the patient
- Dry the tissue
- Apply topical antiseptic

- Communicate with the patient
- Establish a firm hand rest
- Make the tissue taut
- Keep the syringe out of the patient line of sight
- Insert the needle into the mucosa
- Inject several drops
- Slowly advance the needle toward the target

- Deposit several drops of local anesthetic before touching periosteum
- Aspirate
- Slowly deposit the solution
- Slowly withdraw the syringe
- Observe the patient

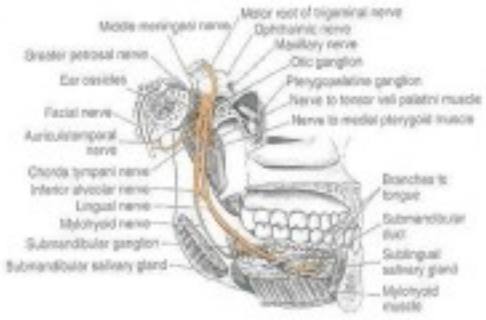


Mandibular Blocks

- **Chart 9-2**
- infiltration is not as successful as maxillary anesthesia
- substantial variability in the anatomy of landmarks when compared to the maxilla
- **pulpal anesthesia:** block of each nerve's dental branches
- **periodontal:** through the interdental and interradicular branches
- **Inferior Alveolar block:** for mandibular teeth + associated lingual tissues and for the facial tissues anterior to the mandibular 1st molar
- **Buccal block:** tissues buccal to the mandibular molars
- **Mental block:** facial tissues anterior to the mental foramen (mandibular premolars and anterior teeth)
- **Incisive block:** for teeth and facial tissue anterior to the mental foramen
- **Gow-Gates:** most of the mandibular nerve
  - for quadrant dentistry

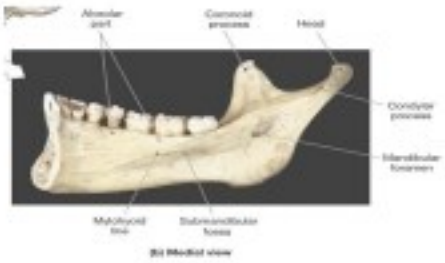
Inferior Alveolar Block

- also called the mandibular block
- most commonly used in dentistry
- for restorative, extraction and periodontal work
  - pulpal anesthesia for extractions and restorative
  - lingual periodonteal anesthesia
  - facial periodonteal anesthesia of anterior mandibular teeth and premolars
- may be combined with the buccal block
- can overlap with the incisive block
- local infiltrations in the anterior area are more successful than posterior injections
- variability in the location of the mandibular foramen on the ramus can lessen the success of this injection
- usually avoid bi-lateral injections since they will completely anesthetize the entire tongue and can affect swallowing and speech



IA Block

- target: slightly superior to the mandibular foramen – **figure 9-27**
  - the medial border of the ramus
- will also anesthetize the adjacent anterior lingual nerve – **figure 9-30**
- injection site is found using hard landmarks
  - palpate the coronoid notch – above the 3rd molar
  - imagine a horizontal line from the coronoid notch to the pterygomandibular fold which covers the pterygomandibular raphe – **figure 9-32**
  - this fold becomes more prominent as the patient opens their mouth wider
  - refer to video notes
  - **figure 9-33**
- needle is inserted into the pterygomandibular space until the mandible is felt – retract about 1 mm
- average depth: 20-25mm
- diffusion of anesthesia will affect the lingual nerve



IA block

- symptoms: harmless tingling and numbness of the lower lip due to block of the mental nerve
- tingling and numbness of the body of the tongue and floor of mouth – lingual nerve involvement
- complications:
  - failure to penetrate enough can numb the tongue but not block sufficiently
  - lingual shock – involuntary movement as the needle passes the lingual nerve
  - transient facial paralysis – facial nerve involvement if inserted into the deeper parotid gland – **figure 9-34**
    - inability to close the eye and drooping of the lips on the affected side
    - hematoma can occur
  - some muscle soreness
  - patient-inflicted trauma – lip biting etc…

Sensory nerve of orofacial region

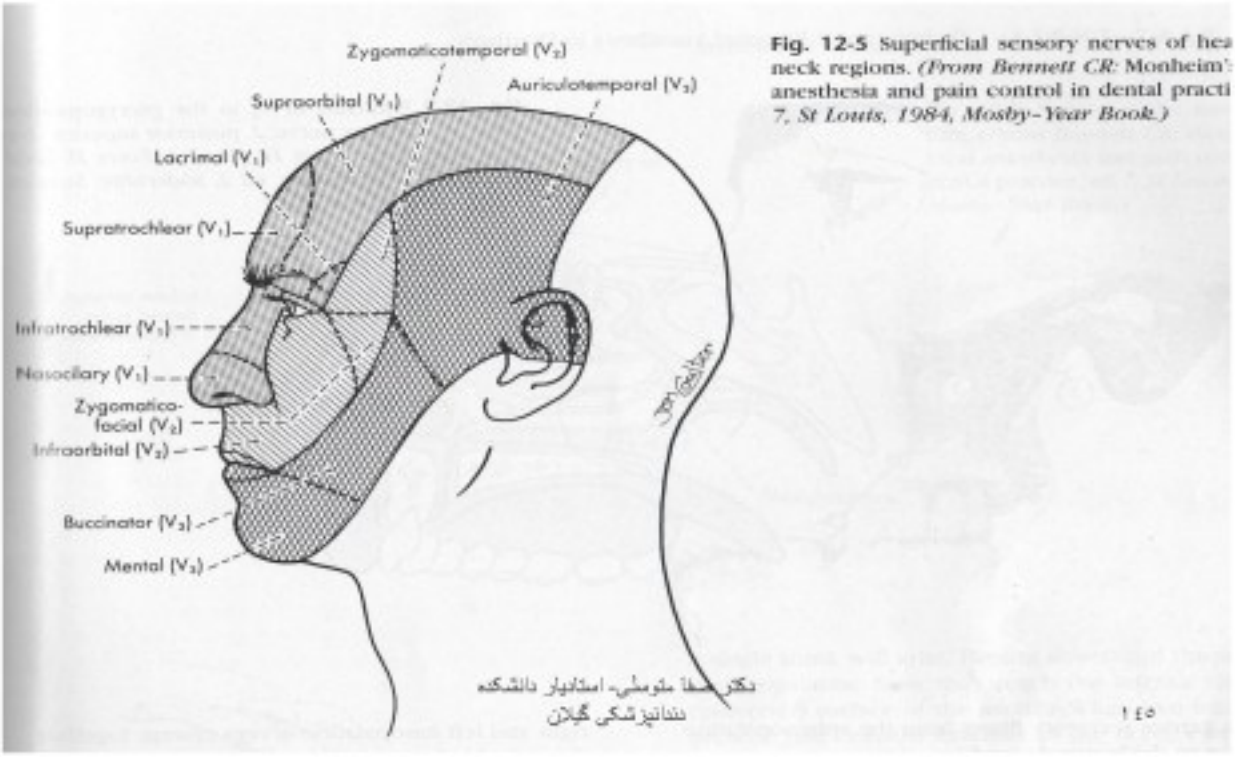


Fig. 12-5 Superficial sensory nerves of hea neck regions. *(From Bennett CR:* Monheim': anesthesia and pain control in dental practi *7, St Louis, 1984, Mosby–Year Book.)*

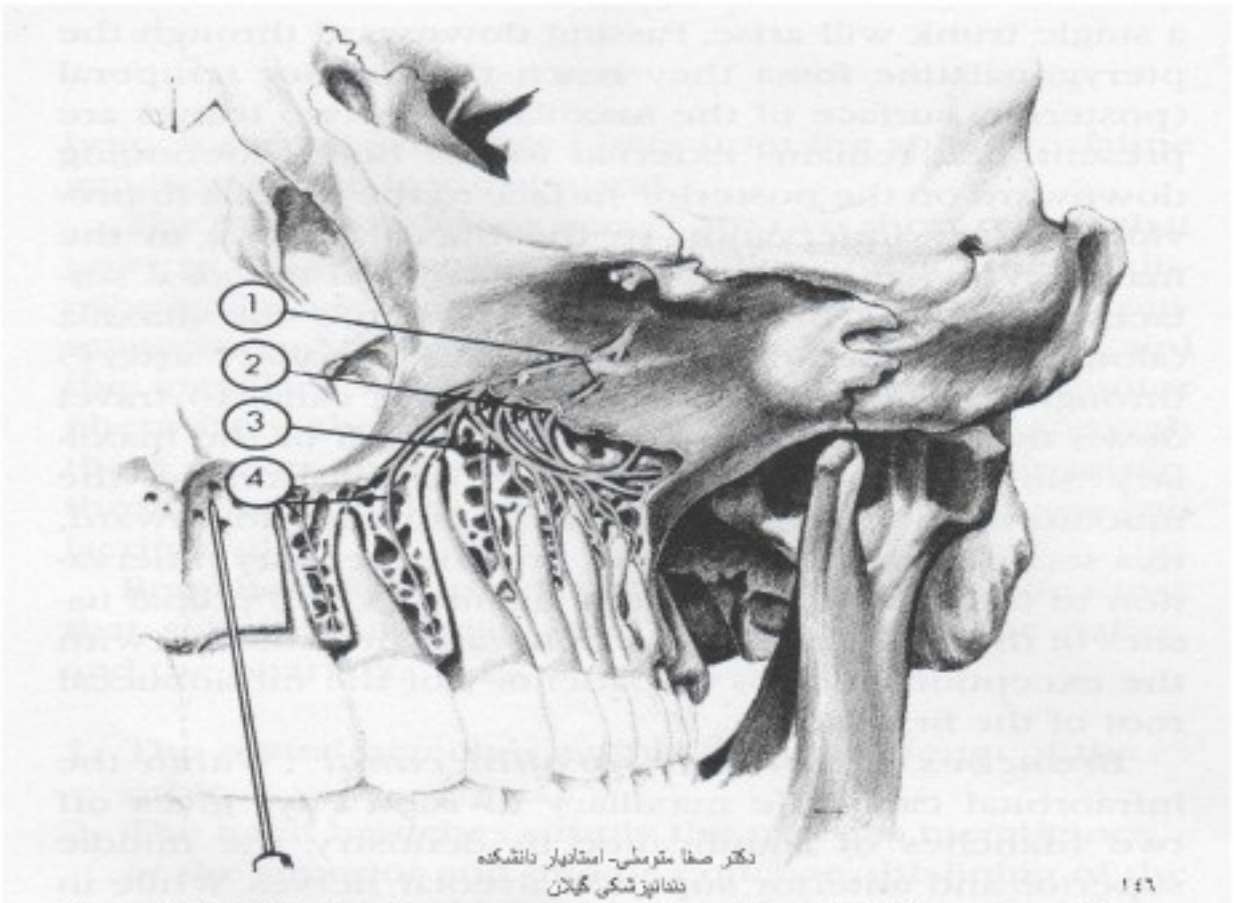


Fig. 12-12 Anterior superior alveolar (ASA) nerve (bone

Anatomical consideration

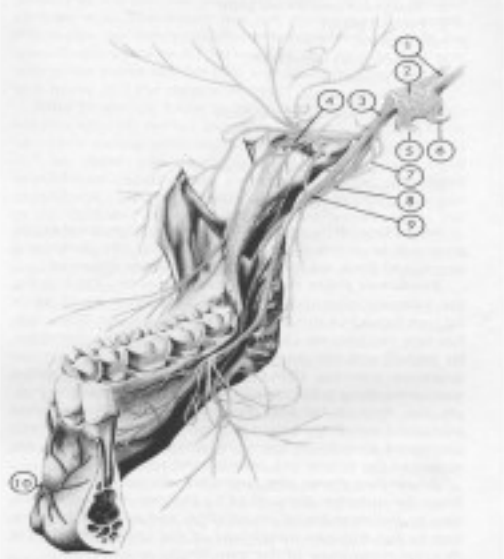


Fig. 12-13 Distribution of the mandibular division (V_3). *1*, Trigeminal nerve; *2*, gasserian ganglion; *3*, mandibular nerve; *4*, buccal nerve; *5*, maxillary nerve; *6*, ophthalmic nerve; *7*, auriculotemporal nerve; *8*, inferior alveolar nerve; *9*, lingual nerve; *10*, mental nerve. *(From Haglund J, Evers H: Local anaesthesia in dentistry, ed 2, Södertälje, Sweden, 1975, Astra Läkemedel.)*

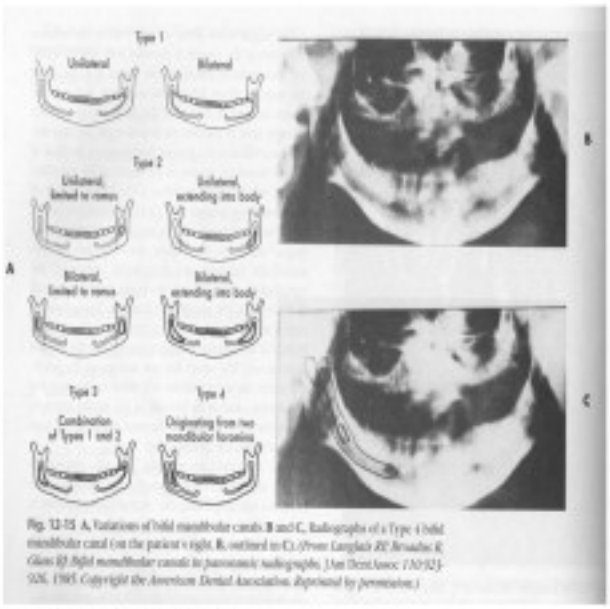


Fig. 12-15 A, Variations of bifid mandibular canals. B and C, Radiographs of a Type 4 bifid mandibular canal (on the patient's right, B, outlined in C). *(From Langlais RP, Broadus R, Glass BJ: Bifid mandibular canals in panoramic radiographs, J Am Dent Assoc 110:923-926, 1985. Copyright the American Dental Association. Reprinted by permission.)*

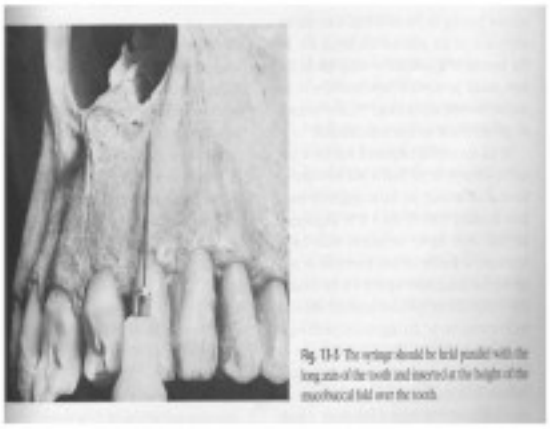


Fig. 13-5 The syringe should be held parallel with the long axis of the tooth and inserted at the height of the mucobuccal fold over the tooth.

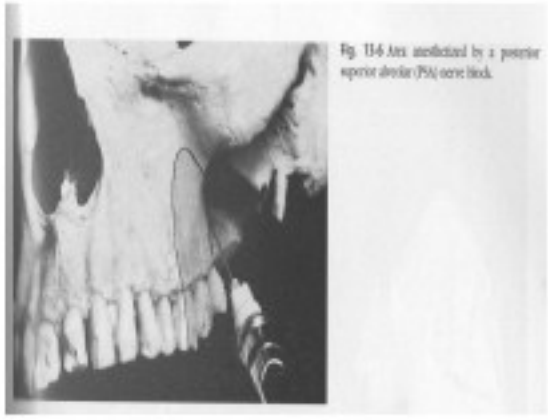


Fig. 13-6 Area anesthetized by a posterior superior alveolar (PSA) nerve block.

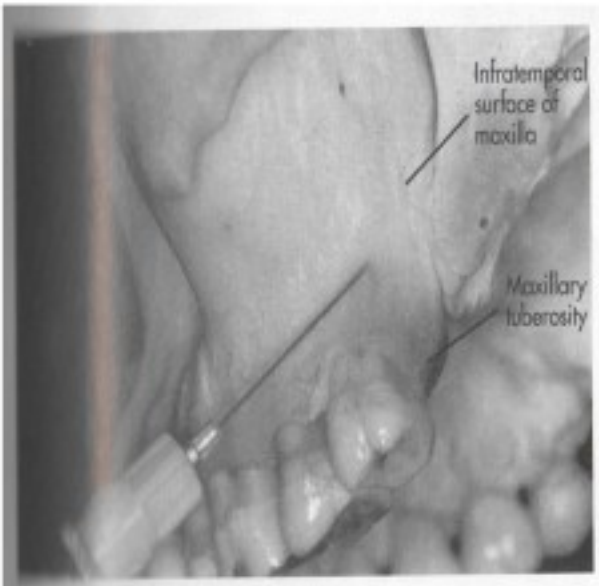


Fig. 13-7 Needle at the target area for a PSA nerve block.

Fig. 13-16 Advance the needle upward, inward, and backward.

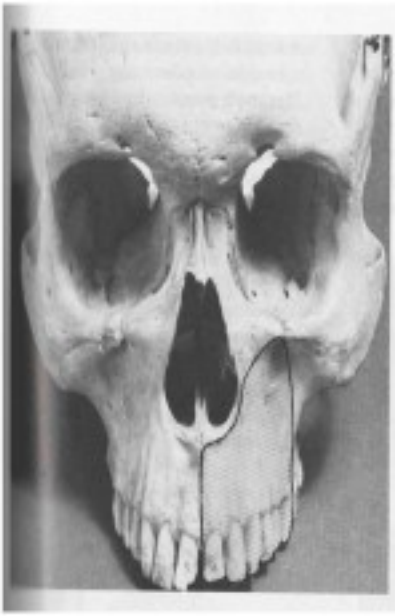


Fig. 13-16 Infraorbital nerve block, showing the area anesthetized in 72% of patients.

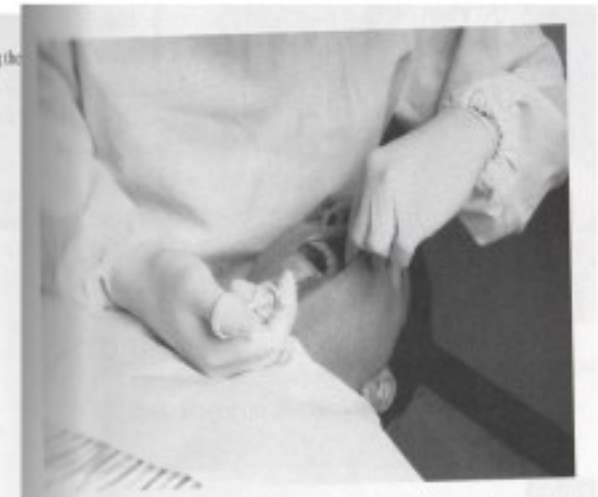


Fig. 13-17 Position of the administrator for a right or left infraorbital nerve block. The patient's head should be turned slightly to improve visibility.

Infraorbital nerve block

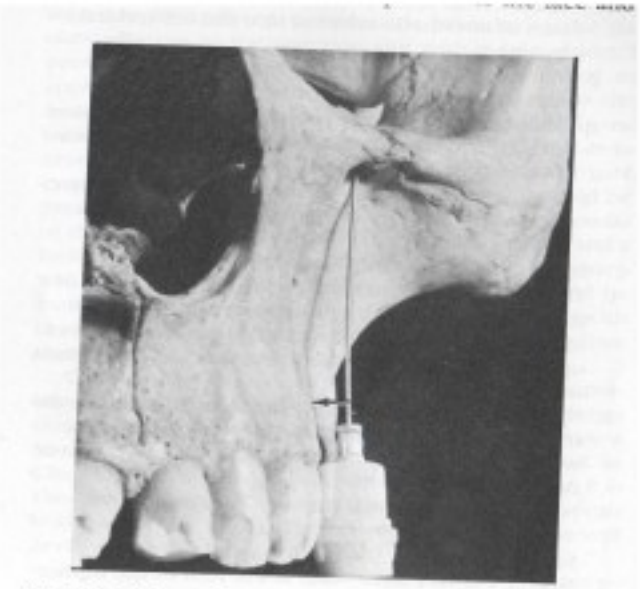


Fig. 13-21 Advance the needle parallel with the long axis of the tooth to preclude premature contacting bone. Notice how the bone of the maxilla becomes concave between the root eminence and the infraorbital foramen (*arrow* and *shadow*).

Nasopalatine nerve block

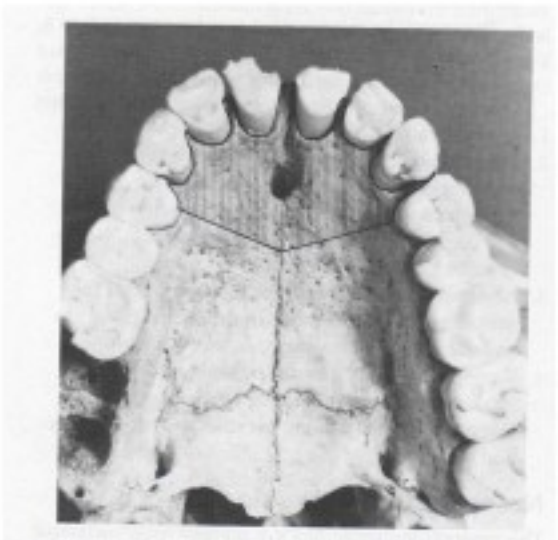


Fig. 13-33 Area anesthetized by a nasopalatine nerve block.

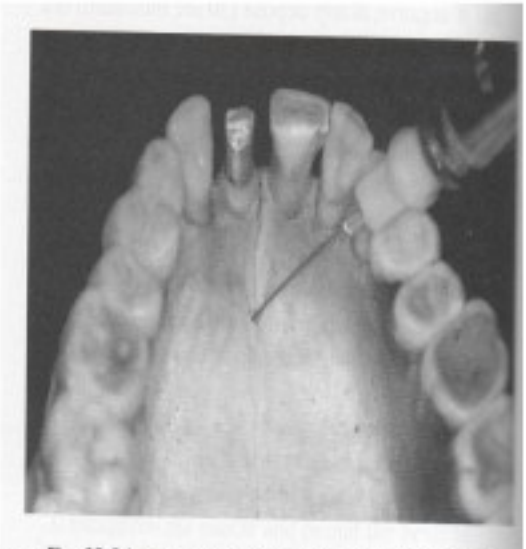
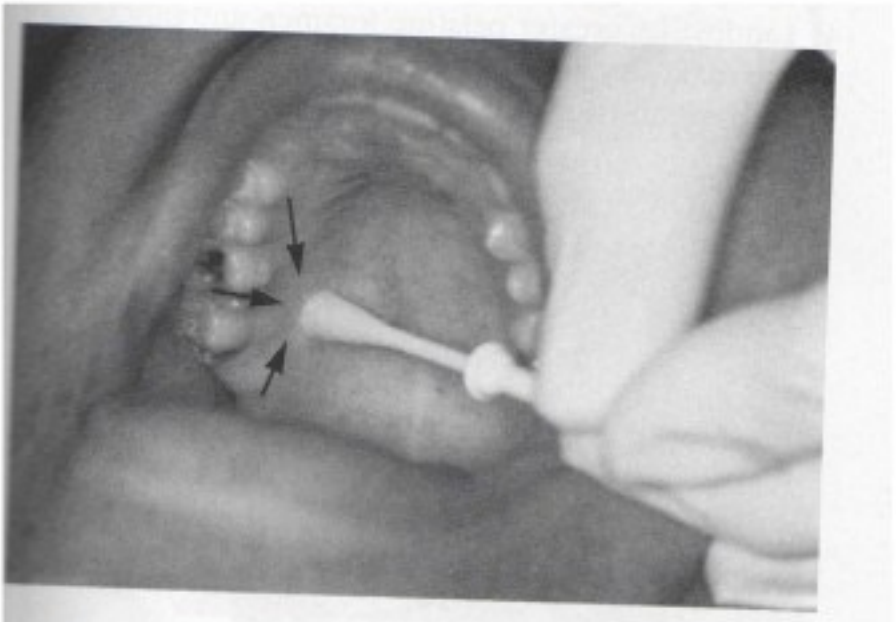


Fig. 13-34 Target area for a nasopalatine nerve block.



ig. 13-23 Notice the ischemia of palatal tissues (*arrows*) nder pressure from the applicator stick.

Maxillary nerve block

- Posterior superior approach
- Greater palatine approach
- Extra oral approach (sigmoid notch)

TABLE 13-2 Location of the Greater Palatine Foramen*

Location	No.	Percent
Anterior half 2nd molar	0	0
Posterior half 2nd molar	63	39.87
Anterior half 3rd molar	80	50.63
Posterior half 3rd molar	15	9.49

From Malamed SF, Trieger N: Intraoral maxillary nerve block: an

TABLE 13-5 Recommended Volumes of Local Anesthetic for Maxillary Techniques

Technique	Volume (ml)
Supraperiosteal (infiltration)	0.6
Posterior superior alveolar	0.9 to 1.8
Middle superior alveolar	0.9 to 1.2
Anterior superior alveolar	0.9 to 1.2
Greater palatine	0.45 to 0.6
Nasopalatine	0.45
Palatal infiltration	0.2 to 0.3
Maxillary nerve block	1.8

Anesthesia technique in mandible

- Nerve block /infiltration

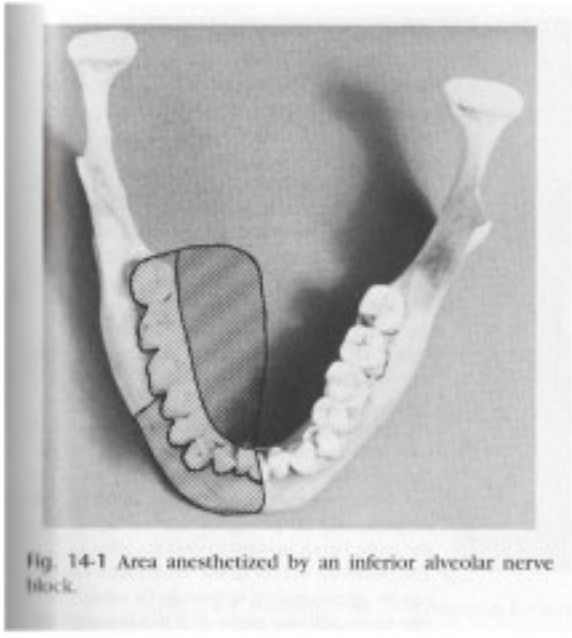


Fig. 14-1 Area anesthetized by an inferior alveolar nerve block.

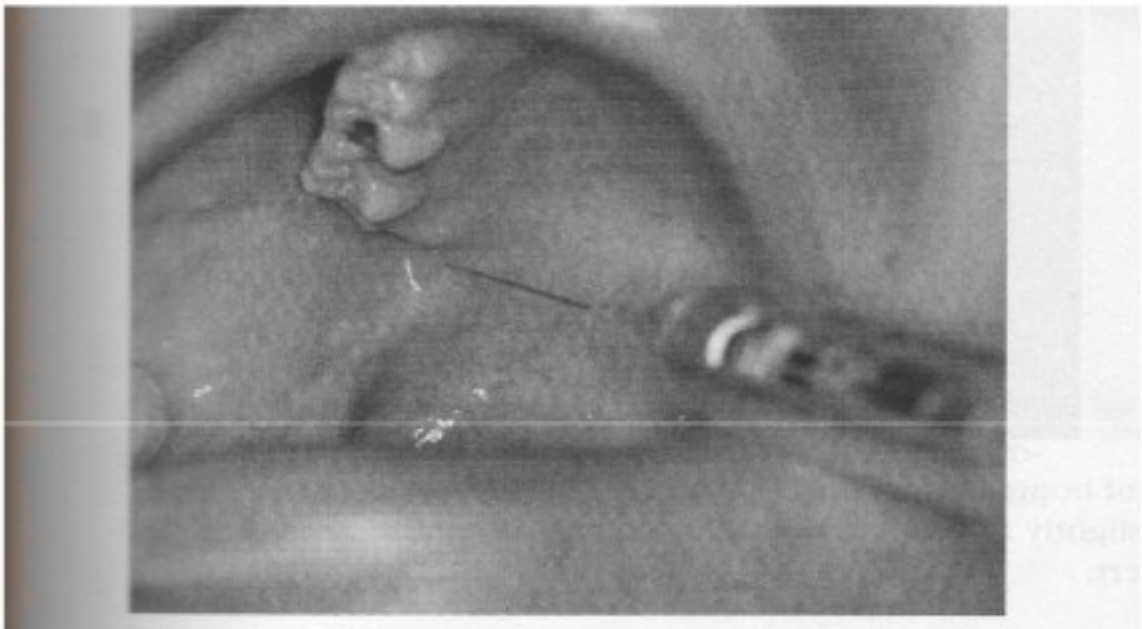


Fig. 14-5 Notice the placement of the syringe barrel at the corner of the mouth, usually corresponding to the premolars. The needle tip gently touches the most distal end of the pterygomandibular raphe.

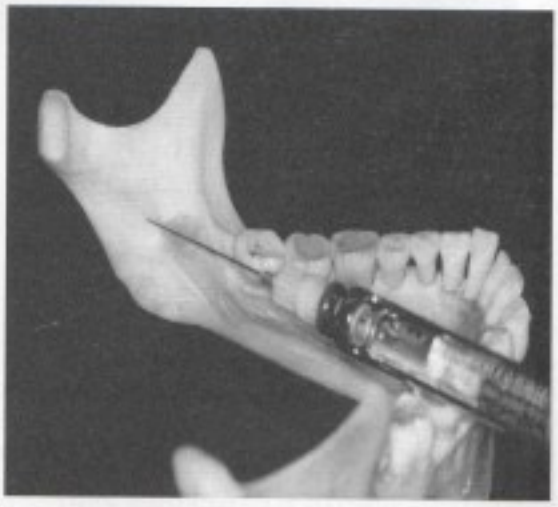


Fig. 14-6 Placement of the needle and syringe for an inferior alveolar nerve block.

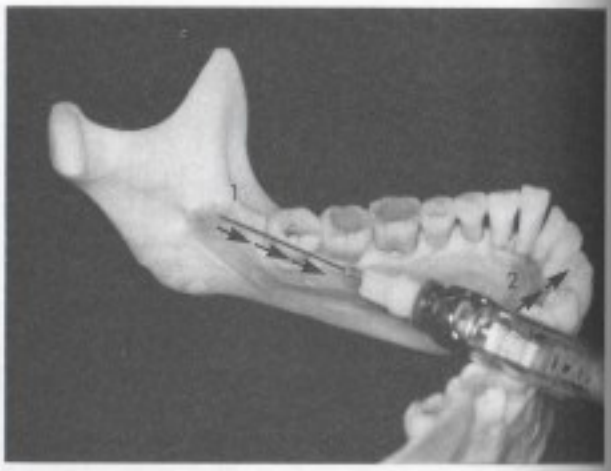


Fig. 14-8 The needle is located too far anteriorly (laterally) on the ramus. To correct: Withdraw it slightly from the tissues (*1*) and bring the syringe barrel anteriorly toward the lateral incisor or canine (*2*); reinsert to proper depth.

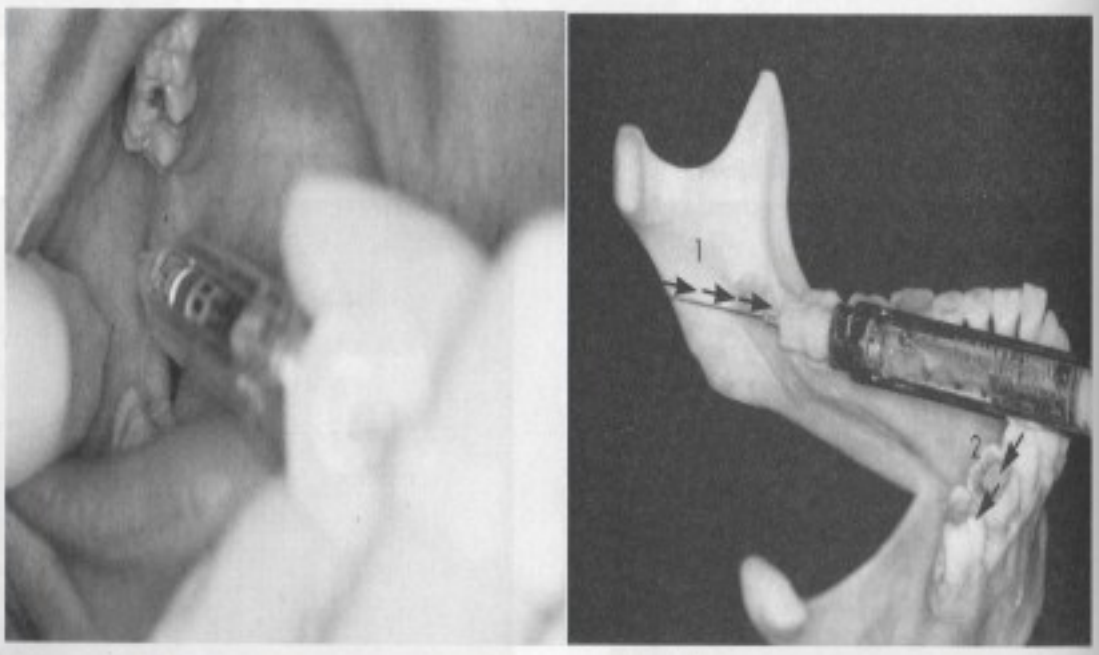


Fig. 14-9 A, Overinsertion with no contact of bone. The needle is usually posterior (medial) to the ramus. B, To correct: Withdraw it slightly from the tissues (*1*) and reposition the syringe barrel over the premolars (*2*); reinsert.

Mandibular nerve block

- Gow gates
- Vazirani /akinosi
- Extraoral approach

Gow gates mandibular nerve block

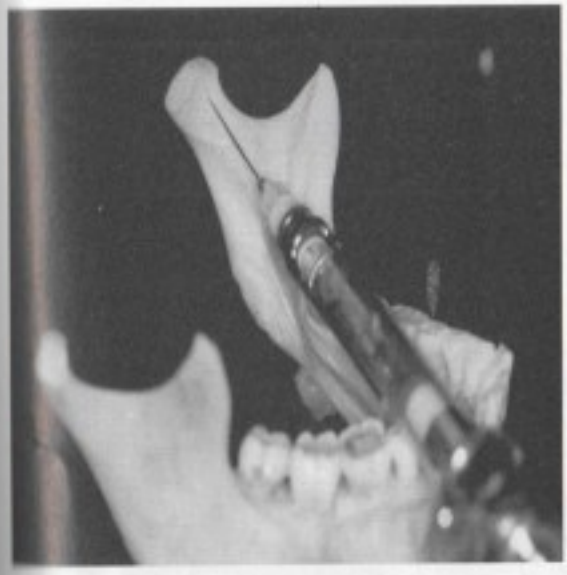


Fig. 14-16 Target area for a Gow-Gates mandibular nerve block—neck of the condyle.

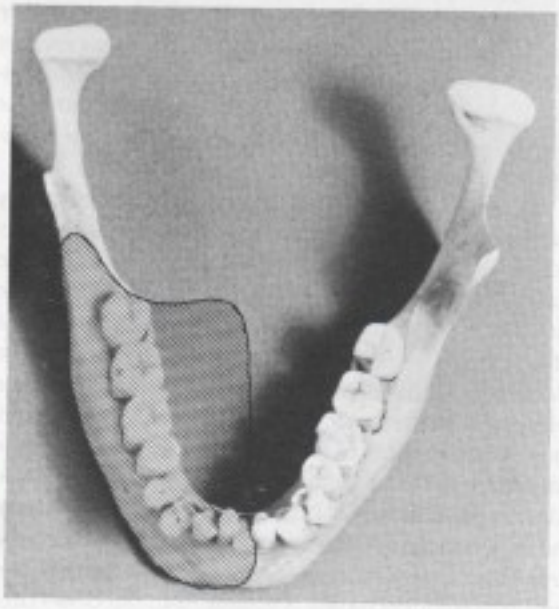


Fig. 14-15 Area anesthetized by a mandibular nerve block (Gow-Gates).

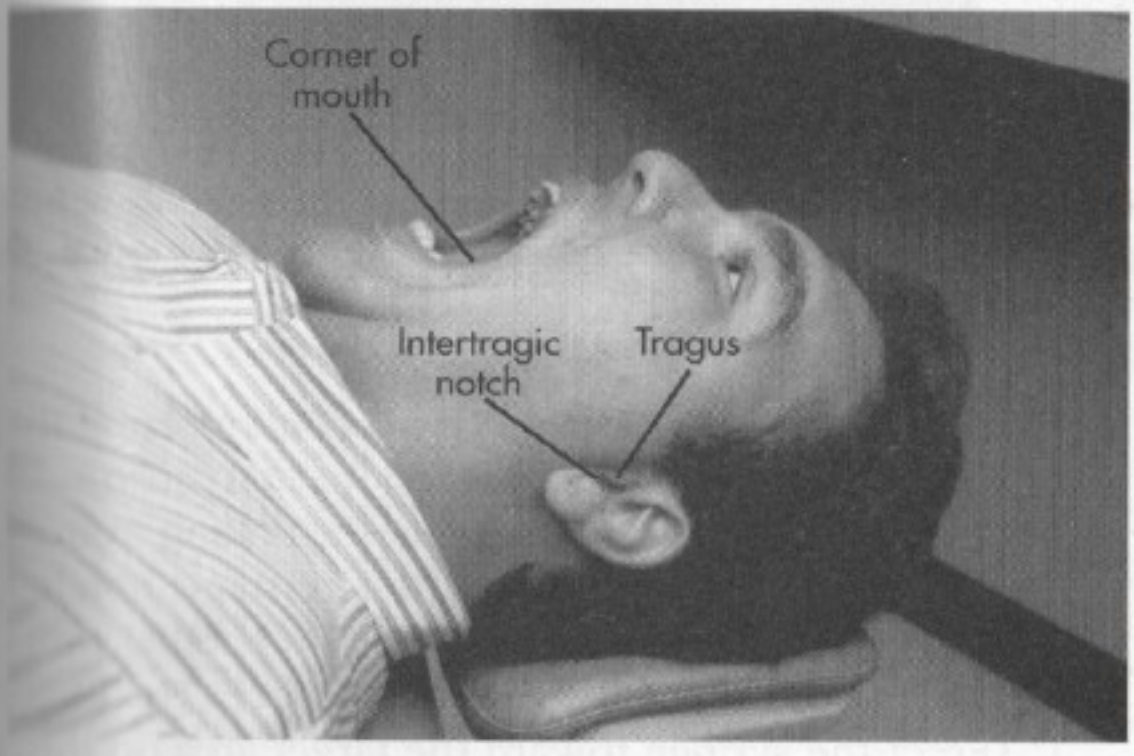
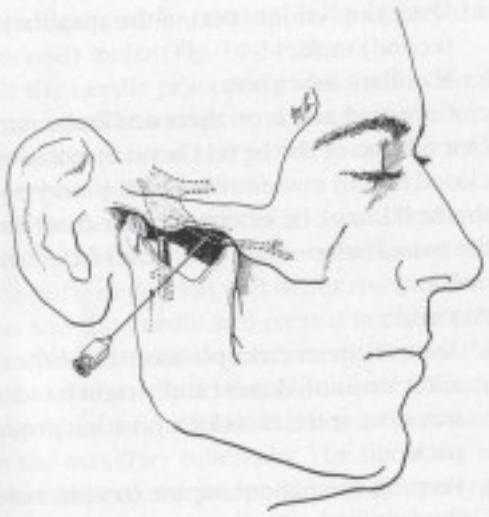


Fig. 14-17 Extraoral landmarks for a Gow-Gates mandibular nerve block.



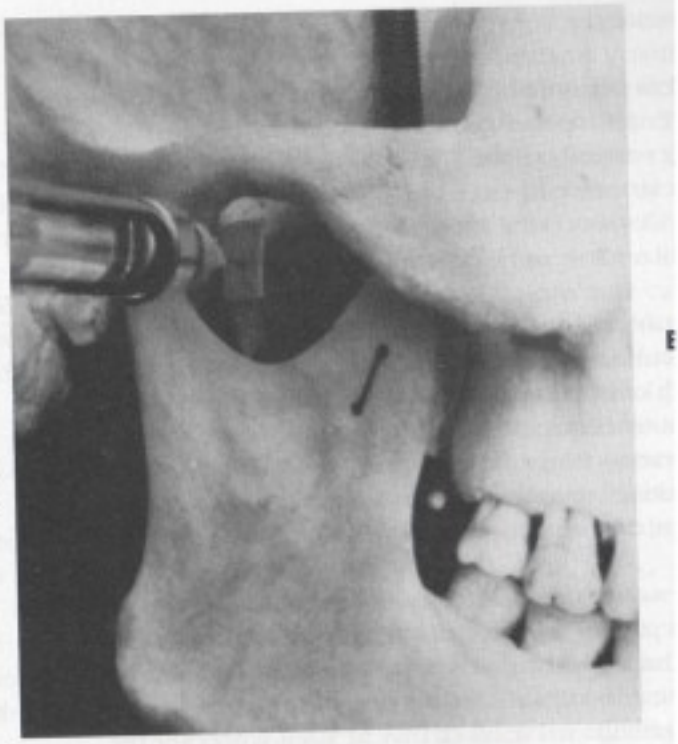


Fig. 14-22 A and **B,** Extraoral mandibular block using lateral approach through the sigmoid notch. *(From Bennett CR:* Monheim's local anesthesia and pain control in dental practice, *ed 6, St Louis, 1978, Mosby-Year Book.)*

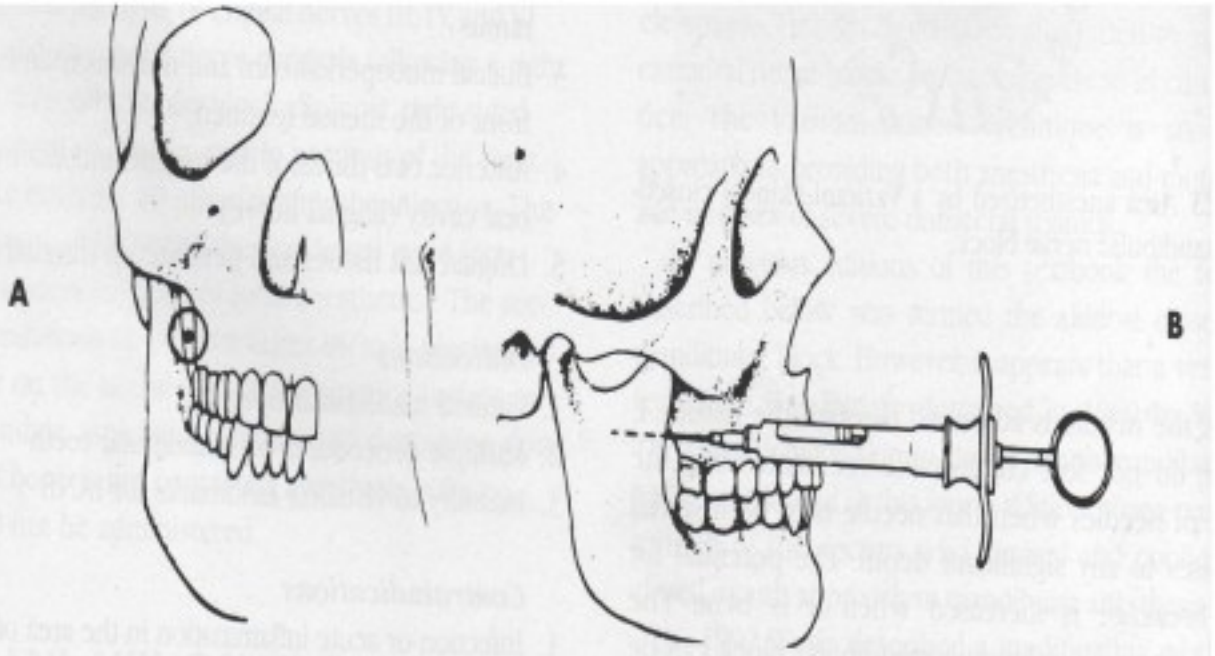


Fig. 14-24 A, Area of needle insertion for a Vazirani-Akinosi block. **B,** Hold the syringe and needle at the height of the mucogingival junction above the maxillary third molar. *(From Gustanis JF, Peterson LJ:An alternative method of mandibular nerve block,* J Am Dent Assoc *103:33-36, 1981. Copyright the American Dental Association. Reprinted by permission.)*

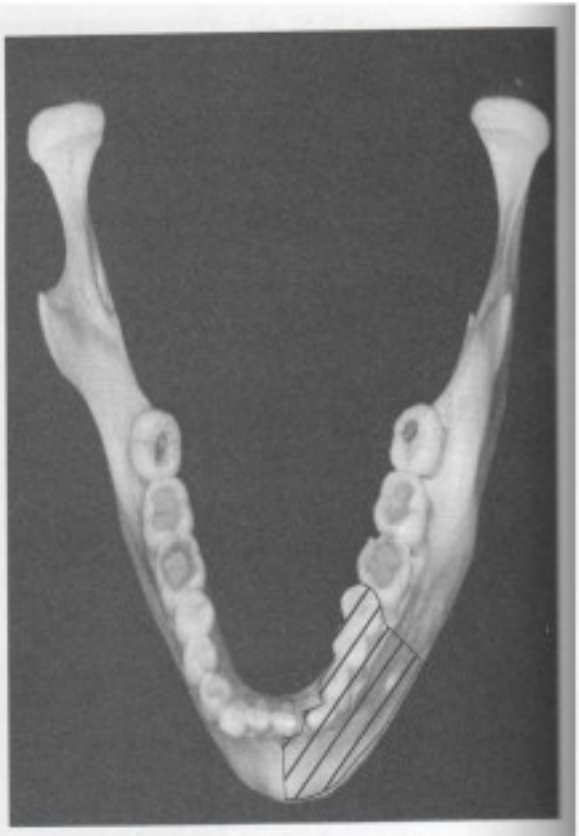


Fig. 14-34 Area anesthetized by an incisive nerve block.

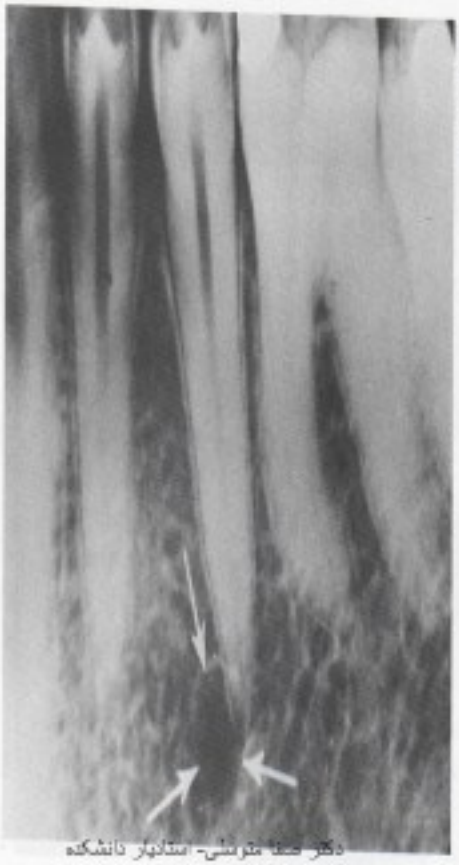


Fig. 14-30 Radiographs in locating the mental (arrows). (Courtesy D. Zielnu.)

TABLE 14-1 Mandibular Teeth and Available Local Anesthetic Techniques

Teeth	Pulpal	Soft tissue	
		Buccal	Lingual
Incisors	Incisive (Inc)	IANB	IANB
	Inferior alveolar (IANB)	GG	GG
	Gow-Gates (GG)	VA	VA
	Vazirani-Akinosi (VA)	Inc	PDL
	Periodontal ligament (PDL) injection	IS	IS
	Intraseptal (IS)	Mental	Inf
	Intraosseous (IO)	PDL	IO
	Infiltration (lateral incisor only)	Inf	
		IO	
Canine	Inferior alveolar	IANB	IANB
	Gow-Gates	GG	GG
	Vazirani-Akinosi	VA	VA
	Incisive	Inc	PDL
	Periodontal ligament injection	PDL	IS
	Intraseptal	IS	Inf
	Intraosseous	IO	IO
		Inf	
		Mental	
Premolars	Inferior alveolar	IANB	IANB
	Gow-Gates	GG	GG
	Vazirani-Akinosi	VA	VA
	Incisive	Inc	PDL
	Periodontal ligament injection	PDL	IS
	Intraseptal	IS	IO
	Intraosseous	IO	Inf
		Mental	
		Inf	
Molars	Inferior alveolar	IANB	IANB
	Gow-Gates	GG	GG
	Vazirani-Akinosi	VA	VA
	Periodontal ligament injection	PDL	PDL
	Intraseptal	IS	IS
	Intraosseous	IO	IO
		Inf	Inf

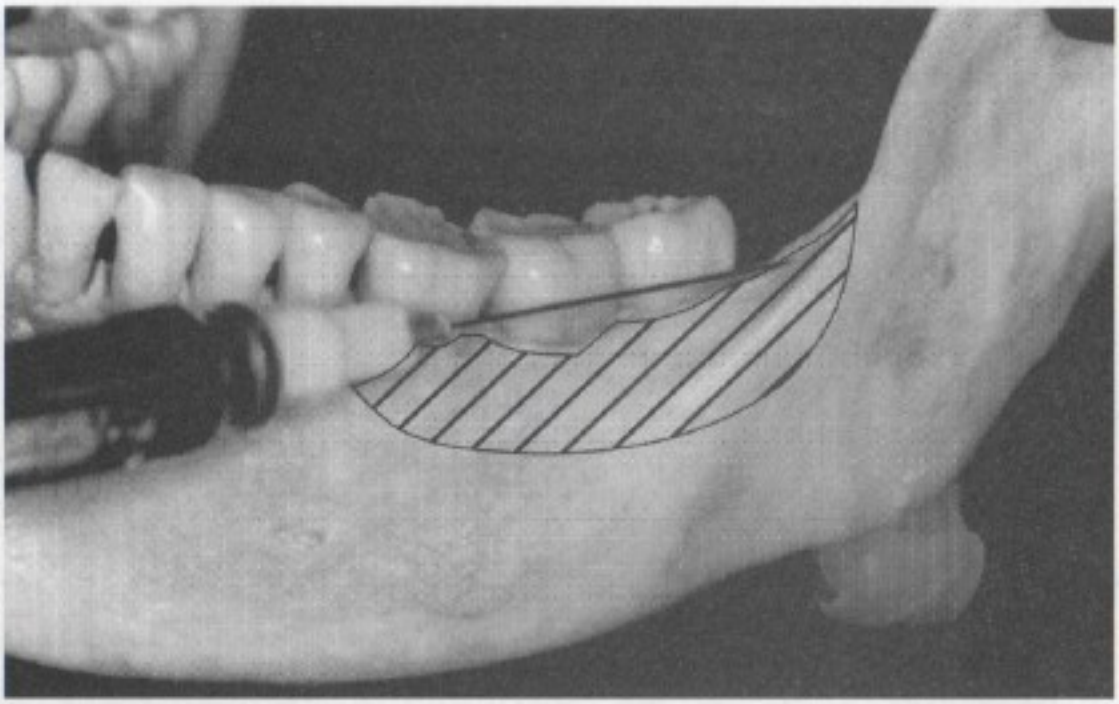


Fig. 14-12 Placement of the needle for, and the area anesthetized by, a buccal nerve block.

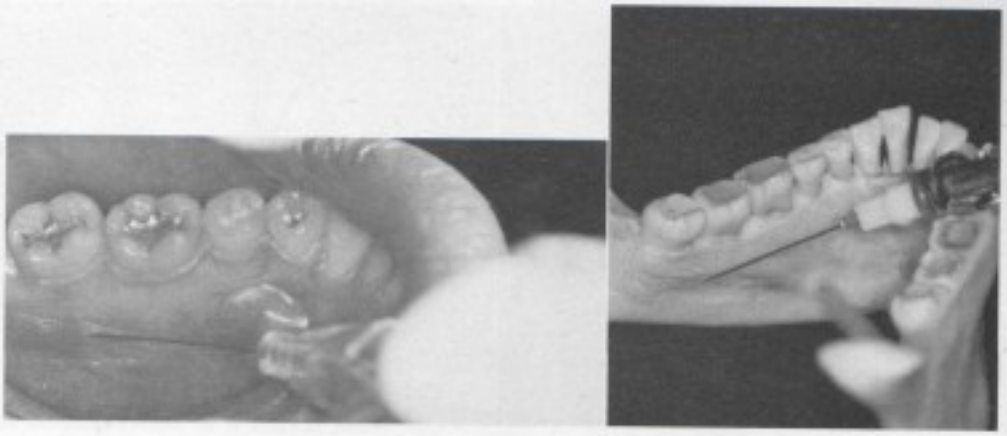


Fig. 14-10 **A,** Retract the tongue to gain access to, and increase the visibility of, the lingual border of the mandible. **B,** Direct the needle tip below the apical region of the tooth immediately posterior to the tooth in question.

Causes of failure

- Technical errors
- Anatomic variation
- Accessory innervation
- Inflamation & infection

Supplemental injection techniques

- Periodontal ligament injection
- Intraosseous injection
- Intraseptal injection
- Intrapulpal injection

Complication of Local anesthesia

Local complication

- Needle breakage
- Pain on injection
- Sustained anesthesia/paresthesia
- Trismus
- Hematoma
- Infection

- Facial nerve paralysis
- Sloughing of tissue
- Soft tissue injury
- Postanesthtic intraoral lesion

Systemic complication

- Toxicity reaction
- Allergic reaction

Toxic reaction

- L.A toxicity
- Epinephrine toxicity

CAUSES OF ADVERSE DRUG REACTIONS

Toxicity caused by *direct extension of the usual pharmacological effects* of the drug:

1. Side effects
2. Overdose reactions
3. Local toxic effects

Toxicity caused by *alteration in the recipient* of the drug:

1. A disease process (hepatic dysfunction, congestive heart failure, renal dysfunction)
2. Emotional disturbances
3. Genetic aberrations (atypical plasma cholinesterase, malignant hyperthermia)
4. Idiosyncrasy

Toxicity caused by *allergic responses* to the drug

TABLE 18-1 Comparison of Allergy and Overdose

	Allergy	Overdose
Clinical response		
Dose	Non-dose related	Dose related
S&S	Similar, regardless of allergen	Relate to pharmacology of drug administered
Management	Similar (epinephrine, histamine blockers)	Differ: specific for drug administered

S&S, Signs and symptoms.

LOCAL ANESTHETIC OVERDOSE: PREDISPOSING FACTORS

Patient factors
- *Age*
- *Weight*
- *Other drugs*
- *Sex*
- *Presence of disease*
- *Genetics*
- *Mental attitude and environment*

Drug factors
- *Vasoactivity*
- *Concentration*
- *Dose*
- *Route of administration*
- *Rate of injection*
- *Vascularity of the injection site*
- *Presence of vasoconstrictors*

Patient related factors

- Age
- Weight
- Systemic disease
- Genetic problem

Drug related factors

- Vasoactivity
- Dosage
- Potency
- Speed of injection
- Vascularity of tissue
- Vasoconstrictors

Maximum recommended dose

- Age
- Weight
- Patient health statue

TABLE 18-2 Maximum Recommended Doses of Local Anesthetics

Drug	Formulation	MRD	mg/lb	(mg/kg)	Author's MRD	mg/kg[17,18]
Articaine	With epinephrine	500†	3.2 (adult)†	(7.0)	3.2 (adult)	7.0
			2.3 (child)†	(7.6)	2.3 (child)	7.6
Lidocaine	Plain	300*	2.0	(4.4)*	300	4.4
	With epinephrine	500*	3.3	(7.0)*	300	4.4
Mepivacaine	Plain	400*	2.6	(5.7)*	300	4.4
	With levonordefrin	400*	2.6	(5.7)*	300	4.4
Prilocaine	Plain	600*	4.0	(8.8)*	400	6.0
	With epinephrine	600*	4.0	(8.8)*	400	6.0

*Manufacturer's recommendation.[15]
†Manufacturer's recommendation.[16]

TABLE 18-3 Comparison of Forms of Local Anesthetic Overdose

	Rapid intravascular	Too large a total dose	Rapid absorption	Slow bio-transformation	Slow elimination
Likelihood of occurrence	Common	Most common	Likely with "high normal" doses if no vasoconstrictors are used	Uncommon	Least common
Onset of signs and symptoms	Most rapid (seconds); intraarterial faster than intravenous	3 to 5 min	3 to 5 min	10 to 30 min	10 min to several hr
Intensity of signs and symptoms	Usually most intense	Gradual onset with increased intensity; may prove quite severe		Gradual onset with slow increase in intensity of symptoms	
Duration of signs and symptoms	2 to 3 min	Usually 5 to 30 min; depends on dose and ability to metabolize or excrete		Potentially longest duration because of inability to metabolize or excrete agents	
Primary prevention	Aspirate, slow injection	Administer minimal doses	Use vasoconstrictor; limit topical anesthetic use or use nonabsorbed type (base)	Adequate pretreatment physical evaluation of patient	
Drug groups	Amides and esters	Amides; esters only rarely	Amides; esters only rarely	Amides and esters	Amides and esters

From Malamed SF: *Medical emergencies in the dental office*, ed 4, St Louis, 1993, Mosby-Year Book.

Sign/Symptom

- Stress/Fear
- Slurred speech
- Euphoria
- Perspiration
- Vertigo
- Vomiting
- Fatigue
- Increase of B.p, P.r, R.R
- Drowsiness/imbalance

- Loss of consciousness
- Tonic/clonic spasm
- CNS Depression
- Decrease of B.P/P.r/R.r

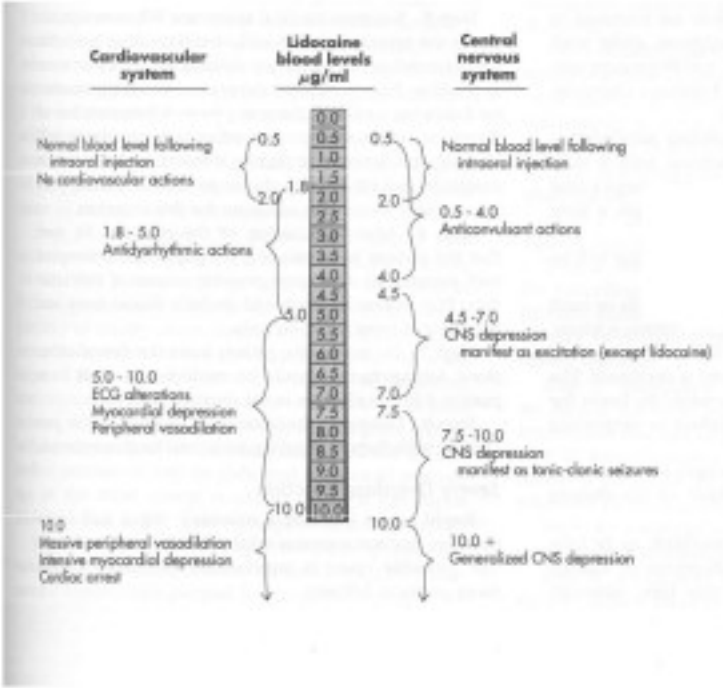


Fig. 18-9 Local anesthetic blood levels and actions on cardiovascular and central nervous sytems. *(From Malamed SF: Medical emergencies in the dental office, ed 4, St Louis, 1993, Mosby–Year Book.)*

Management

- Stop dental treatment
- Reassure patient
- Give oxygen
- Control v/s
- Anticonvulsive therapy
- Intravenous fluids
- Vasoactive agents

TABLE 18-4 Dilutions of Vasoconstrictors Used in Dentistry

Dilution	Drug available	mg/ml	mg per cartridge (1.8 ml)	Maximum no. of cartridges used for healthy patient and cardiac-impaired patient
1:1000	Epinephrine (emergency kit)	1.0	Not applicable	Not available in local anesthetic cartridge
1:10,000	Epinephrine (emergency kit)	0.1	Not applicable	Not available in local anesthetic cartridge
1:20,000	Levonordefrin	0.5	0.09	10 (H), 2 (C)
1:30,000	Levarterenol	0.034	0.06	5 (H), 2 (C)
[illegible]	[illegible]	0.02	0.036	5 (H), 1 (C)
1:50,000	Epinephrine	0.02	0.036	5 (H), 1 (C)
1:100,000	Epinephrine	0.01	0.018	10 (H), 2 (C)
1:200,000	Epinephrine	0.005	0.009	20 (H), 4 (C)

From Malamed SF: Medical emergencies in the dental office, ed 4, St Louis, 1993, Mosby-Year Book.
H, Healthy patient; C, cardiac-impaired patient.

Allergic reaction

- Dermatitis
- Bronchial spasm
- Anaphilaxy

TABLE 18-5 Classification of Allergic Diseases (after Gell and Coombs)

Type	Mechanism	Principal antibody or cell	Time of reactions	Clinical examples
I	Anaphylactic (immediate, homocytotropic, antigen-induced, antibody-mediated)	IgE	Seconds to minutes	Anaphylaxis (drugs, insect venom, antisera) Atopic bronchial asthma Allergic rhinitis Urticaria Angioedema Hay fever
II	Cytotoxic (antimembrane)	IgG IgM (activate complement)		Transfusion reactions Goodpasture's syndrome Autoimmune hemolysis Hemolytic anemia Certain drug reactions Membranous glomerulonephrosis
III	Immune complex (serum sickness–like)	IgG (form complexes with complement)	6 to 8 hr	Serum sickness Lupus nephritis Occupational allergic alveolitis *Acute viral hepatitis*
IV	*Cell-mediated (delayed) or* tuberculin-type response	—	*48 hr*	*Allergic contact dermatitis* Infectious granulomas (tuberculosis, mycoses) Tissue graft rejection Chronic hepatitis

Adapted from Krupp MA, Chatton MJ: *Current medical diagnosis and treatment*, Los Altos, Calif, 1994, Lange Medical.

TABLE 18-6 Contents of Local Anesthetic Cartridge

Ingredient	Function
Local anesthetic agent	Conduction blockade
Vasoconstrictor	Decrease absorption of local anesthetic into blood, thus increasing duration of anesthesia and decreasing toxicity of anesthetic
Sodium metabisulfite	Antioxidant for vasoconstrictor
Methylparaben*	Preservative to increase shelf life; bacteriostatic
Sodium chloride	Isotonicity of solution
Sterile water	Diluent

From Malamed SF: *Medical emergencies in the dental office*, ed 4, St Louis, 1993, Mosby–Year Book.

*Methylparaben has been excluded from all local anesthetic cartridges manufactured in the United States since January 1984, although it is still found in multidose vials of medication.

TABLE 18-7 Frequency of Dermal Reactions in Patients Exposed to Various Local Anesthetic Agents

Agent	Nonallergic patients (n = 60)	Allergic patients (n = 11)
NaCl	0	0
Procaine	20	8
Chloroprocaine	11	8
Tetracaine	25	8
Lidocaine	0	0
Mepivacaine	0	0
Prilocaine	0	0
Methylparaben	8	NA

From Aldrete JA, Johnson DA: Evaluation of intracutaneous testing for investigation of allergy to local anesthetic agents, *Anesth Analg* 49:173-183, 1970.

NA, Not available.

Anaphylactic shockóó

- Skin reaction
- Muscle spasm
- Ventilatory disturbance
- Cardiovascular depression

Skin reaction

- Erythem/pruritus
- Urticaria
- Vasomotor rhinitis
- Pilomotor erection
- Conjunctivitis
- Nausea/Vomiting

Muscle spasm

- Abdominal cramp
- Diarrhea
- Vomiting
- Defecation/urination

Cardiovascular problem

- Pale
- Lightheadness
- Hypotension
- Tachycardi/Dysrythmia
- Loss of consciousness
- Cardiac arrest

Management of anaphylactic shock

Supine position

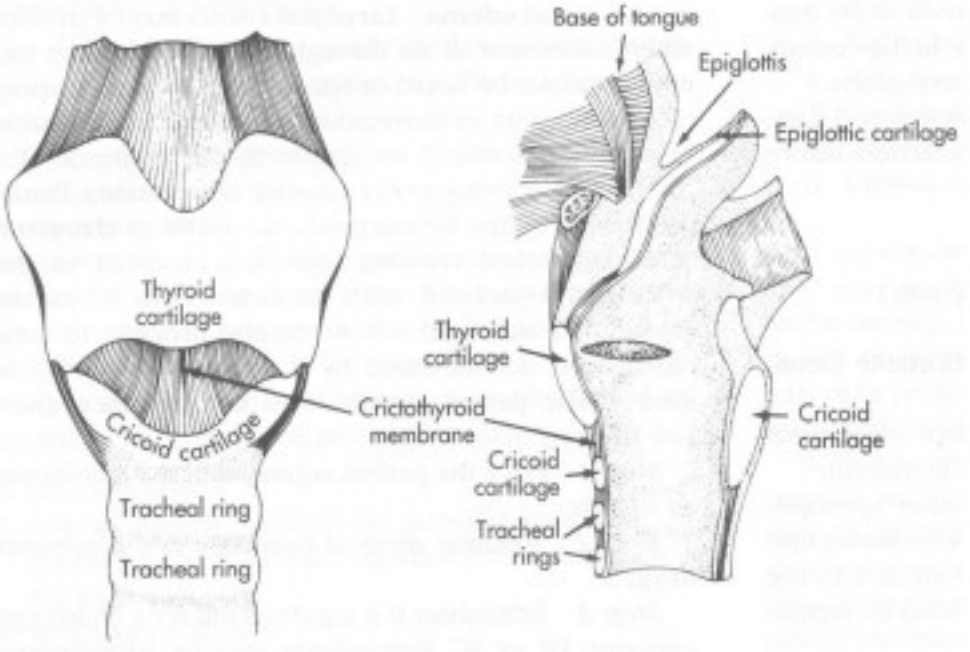
Control vital sign

Quickly Do

Basic life support

Management

- Supine position
- Check V/S
- Epinephrine,IV/IM Q/5-10 minute
- Give oxygen
- Antihistamine
- Corticosteroids



Local Anesthetics: This won't hurt a bit

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Outline

- History
- Local Anesthetics
  - Amides and Esters
  - Structure
  - Mechanism
- Pharmacology
  - General
  - Absorption and Distribution
  - Metabolism
  - Side Effects and Toxicity
  - Future Drugs

A Case to be forgotten?

This won't hurt a bit

If you want to make it into the history books as a hero of medical science, you can't beat a bit of experimentation—on yourself, that is. Is a new drug safe? Take some and find out. Does that vaccine work? Try it and see. The only catch is that you have to survive the experiment long enough to write up your results in a suitably eminent medical journal. One man who did, and earned worldwide fame, was the German surgeon August Bier. In 1898, Bier invented spinal anaesthesia. After a few promising tests on patients, Bier wanted to find out how much they felt during an operation and why they developed horrible headaches afterwards. So, one summer's evening, he asked his assistant to anaesthetize him. It was an experiment they might have preferred forgotten.

Stephanie Pain, New Scientist 2002 173(2330): 48
Wells JA, Philadelphia Academy of Surgery (Ann Surg) 1920, pg 504.

August Bier

"Medical scientists are nice people, but you should not let them treat you!"

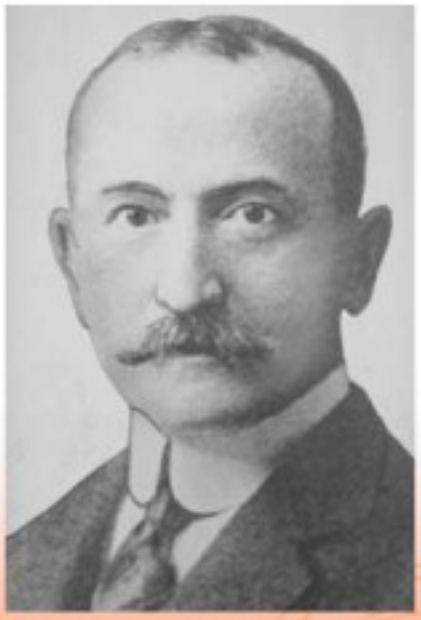
August Bier, unknown date

Cocaine fortified Wine

Lets go Back a bit more

- Sigmund Freud
- Used to treat morphine addiction in late 1870's
- Described uses in article in 1884 – Űber Coca
- Reported localized numbing effect
- Personal Use?

Freud said to his friend…



- Karl Kolher
- 1884
- Applied topically to an eye prior to surgery
- Mixed Success

And they told two people and…

- 1885 - William Stewart Halsted (famous surgeon) used cocaine in a peripheral nerve block
- Only paper he published in area
- In Picture: (L to R) Welch, Halsted, Osler, Kelly (1905, John Hopkin's, painted by Stewart)

Back to the case to be forgotten

- Bier and Hildebrandt were using spinals on animals and patients
  - Some controversy… James Corning was also credited with inventing the spinal
  - Hildebrant supported Corning… angry at Bier?
- General Anesthetics were very dangerous
- Technique became popular – death rate was about 1:450 to 1250

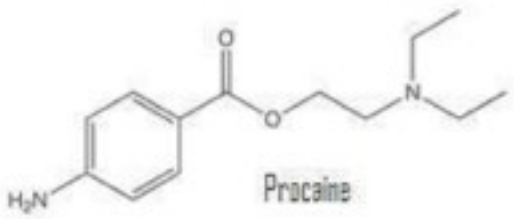
"Cocaine"

If you want to hang out, you've got to take her out, cocaine
If you want to get down, get down on the ground, cocaine
She don't lie, she don't lie, she don't lie, cocaine
If you got bad news, you want to kick them blues, cocaine
When your day is done and you got to run, cocaine
She don't lie, she don't lie, she don't lie, cocaine
If your thing is gone and you want to ride on, cocaine
Don't forget this fact, you can't get it back, cocaine
She don't lie, she don't lie, she don't lie, cocaine

JJ Cale, Troubadour, 1976

Cocaine Abuse

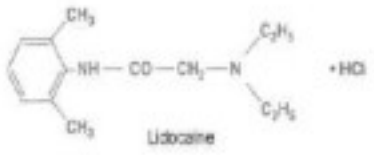
Alternatives...

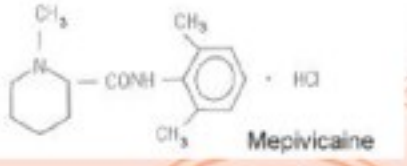


- Very quickly the problems with abuse of cocaine were recognized
- First alternative, procaine, invented 1898
- Procaine was introduced as Novacaine in 1905
- Developed by modifying or making derivatives of cocaine

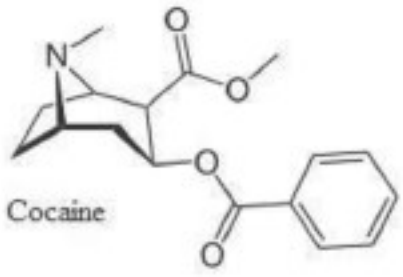
Alternatives

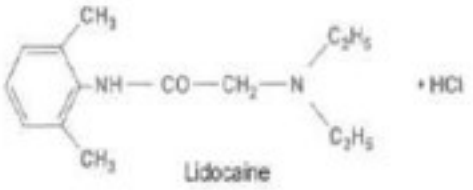
- During WW II Lidocaine was developed
- Lidocaine caused lots of vasodilation
- Experimentation resulted in the formation of new products
- Mepiviciane followed in the 1950's and was less vasodilating and safer to use with cardiac meds

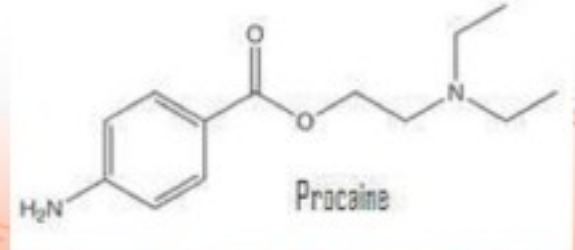




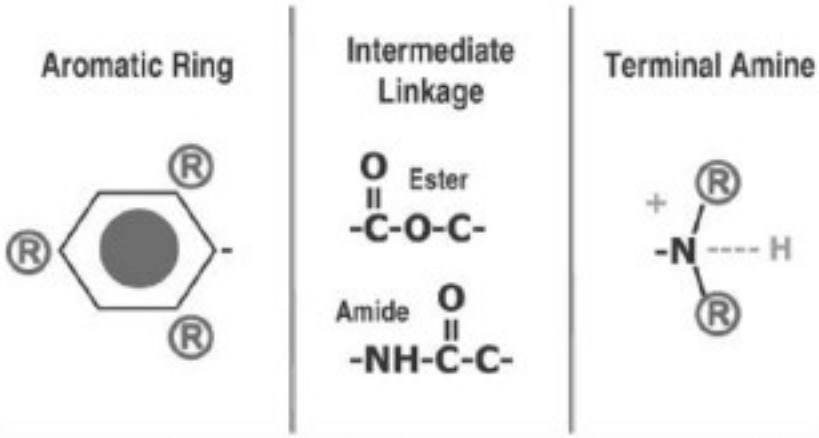
Structure







Structure

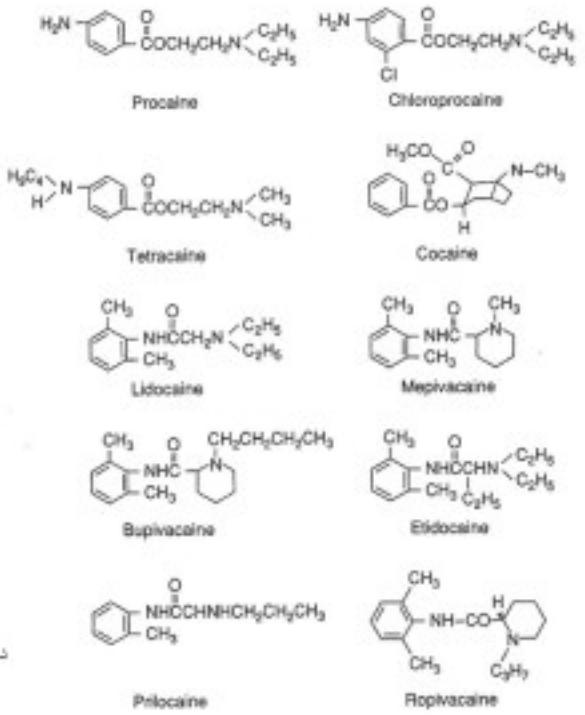


- Aromatic Ring – fat soluble (hydrophobic)
- Terminal Amine – water soluble (hydrophillic)
- Ampophoteric character

Structure

- Sold as solutions of base hydrochloride salts in water
- Only the free base form of the drug can cross a membrane
- The preparations of LA's are acidic and very little free base is found in preparations at pH <5
- "Crack" is the free base of cocaine hydrochloride

Amides and Esters



Amides and Esters

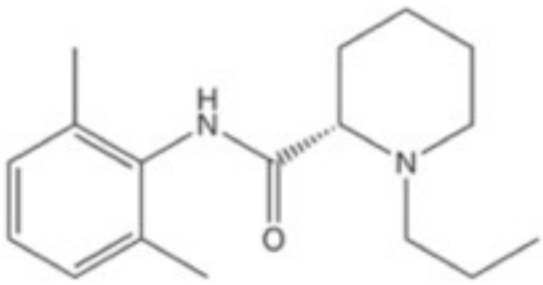
Esters	Potency	Onset	Duration (min)
Procaine	1	Slow	45-60
Chloroprocaine	4	Rapid	30-45
Tetracaine	16	Slow	60-180
Amides			
Lidocaine	1	Rapid	60-120
Etidocaine	4	Slow	240-480
Prilocaine	1	Slow	60-120
Mepivicaine	1	Slow	90-180
Bupivicaine	4	Slow	240-480
Levobupivicaine	4	Slow	240-480
Ropivicaine	4	Slow	240-480

Amides and Esters

Esters	Onset	pK	Non-Ionized Fraction pH 7.4 (%)	Lipid Solubility
Procaine	Slow	8.9	3	0.6
Chloroprocaine	Rapid	8.7	5	
Tetracaine	Slow	8.5	7	80
Amides				
Lidocaine	Rapid	7.9	25	2.9
Etidocaine	Slow	7.7	33	141
Prilocaine	Slow	7.9	24	0.9
Mepivicaine	Slow	7.6	39	1
Bupivicaine	Slow	8.1	17	28
Levobupivicaine	Slow	8.1	17	28
Ropivicaine	Slow	8.1	17	

Amides and Esters

- Pipecoloxylidide local anesthetics
  - Mepivicaine
  - Bupivicaine and Levobupivicaine
  - Ropivicaine
- Have chiral centers and each enantiomer has different pharmacologic properties
- The S isomers appear to be less neurotoxic and cardiotoxic than the R isomers
- Ropivicaine and Levobupivicaine have been developed as enatiomerically pure products



Mechanism

- Sodium Channel
  - At least 9 types are known
    - Named Na_V from 1.1 to 1.9
  - Different neurons have different types
  - Some subtypes are exclusive to sensory neurons (low threshold types)
  - True differential blockade may be possible

Mechanism - Nerves

- At resting potential
  - Axonoplasm is negative (around -70mV)
  - Membrane is freely permeable to K+ and Cl-
  - Membrane is only slightly permeable to Na+

Mechanism - Nerves

- Nerve excitation causes
  - Increase in the permeability of the membrane to Na+
  - The rapid influx of Na+ to the interior of the nerve cell causes the axonoplasm to become more positive
  - The firing threshold is reached (-50 to -60mV)
  - An action potential is created

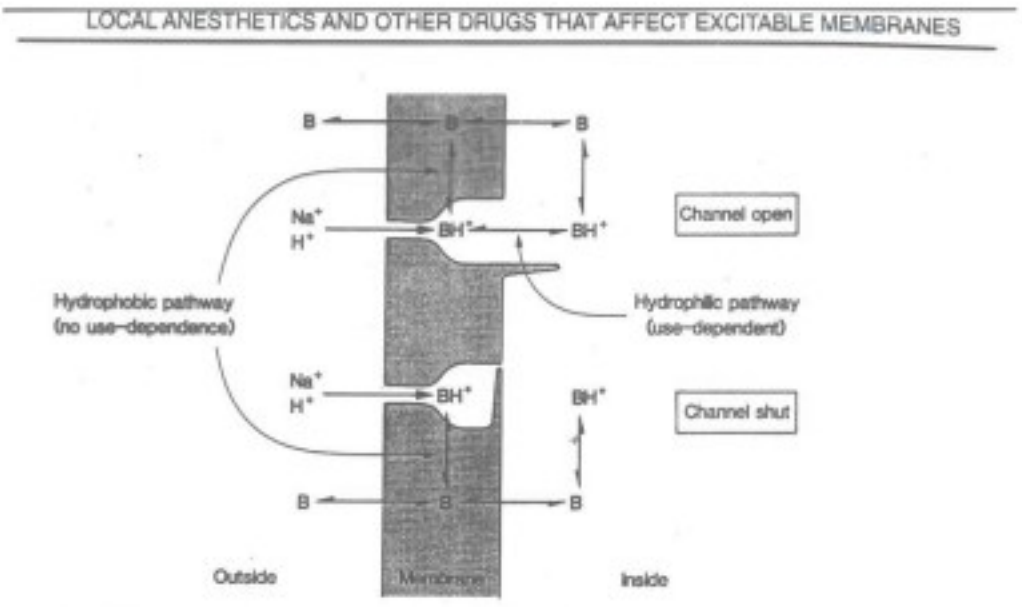
Mechanism - Nerves

- Repolarization
  - At the end of the action potential, the electric potential is positive (+40mV)
  - The nerve membrane becomes impermeable to Na+
  - There is an efflux of K+ and there is a return to normal resting potential

Mechanism

- Prevent transmission of nerve impulses
- Stabilization of closed inactivated Na^+ Channels
  - Specific local anesthetic receptor site?
  - Inside of cell (internal or H gate)
  - LA must first attach Na^+ Channel in active open state
  - Prevents conversion to rested closed and eventually open active states
- Prevents Na^+ permeability from increasing slowing the rate of depolarization and preventing the threshold potential from being reached
- No action potential is propagated
- No alteration of resting potential occurs

Mechanism



Mechanism

- Frequency Dependent Blockade
  - Degree of blockade is increased each time a channel opens
  - Channel access is only available during the open activated state
  - Increase blockade is found in faster firing neurons
- Degree of blockade is a property of nerve anatomy and firing rate
- Other drugs that affect neuronal firing rate may affect degree of LA blockade (anticonvulsants, barbiturates)

Mechanism – Other Targets

- Voltage dependent K^+ channels
- Ca^{2+} Channels (L type)
- Possibly G-protein coupled receptors
- TRPV1 (capsaicin receptor) a type of ion channel

Differential Conduction Blockade

- B-fibers are affected at the lowest concentrations
- Small C-fibers
- C-fibers and small and medium A-fibers
- Result
  - Loss of pain and temperature
  - Touch, propioception and motor preserved
- High concentrations all can be blocked

Order of Blockade

1. pain
2. cold
3. warmth
4. touch
5. deep pressure
6. motor

- Recovery is in reverse

Cm – Minimum Concentration

- *Cm* is the minimum concentration of a LA to produce a conduction blockade
- Analogous to MAC for inhaled AA
- Factors Affecting *Cm*
  - Nerve Fiber diameter (increases)
  - Increased tissue pH (decreases)
  - Increased rates of nerve firing (decreases)
  - Length of nerve exposed to LA (longer better block)
- Unique to each LA
- *Cm* for motor neuron roughly 2X sensory neuron

Pharmacology

- LA are weak bases
- pK value determines amount of free drug
- pK's are above physiologic pH
- <50% of drug is not protonated (lipid soluble)
- Example: Lidocaine
  - pH = 7.2, ionized fraction 17%
  - pH = 7.4, ionized fraction 25%
  - pH = 7.6, ionized fraction 33%
- Accounts for poor effectiveness when acidosis (local or systemic) is present
- pK's closest to physiologic pH (7.4) have most rapid onset

Pharmacology

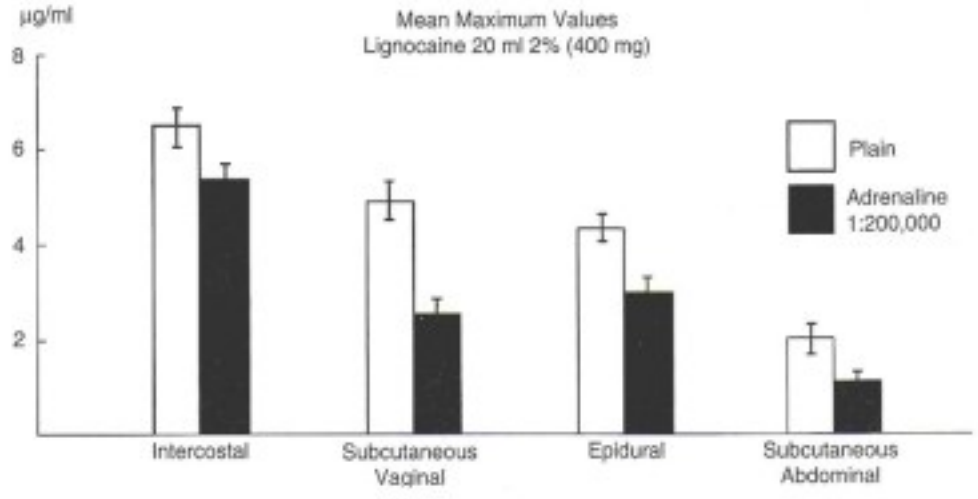
- Potency
  - pK of LA
  - Vasodilator activity (onset and duration)
  - Lipid solubility
    - sequestration

Absorption and Distribution

- Site of injection
- Dose

- Rate of tissue distribution
- Rate of clearance

Absorption and Distribution



Absorption and Distribution

- Lung
  - Significant uptake of LA's
  - Dose dependent – less at high concentrations
  - Propanolol limits bupivicaine extraction

- Pregnancy and Placenta
  - Increased maternal sensitivity to LA's
  - Altered protein binding of LA's
  - Higher serum concentrations (free) and less bound LA
  - LA's cross placenta
    - Esters cross much less than amides
    - Ion trapping of protonated LA can occur due to acidic fetal pH
  - PIH slows the rate of LA clearance (lidocaine)

Clearance

- Clearance = amount of plasma volume cleared of drug in given time (volume/time)

- Relatively little LA is cleared without metabolism

- Amides
  - Liver cytochromes (Cyp 1A9 and Cyp 3A4)
- Esters
  - plasma esterases and to lesser degree liver esterases

- Clearance is affected by hepatic blood flow
  - Propanolol has been shown to reduce clearance of LA's (bupivcaine best evidence)
  - Thought to be due to reduction in hepatic blood flow

- Renal clearance is limited due to solubility

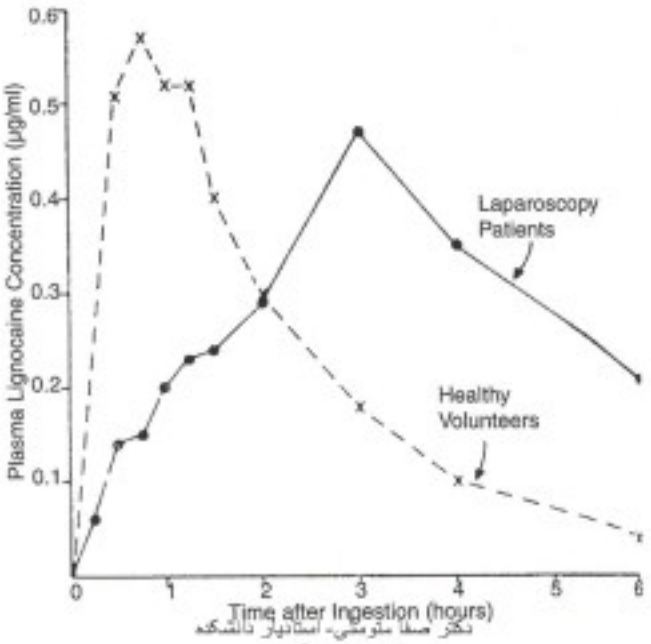
Clearance and Drug-Drug Interactions?

- Cytochrome P450 3A4
  - **Inhibitors**:Amiodarone, amprenavir, cannaboids, cimetadine, clarithromycin, clotrimazole, cyclosporin, delavirdien, diltiazem, ethinylestradiol, erythromycin, fluconazole, fluoxetine, fluvoxamine, indinavir, itraconazole, ketoconazole, metonidazole, mibefradil, micronazole, nefazadone, nelfinavir, nicardipine, norfloxacin, propafol, quinine, ritonavir, saquinavir, sertraline, troleandomycin, verapamil, zafirlukast
  - Themes
    - HIV
    - Fungal Infections
    - Depression
    - Cardiac
    - Asthma
    - Anesthesia
  - No drug interactions reported but you may want to be more careful with dosing

Clearance and Drug-Drug Interactions

- Cytochrome P450 1A9
  - Variable expression – small portion of population has non-functional enzyme
  - Inducers: caffeine and smoking
  - Inhibitors: fluvoxamine, fluoxetine

Clearance - Anesthesia

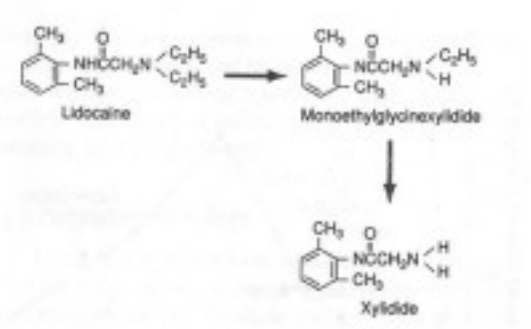


Drug Interactions

- **Barbiturates, Opioids, Anti-anxiety drugs**
  - CNS depressants administered in conjunction with local anesthetics lead to potentiation of the CNS depressant actions
- **Barbiturates**
  - Drugs inducing hepatic microsomal enzymes may alter rate of biotransformation
- **Depolarizing muscle relaxant**
  - Esther local anesthetic + Succinylcholine = prolonged apnea
  - Mechanism?

Lidocaine Metabolism

- Liver (CYP 1A2, CYP 3A4)
- Oxadative dealkylation
- Metabolites are active
- Protect against cardiac arrhythmias
- Metabolites renally cleared
- Hepatic blood flow important – high first pass effect
- PIH – relatively poor clearance of lidocaine
- Decreased protein binding in pregnancy
- Monoethylglycinexylidide is toxic and there are recommendations to monitor levels if >900 mg total dose lidocaine is given (Is this possible?)

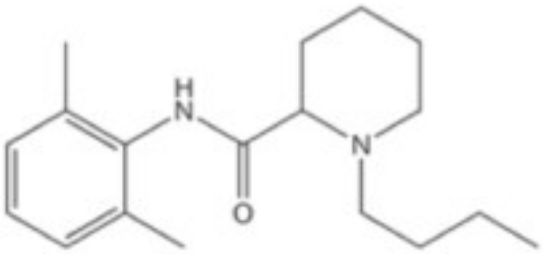


Prilocaine Metabolism

- Liver (CYP 1A2)
- Metabolite called orthotoluidine is an oxidizing agent
- Orthotoluidine will convert hemoglobin to methemoglobin
- Methhemoglobinemia results at doses over 600 mg (up to 3 to 5 g/L)
- Dose should not exceed 7 mg/kg
- Decreased oxygen carrying capacity
- Administration of methlyene blue can reverse methemogobinemia

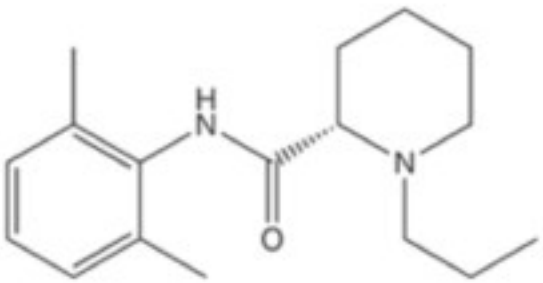
Bupivicaine Metabolism

- Liver (CYP 3A4, CYP 1A2)
- Multiple possible paths
- Metabolites are renally cleared
- 2,6-pipecikoxylidide derivatives can accumulate in renal failure (toxic effects)
- a1-acid glycoprotein bound – higher serum concentrations following trauma or surgery



Ropivicaine Metabolism

- Liver (CYP 1A2, CYP 2C11, CYP 3A4)
- Metabolites are renally cleared
- 2,6-pipecikoxylidide derivatives can accumulate in renal failure (toxic effects)
- Cleared faster than bupivicaine – mitigates toxicity

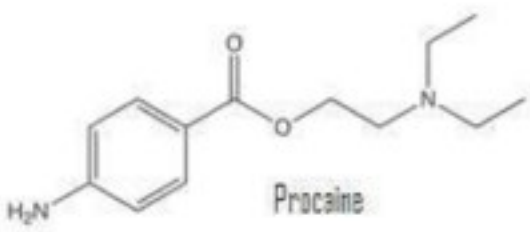


LA Ester Metabolism

- Plasma cholinesterases > liver esterases
- Cocaine is only exception (liver mostly)
- LA toxicity is inversely proportional to rate of hydrolysis
- Metabolites are generally inactive
- Metabolites cleared by kidney
- Hepatic disease slows rates of metabolism

Procaine

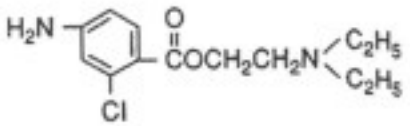
- Metabolized to para-aminobenzoic acid (PABA)
- May cause allergic reactions
- Moderate rate of hydroloysis



- PABA is a common metabolite to all Ester LA and allergic cross reactivity is often seen

Chloroprocaine

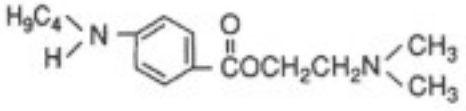
- Metabolized 3.5 times faster than procaine
- Thought to be useful in situations where plasma esterase activity is low
  - Neonates
  - Pregnancy
- However, even at reduced amounts and activity of plasma esterases the rates of hydrolysis are fast



Chloroprocaine

Tetracaine

- Slowest rates of hydrolysis of the esters

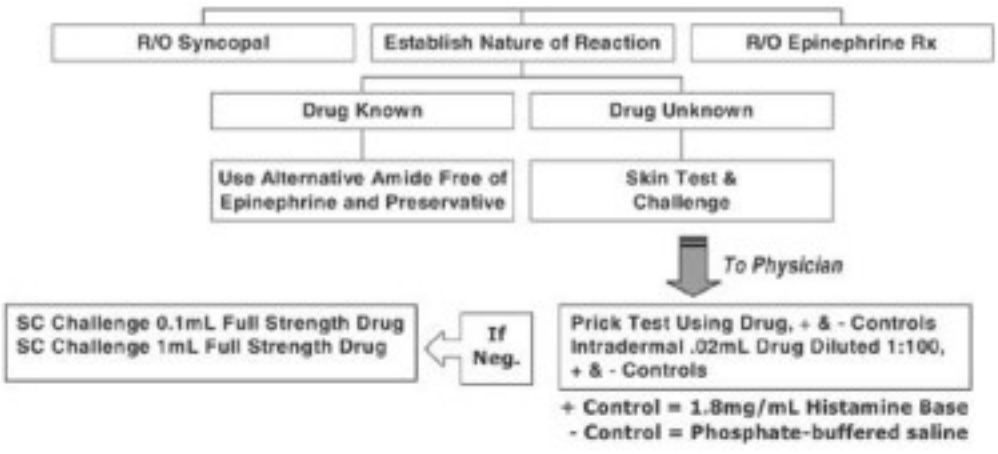


Tetracaine

Side Effects - Allergy

- Rare Events
- <1% of all adverse reactions
- Often systemic toxicity is attributed to allergy
- Esters are more likely to cause allergy
  - PABA
- Allergy is usually due to preservatives
  - methyl paraben (structurally similar to PABA)
  - Sodium metabisulphite
- Antibodies are made to preservatives not LA
- Known allergies to Ester LA do not preclude use of Amide LA
- Allergy determination
  - History
  - Skin testing
  - Intradermal testing
- Epi – can cause hypotension and sometimes syncope following LA administration is actually intravascular injection

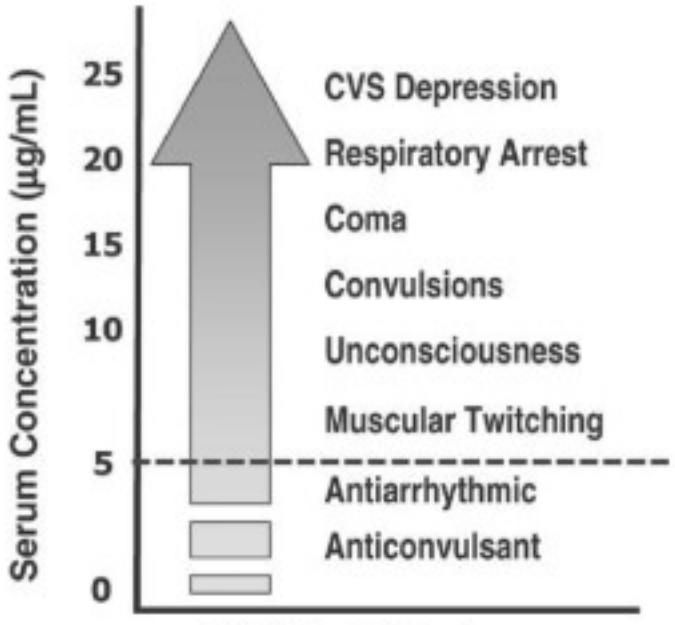
Allergy



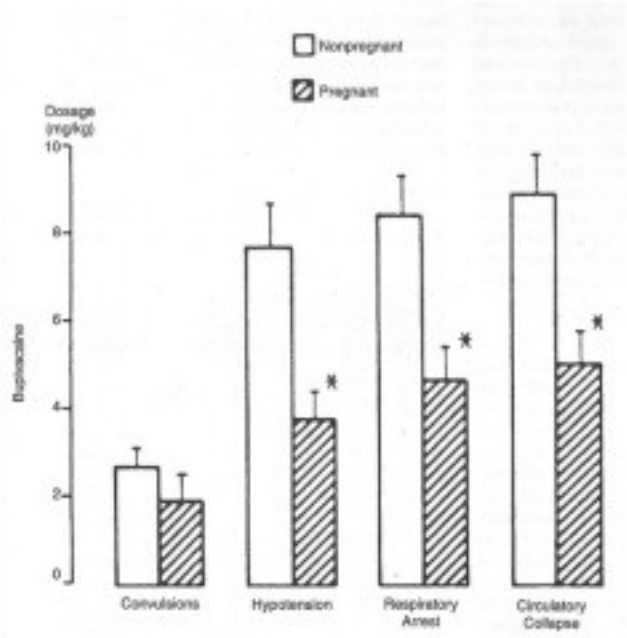
Systemic Toxicity

- Too much LA in plasma
  - Rate of absorption versus distribution
  - Drug
  - Where it is injected
    - IV
    - Depot
- Low $PaCO_2$ increases likelihood of seizures
- Hyperkalemia increases toxicity
- High serotonin levels may increase likelihood of seizures (SSRI's, MAOI's – little research)

Systemic Toxicity - Lidocaine



Systemic Toxicity - Bupivicaine



Systemic Toxicity - Treatment

- ABC's
- Supportive Care
- Rescuable – Don't Stop CPR
- Consider Cardio Pulmonary Bypass
- Antidotes
  - Bretylium (not an option anymore)
  - Lidocaine for Bupivicaine (theoretical)
  - Intralipid infusion
    - 0.25 g/Kg/min for minimum 10 minutes
    - Central line

Weinberg GL, Anesthesiology 1998; 88: 1071-5.
Weinberg G, Regional Anesthesia and Pain Medicine 2003; 28: 198-202.

Local Toxicity

Neurotoxicity

- Range of symptoms: patch numbness to muscle weakness
- Often blamed on positioning during delivery

- **Transient Radicular Irritation**
  - Severe pain lower back, buttocks, posterior thigh
  - Develops within 24 hours of dosing
  - May require opiods
  - Recovery usually in one week
  - Lidocaine and Mepivicaine implicated – dose dependent
  - Less problems with bupivicaine, ropivicaine, tetracaine
  - Some concerns about epi/norepi exacerbating problem

Local Toxicity

Cauda Equina Syndrome

- Sensory anesthesia
- Bowel and bladder sphincter dysfunction
- Paraplegia

- Lidocaine implicated – use of spinal catheters

Anterior Spinal Artery Syndrome

- rare
- Paresis with spared or partial sensory deficit
- Mechanism not known
- Difficult to distinguish from epidural hematoma / abscess
- Risk Factors
  - Advanced age
  - Peripheral Vascular Disease

Methemoglobinemia

- Life threatening
- Congenital :
  - NADH methemoglobin reductase (diaphorase I) deficiency
  - hemoglobin M disease
  - pyruvate kinase deficiency
  - G-6-PD deficiency
- Culprits
  - Prilocaine
  - Benzocaine
  - Cetacaine
  - Lidocaine (pediatric > adult)
- Common Non LA: NTG, phenytoin, sulfonamides
- Reversed by methylene blue
  - 1 to 2 mg/kg IV over 5 minutes
  - Do not exceed 7-8 mg/kg
  - Normal Hgb restored in 20 to 60 minutes
  - Benefits may be transient due to depot of LA in adipose tissue or clearance of methylene blue

LA Resistance

- Case Reports of LA Failure
- Reported in Complex regional pain syndromes
- Associated with Spinal Anesthetics
- Peripheral nerve blocks or local infiltration work – but degree of block may be less
- DDx
  - Failure of technique
  - Anatomic differences in spinal cord
  - Anxiety – mental status of patient
  - Possible Genetic polymorphisms?
    - Few Na Channel polymorphisms are known – marginal effect on function of channel
      - Liddle's Syndrome
      - Prolonged QT – possible
      - Epilepsy
      - Kavlock, BMC Anesthesiology 2004, 4:1.

Uses

- Local infiltration
- Nerve Blocks
- IVRA (Bier Block)
- Epidural
- Spinal
- Total Spinal (aka dural anesthetic)
- Grand Mal Seizure suppression
- Ventricular arrhythmia suppression
- Tachycardia suppression (intubation)
- Anti-inflammatory effects
- Bronchodilation – AW reactivity
- Liposuction

New Products

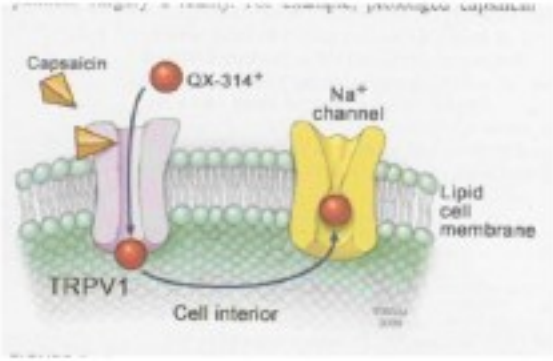
- Few “new” products

- Enatiomerically pure LA’s
  - Levobupivicaine
  - Ropivicaine

- Liposomal preparations
  - Longer duration
  - Transdermal absorption

Possible New Product

- Other Channels
  - TRPV1 (capsaicin receptor) can be used to introduce analogs into some neurons
  - Lidocaine has also been shown to open TRPV1
  - New drug QX-314$^+$ (permanently charged lidocaine) introduced into cells using TRPV1 producing differential blockade



Question 1

Based on pKa which local anesthetic should be fastest acting at normal physiologic pH?

A. Lidocaine (pKa 7.9)
B. Mepivicaine (pKa 7.6)
C. Bupivicaine (pKa 8.1)
D. Procaine (pKa 8.9)

Question 2

Which reason below might not explain why mepivicaine does not have the fastest onset compared with lidocaine?

A. Lipid Solubility
B. Vasodilatation of tissues by local anesthetic
C. pH = 7.1
D. Local anesthetic potency

Question 3

Which local anesthetic should be safe to use in a patient with previous allergy to procaine?

A. Preservative free procaine
B. Tetracaine
C. Lidocaine
D. None of the above

Question 4

A dialysis patient has an epidural. The pain serivce has been using 0.125% bupivicaine. Which factor would reduce the risk of toxicity?

A. The patient is on parnate
B. The patient missed dialysis today
C. The patient has liver impairment
D. The patient has a blood $PC0_2$ of 50

Question 5

Local anesthetics stabilize?

A. The open H gate
B. The closed Sodium Channel Channel
C. The rested closed Sodium Channel
D. The open Sodium Channel

Question 6

During pregnancy local anesthetics:

A. Bind albumen more avidly
B. Bind alpha-1-acid-glycoprotein more avidly
C. Cross the placenta freely
D. Fetal plasma proteins bind local anesthetic more avidly than maternal plasma proteins

Question 7

Two minutes following IV injection of bupivicaine, one would expect to find the highest concentrations of local anesthetic in the?

A. Lung
B. Vessel Rich organs
C. Muscle
D. Blood

Question 8

Despite a well mother, a newborn appears to be lethargic and hypo-responsive. Which factor could best explain these clinical findings:

A. Maternal overdose of Local Anesthetic
B. Using Bupivicaine versus Levobupivicaine in epidural
C. A cord blood gas pH of 7.05
D. Using Ropivicaine in epidural

Question 9

Which block should produce the lowest serum concentrations of bupivicaine if 100 mg were injected?

A. Epi-vaginal
B. Intercostal
C. Caudal
D. Subcutaneous abdominal skin infiltration using bupivicaine with epinephrine

Question 10

A infant presents in the ER following circumcision. The infant appears blue and has had a seizure. Which piece of clinical information would help quickly diagnose the infant.

A. CXR
B. ABG
C. CBC
D. History of EMLA use prior to circumcision

The End

- That's all Folks!
- Thank-you
- Questions… Answers possibly?