

# SYSTEMIC COMPLICATIONS OF LOCAL ANESTHESIA

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# TOXICITY

- The toxic dose for most agents used in oral and maxillofacial surgery is between 300 and 500 mg (about 5mg/kg).
- In a standard 1.8 ml dental cartridge of 2% solution of local anesthetic, there is 36 mg of the drug (20mg/ml X 1.8ml=36mg).
- The injection of 10 cartridges of 2% solution would be in the range of toxicity.

- The precise toxic level varies with the age, weight and condition of the patient as well as site and rapidity of injection and concentration of the vasoconstrictor, all of which affects absorption.
- Two body systems are mainly affected by toxic level of circulating local anesthetic drug:
  - The cardiovascular system
  - The central nervous system

# Cardiovascular effects

- At non-toxic level there is no appreciable systemic cardiovascular effect from the injection of local anesthetics.
- However, as toxic level are approached, the blood pressure is affected.
- Most of the local anesthetics are vasodilators, blood pressure is decreased owing to decrease in peripheral resistance.

**Blood pressure = Total peripheral resistance X cardiac output**

- This is followed at increasing level by a decrease in myocardial contractility, since local anesthetics also affect nerve conduction in the heart.
  - This results in a decreased heart rate that



decreased cardiac output.



Further decrease in blood pressure

**Cardiac output = heart rate X stroke volume**

- The heart contains its own intricate neuronal conduction system that can also be inhibited or completely blocked by the local anesthetic agent.
- At toxic levels, depression of intracardiac nerve conduction can result in arterioventricular dissociation, ventricular rhythm, ventricular fibrillation and ultimately cardiac stand still.

# Central nervous system effects

- CNS contains facilitatory neurons and inhibitory neurons
- At non-toxic therapeutic levels the LA agents have no effect on CNS
- As they reach toxic level,
  - the conduction of inhibitory neurons is usually blocked.
  - Action of facilitatory neurons is unmodified i.e., convulsive like movements.



- As the dose increases further, the facilitatory neurons are also blocked resulting in cessation of function.
- Certain amide type agents i.e., lidocaine affect primarily facilitatory neurons, hence depression is seen rather than excitation.
  - De Jong, Robler and Corbin (1969)
- The respiratory system is affected by CNS depression which can result in respiratory arrest.

- At toxic levels of LA agents both cardiac and respiratory arrest may begin
- Toxic reactions are generally preventable by avoiding intravascular injection through the aspiration and by limiting dosage to reasonable quantities

# Hypersensitivity (allergy)

- Hypersensitivity is manifested by skin rash, urticaria, edema, and its full blown state by anaphylaxis.
- Patient may be eliminated as allergic to local anesthetics and classified under idiosyncratic reactors on basis of history

- If it can be determined that the reaction was in response to procaine or another ester-type anesthetic, an amide type can be substituted.
- If the reaction supposedly was to an amide type agent, several alternatives are available-
  1. Have the patient skin tested for reaction to specific LA to be used.
  2. If allergy is due to methyl paraben, cardiac lidocaine, which doesn't contain methyl paraben can be used.
  3. If allergy is to the anesthetic, a 10% solution of diphenhydramine hydrochloride (Benadryl), which has anesthetic properties as well as being an antihistamine can be used.

# Anaphylactic Shock

- Anaphylactic shock is a life threatening reaction.
- The sign and symptoms are rapidly occurring and progressive.
- The patient may experience urticaria, abdominal cramping, diarrhea.
- This is accompanied by respiratory distress, cyanosis, hypotension, cardiovascular collapse and unconsciousness.

- Treatment must be rapid and succinct.
- The patient is placed in a supine position and airway is controlled.
- Oxygen is administered and it may be necessary to ventilate the patient manually.
- Epinephrine (0.3-0.5mg) is given immediately either subcutaneously or intravenous.

- An antihistamine and a steroid may also need to be administered.
- Cardiopulmonary resuscitation is started and patient should be transferred to the hospital in an ambulance as soon as possible.

# Idiosyncratic reactions

- Idiosyncrasy is an abnormal reaction to a normal dose of a drug
- These reactions are extremely variable and unpredictable
- They may resemble toxic or allergic reactions but differ in terms of etiology



- Treatment of idiosyncratic reactions vary with the symptoms and is often the same as the therapy used for similar conditions classified as toxic or allergic in origin.
- Of prime importance in all instances in maintenance of airway and support of respiration and circulation.
- Syncope has frequently been considered an idiosyncratic reaction.

# **Syncope (vasovagal attack)**

- Syncope is a sudden, transient loss of consciousness, usually secondary to cerebral ischemia.

# Pathophysiology

Psychogenic and non-psychogenic factors

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graph TD; A[Psychogenic and non-psychogenic factors] --> B[Increased catecholamine release]; B --> C[Decreased peripheral vascular resistance];
```

Increased catecholamine release

Decreased peripheral vascular resistance

Pooling of blood in periphery

```
graph TD; A[Pooling of blood in periphery] --> B[Decreased arterial blood pressure]; B --> C[PRE SYNCOPE (EARLY STAGE)];
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Decreased arterial blood pressure

PRE SYNCOPE (EARLY STAGE)

Decompensation

```
graph TD; A[Decompensation] --> B[PRE SYNCOPE (LATE STAGE)]; B --> C[Reduced cerebral blood flow]; C --> D[Lightheadedness , SYNCOPE]; D --> E[Seizure activity];
```

PRE SYNCOPE (LATE STAGE)

Reduced cerebral blood flow

Lightheadedness , SYNCOPE

**If prolonged**

Seizure activity

# Clinical manifestations

- **PRE SYNCOPE (EARLY STAGE)**
  - Tachycardia
  - Feeling of warmth
  - Pallor
  - Perspiration
  - Rapid breathing caused by compensatory mechanism

- **PRE SYNCOPE (LATE STAGE) :-**
  - Reflex vagally mediated bradycardia
  - Nausea
  - Weakness
  - Hypotension
  - Cold extremities

- **SYNCOPE**

- Irregular breathing
- Dilatation of pupils
- Bradycardia
- Thready pulse
- Loss of consciousness

- **POST SYNCOPE (RECOVERY)**

- May exhibit pallor
- Nausea
- Weakness and sweating for few minutes to many hours



# MANAGEMENT

- **PRODOME:**

- Terminate all dental treatment
- Position patient in supine position with leg raised above the level of head
- Attempt to calm patient
- Place cool towel on patient's forehead
- Monitor vital signs

- **SYNCO PAL EPISODE**

- Terminate all dental procedures
- Position patient in supine position with legs raised
- Check for breathing
  - If absent:
    - Start life support
    - Summon medical assistance
    - Consider other causes of syncope including hypoglycemia, cerebral vascular accident or cardiac dysrhythmia
  - If present:
    - Inhalation of aromatic spirit of ammonia, administer oxygen.
    - Monitor vital signs.

**Thank you**