

# Possibilities of anesthesia in childhood

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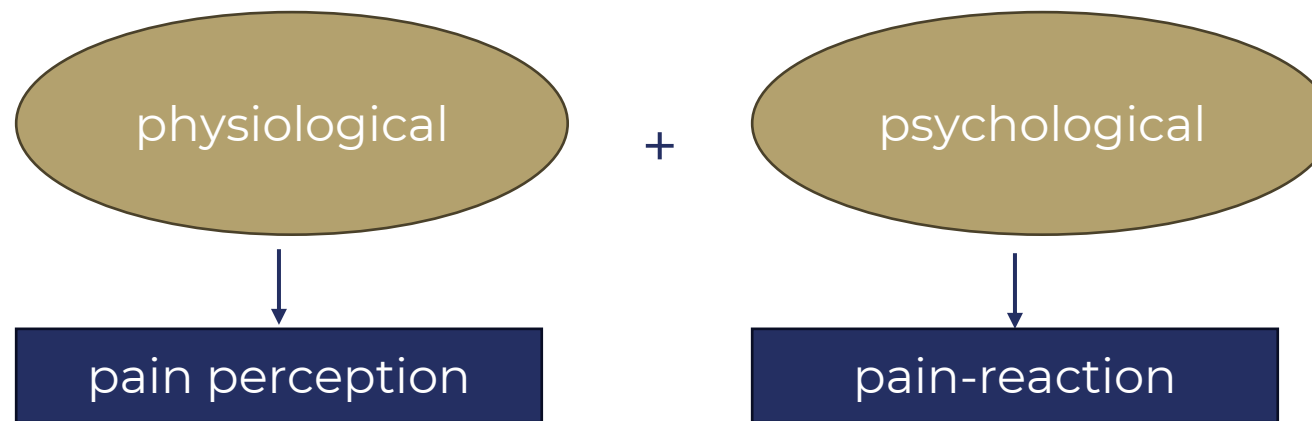
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# Pain

- **def:** „An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage
- components:



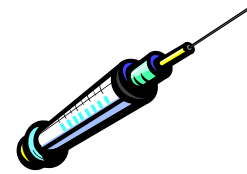
Raja SN, Carr DB, Cohen M, Finnerup NB, Flor H, Gibson S, Keefe FJ, Mogil JS, Ringkamp M, Sluka KA, Song XJ, Stevens B, Sullivan MD, Tutelman PR, Ushida T, Vader K. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. *Pain*. 2020 Sep 1;161(9):1976-1982. doi: 10.1097/j.pain.0000000000001939. PMID: 32694387; PMCID: PMC7680716.

# Intensity of pain-reaction

- influenced by:
  - age
  - sleep quality
  - social background, parental patterns
  - prior experiences
  - general health condition
  - mood
  - stage of psychological and intellectual development

# Aim: **pain-free** dental treatment

- local anesthesia (LA)
- conscious sedation
- general anesthesia (GA) / narcosis



# Local anesthesia

Temporary loss of sensation in one part of the body produced by a topically-applied or injected agent.

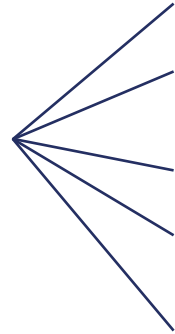
American Academy of Pediatric Dentistry. Use of local anesthesia for pediatric dental patients. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:385-92.

# Methods

terminal  
anesthesia

block  
anesthesia

ganglion  
anesthesia



- topical (mucosal)
- submucosal
- intramucosal
- intraligamentary
- intraosseous



# Childhood characteristics

- jaw
  - structural differences – thinner cortical bone → better infiltration
  - anatomical differences - smaller size
- higher metabolic rate

➔ terminal anesthesia  
anesthetic agent – ample potency, low systemic toxicity, reasonable duration of action

# General principles

- detailed, accurate anamnesis
- proper explanation – what, why and how we do it
- steady hands
- slow and steady drug administration
- warning for numbness



# Local anesthetics

# Types of local anesthetics

| Ester             |                     | Amide            |  |
|-------------------|---------------------|------------------|--|
| Generic name      | Brand name          | Generic name     | Brand name                                 |
| procaine          | Novocaine           | <b>lidocaine</b> | Lidocaine, Lidocan, Xylocaine              |
| tetracaine        | Pantocain           | <b>articaine</b> | Carticain, Ultracain, Ubistesin, Septanest |
| <b>benzocaine</b> | Anacaine, Topicaïne | bupivacaine      | Bupivacaine, Marcaine                      |
|                   |                     | mepivacaine      | Carbocaine, Scandonest                     |
|                   |                     | prilocaine       | Citanest, Xylonest                         |

# Local anesthetics used in childhood

## • Lidocaine

- products:
  - Inj. Lidocaine 2% - epinephrine 0,001% (20mg/0,01mg/ml)
    - **max dosage**
      - **AAPD - 4,4 mg/kg**
      - **manufacturer's recommendation (MRD): 7mg/kg**
  - Inj. Lidocaine 2% - without epinephrine **(MRD): 5mg/kg**
  - Spray Lidocaine 10%
  - Ung. Lidocaine 5 %
- contraindication: allergy - rare



American Academy of Pediatric Dentistry. Use of local anesthesia for pediatric dental patients. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:385-92.

[https://www.hazipatika.com/gyogyszerkereso/termek/lidocain\\_adrenalin\\_20\\_mg\\_001\\_mg\\_ml\\_oldalatos\\_injekcio/941](https://www.hazipatika.com/gyogyszerkereso/termek/lidocain_adrenalin_20_mg_001_mg_ml_oldalatos_injekcio/941)

# Local anesthetics used in childhood

- **Articaine**

- products:

- Inj. Ultracain DS forte 4 % - epinephrine (40mg/0,012mg/ml) **7mg/ kg**
    - Inj. Ultracain 1%, 2% - without epinephrine **5mg/ kg**

- excellent diffusion

- until 10-12 yo: for terminal infiltration of lower primary molars and premolars

- 4 yo <: first choice

- faster metabolism than lidocain – amide linkage + ester group in its structure

- contraindication:

- narrow angle glaucoma
    - < 4 yo – manufacturer's recommendation



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[https://www.hazipatika.com/gyogyszerkereso/termek/ultracain\\_ds\\_forte\\_oldatos\\_injekcio/1743](https://www.hazipatika.com/gyogyszerkereso/termek/ultracain_ds_forte_oldatos_injekcio/1743)

# Local anesthetics used in childhood

- **Benzocaine**

- 20% gel
  - topical anesthesia
  - flavored
  - risk of acquired methemoglobinemia
- **contraindicated:**
  - methemoglobinemia – Hb can carry oxygen, but is unable to release it effectively to the tissues
  - < 2 yo (OTC products)



American Academy of Pediatric Dentistry. Use of local anesthesia for pediatric dental patients. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:385-92.

<https://recalls-rappels.canada.ca/en/alert-recall/benzocaine-products-should-not-be-used-children-under-two-years-age>

<https://www.fda.gov/news-events/press-announcements/fda-takes-action-against-use-otc-benzocaine-teething-products-due-serious-safety-risk-lack-benefit>

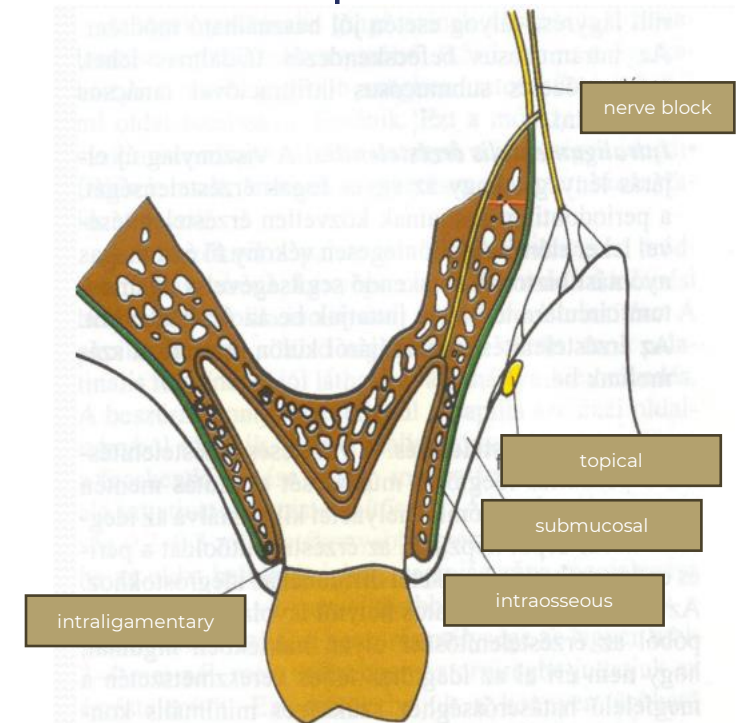
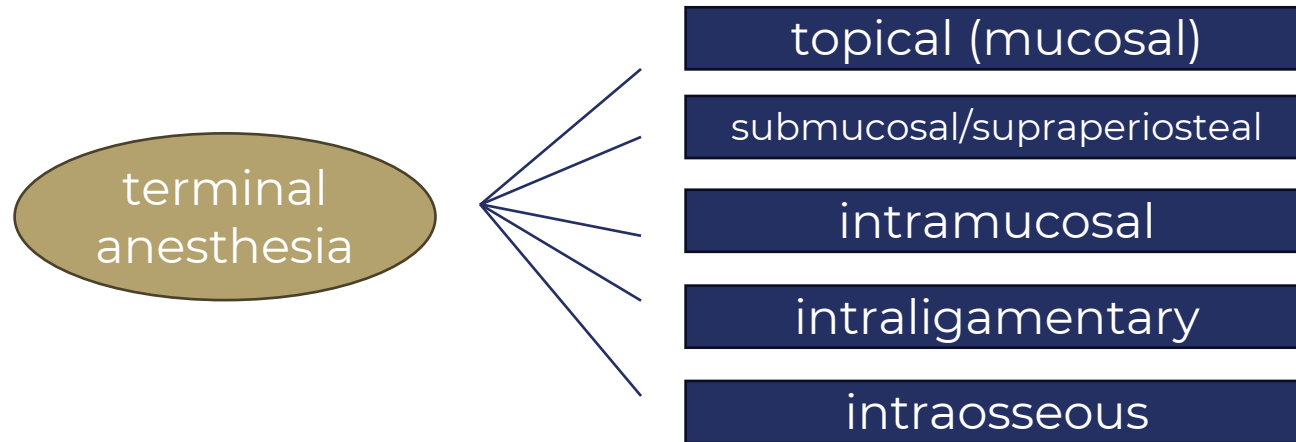
<https://www.amtouch.com/shop-by-category/anesthetic/crosstex-gumnumb-topical-anesthetic/>

# Methods of local anesthesia

terminal anesthesia

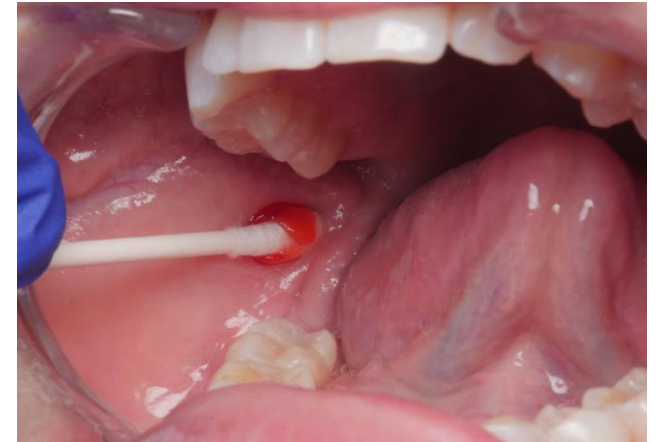
# Terminal infiltration anesthesia

- anesthetizes the terminal nerve ending of the dental plexus



# Terminal anesthesia– topical (mucosal) anesthesia

- targeting free nerve endings in the mucosa
- up to 2-3 mm
- rapid absorption – gel, cream, spray
- onset: ~ 30sec.
- ind:
  - numbing the insertion point
  - extraction of mobile, root-resorped primary teeth



<https://www.amtouch.com/shop-by-category/anesthetic/crosstex-gumnumb-topical-anesthetic/>  
<https://www.egeszsegkalauz.hu/gyogyszerkereso/termek/lidocain-egis-kulsoleges-oldatos-spray/945>  
<https://www.vulephoto.com/Dental/How-to-Apply-Topical-and-How-to-Buffer-Your-Injections/i-Zw24MqG>



# Terminal anesthesia – submucosal infiltration

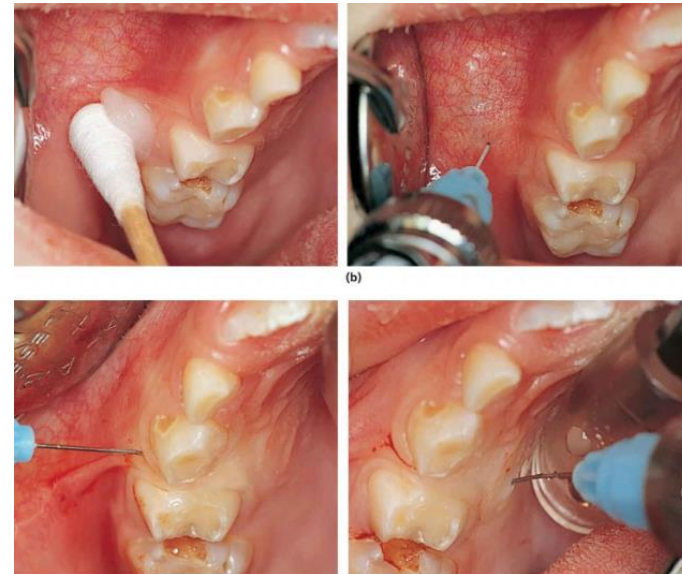
- the submucosal layer is present
- deposited near to the apex
- continuous deposition during insertion
  - insertion canal preparation
  - avoid accidental intravascular injection



Lasemi, Eshagh & Navi, Fina & Motamedi, Mohammad & Jafari, Seyed & Talesh, Kourosh & Qaranizade, Kamal & Lasemi, Reza. (2015). Novel Modifications in Administration of Local Anesthetics for Dentoalveolar Surgery. 2. Chapter 4. 10.5772/59235.

# Terminal anesthesia – intramucosal infiltration

- gingiva propria - submucosal layer is absent (attached gingiva, hard palate)
- smaller amount of drug is administered
- very painful – submucosal inf. before insertion (transpapillary infiltration)
- ind:
  - inflamed tissues
  - primary tooth extraction



<https://pocketdentistry.com/9-pain-pain-control-and-sedation/>

# Terminal anesthesia – intraligamentary anesthesia

- injection directly into the periodontal ligaments against the high periodontal tissue resistance
- **ind:** single tooth anesthesia - ∅soft tissue numbness
- **contra**indication:
  - inflammation or infection at the injection site (gingivitis, periodontitis)
  - risk of endocarditis
  - haemorrhagic diathesis



<https://www.dreamstime.com/d-render-human-jaw-intraligamentary-anesthesia-procedure-over-white-background-image258318697>

# Terminal anesthesia– intraligamentary anesthesia

- Carpule syringe
  - thin needle , high-pressure injection – painful
  - 0,4 ml/ permanent tooth
- CCLAD – computer-controlled local anesthetic delivery
  - Wand™ STA System, Quicksleeper
  - continuous administration at a constant, low-speed
  - primary teeth: 0,2-0,4 ml - 2 insertion points
  - 6 yo - : single root: 0,4-0,9 ml – 1 insertion point  
multiple roots : 1,2 ml – 1 insertion point



<https://www.medicalexpo.com/prod/dentalhitec/product-71964-7059>

[https://www.researchgate.net/figure/The-Wand-R-STA-Milestone-Scientific-a-computer-controlled-local-anesthesia-delivery\\_fig4\\_323759238](https://www.researchgate.net/figure/The-Wand-R-STA-Milestone-Scientific-a-computer-controlled-local-anesthesia-delivery_fig4_323759238)

<https://www.sciencephoto.com/media/778410/view/novocaine-carpule-in-anaesthetic-syringe>

# Terminal anesthesia – intraosseous anesthesia

- CCLAD systems made it possible
- directly into the cancellous bone adjacent to the tooth to be anesthetized – soft tissue numbness ↓
- even with teeth characterized by MIH (molar incisor hypomineralisation)
- cons:
  - root damage
  - higher chance for systemic reactions ~intravascular injection:  
*e.g. palpitation, increased heart rate*

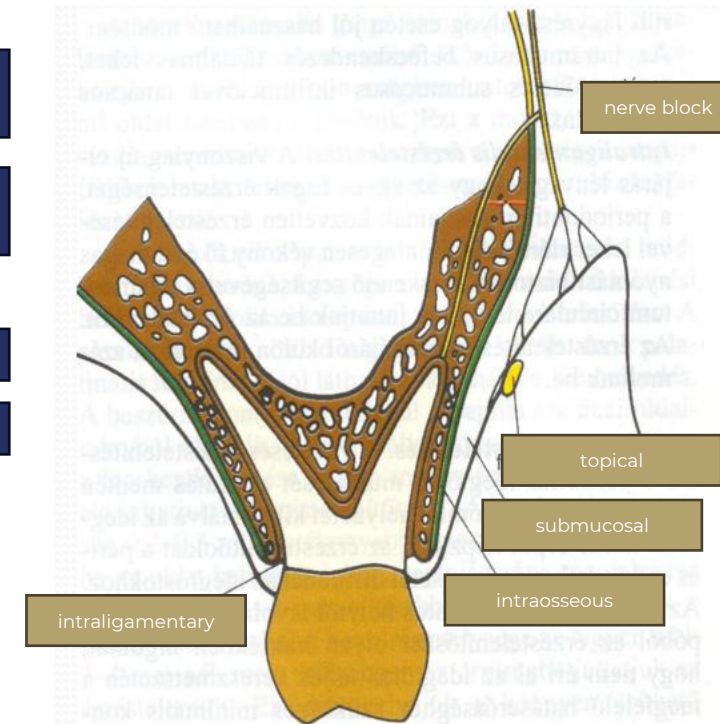
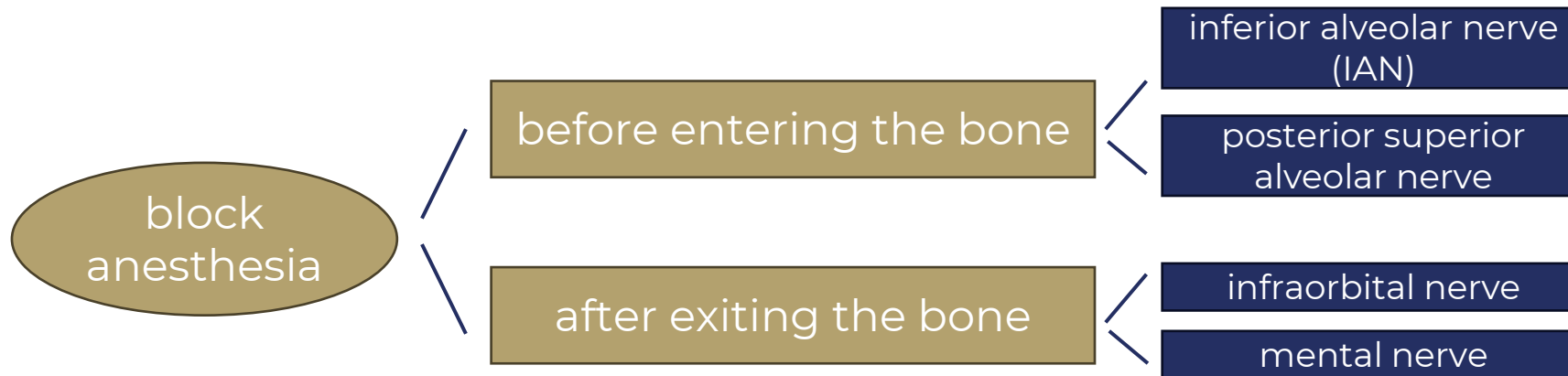
# Terminal anesthesia – intraosseous anesthesia

# Methods of local anesthesia

block anesthesia

# Block anesthesia/ nerve block

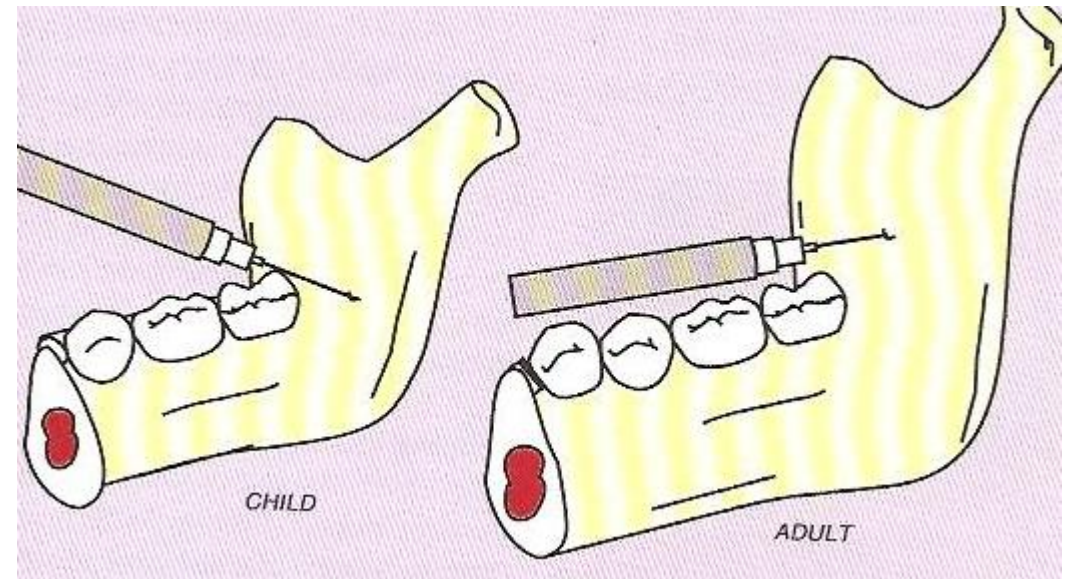
- anesthetic agent is administered around the nerve





# Inferior alveolar nerve (IAN) block

- mandibular primary and permanent teeth
- position of mandibular foramen
  - < 6 yo: below the occlusal plane
  - 6-12 yo: at the level of occlusal plane
  - 12 yo <: above the occlusal plane



# Complications of LA - systemic

- etiology: anesthetic drug
- rapid onset
  - **overdose** reactions
    - local anesthetic (LA) toxicity: early CNS stimulation symptoms, late CNS depression symptoms
    - vasoconstrictor (epinephrine) toxicity: elevated heart rate, BP, restlessness, tremor
  - **allergy**: dermatitis, urticaria, angioedema, bronchospasm, anaphylaxis
    - ***allergy to one amide doesn't rule out the use of another***
    - ***allergy to one ester rules out the use of another!***

American Academy of Pediatric Dentistry. Use of local anesthesia for pediatric dental patients. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:385-92.

# Complications of LA - local

- cause: technique/execution
  - needle breakage
  - hematoma
  - trismus
  - soft tissue injury
  - paresthesia
  - post anesthetic intraoral lesions: morsicatio, ulcer

# Contraindication

- non-cooperative patient
- major bleeding diathesis
- infection around the injection site
- allergy



# Conscious sedation

# Conscious sedation

- = drug-induced depression of consciousness
  - moderate:
    - protective reflexes are intact
    - verbal contact with the patient is maintained
    - response to verbal or tactile stimulation
- **indication:**
  - dental phobia and anxiety
  - traumatic and long dental procedure
  - 3 yo<
  - mentally challenged
  - ineffective local anesthesia

# Methods of conscious sedation

- Routes of drug administration:
  - oral (per os)
  - intramuscular
  - intravenous (iv)
  - rectal
  - inhalational

# Conscious sedation – per os sedation

- **Benzodiazepine** derivates
  - **diazepam** (Seduxen): 0,2-0,5mg /kg
    - 5mg pill
    - 1 pill the night before, another pill 1,5 hr before tx
    - long lasting
  - **midazolam** (Dormicum): 0,3-0,5mg /kg
    - 7,5 / 15mg pill per os
    - 1 pill the night before, another one 1 hr before tx
    - duration: 1-2 hrs



<https://pirulapatika.hu/210031314/adatlap>  
<https://pirulapatika.hu/210009309/adatlap>



# Conscious sedation– inhalation sedation

- **N<sub>2</sub>O / O<sub>2</sub> – nitrous oxide/oxygen**
  - analgesia – pain control
  - anxiolysis
  - mild anesthetic effect – local anesthesia necessary
- **indication:**
  - 3 yo <
  - fearful or anxious patient
  - moderate mental disability
  - muscular tone disorders prone to unintentional movement
  - strong or hypersensitive gag reflex
  - profound local anesthesia or analgesia cannot be obtained
  - lengthy dental procedure – alleviate treatment fatigue



American Academy of Pediatric Dentistry. Use of nitrous oxide for pediatric dental patients. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:393-400.

<https://www.muzzeysmiles.com/using-nitrous-oxide-to-help-kids-with-difficult-dental-appointments/>

# General anesthesia - narcosis

# General anesthesia

- = drug-induced loss of consciousness during which
  - the patient is not arousable, even by painful stimulation
  - the ability to independently maintain ventilatory function is impaired
  - CV function may be impaired
- **Indication:**
  - moderate, severe mental and physical disabilities
  - severe psychiatric disorders
  - < 3yo
- **Aim:**
  - anaesthesia
  - amnesia
  - unconsciousness
  - areflexia
  - depression of neuromuscular function



Coté CJ, Wilson S; AMERICAN ACADEMY OF PEDIATRICS; AMERICAN ACADEMY OF PEDIATRIC DENTISTRY. Guidelines for Monitoring and Management of Pediatric Patients Before, During, and After Sedation for Diagnostic and Therapeutic Procedures. Pediatrics. 2019 Jun;143(6):e20191000. doi: 10.1542/peds.2019-1000. PMID: 31138666.  
<https://www.chp.edu/our-services/dental-services/patient-procedures/anesthesia>

# General anesthesia

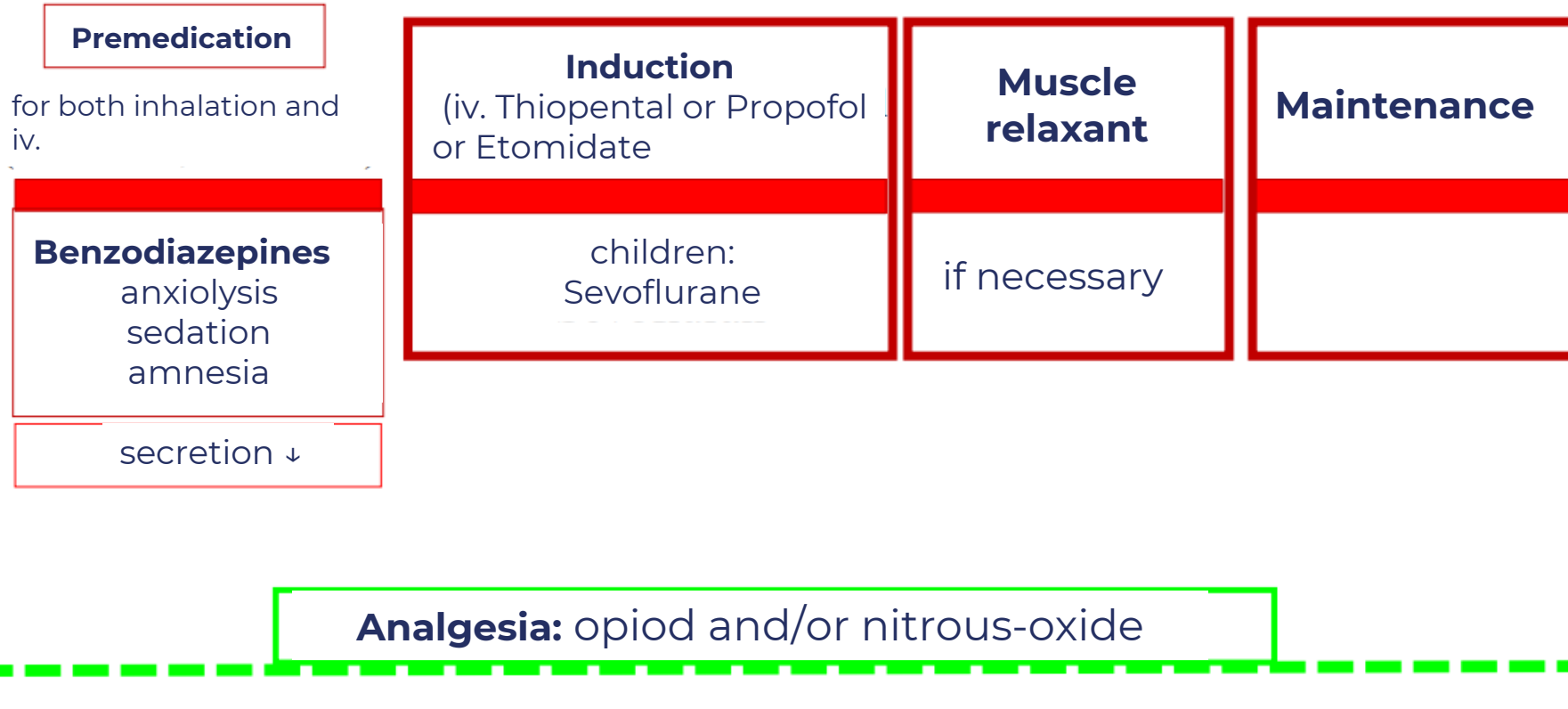
- **Contraindication:**

- severe medical conditions (hepatic, renal, CV, respiratory, neurological)
- cervical spine pathology (intubation)
- infectious disease
- allergy



<https://www.chp.edu/our-services/dental-services/patient-procedures/anesthesia>

# Clinical application: inhalation and intravenous anesthesia



translated from : Al-Khrasani Mahmoud: Általános érzéstelenítők és perianesztetikus medikáció. Tantermi előadás, Semmelweis Egyetem 2020.

# Preoperative medication

- proper examination, anamnesis
- **aim:**
  - ensure positive surgical outcome
  - reduce anxiety
  - reduce the incidence of side effects: salivation, bradycardia, post-op nausea and vomiting
- **Anxiolysis**
  - **benzodiazepines** (diazepam, midazolam)
    - sedatives, amnesia in 60 %
    - antagonist/antidote: flumazenil
  - **antihistamines**
    - sedative (side effect)
    - bronchodilator
    - antiemetic effect

Al-Khrasani Mahmoud: Általános érzéstelenítők és perianesztetikus medikáció. Tantermi előadás, Semmelweis Egyetem 2020.

# Preoperative medication

- **Analgesia**

- patient is in pain before the operation or
- GA is induced by a weak analgesic
- decrease the post-op. analgesic consumption
  - **opioids** (morphine, fentanyl, sufentanil) – for intense surgical pain
  - **NSAID**

- **Antiemesis**

# Preoperative medication

- **Parasympatholytics**

- **atropine**

- salivary secretion ↓
    - tachycardia → blocks the reflex cardiac vagal effect (bradycardia)
    - rarely used nowadays

- **scopolamine**

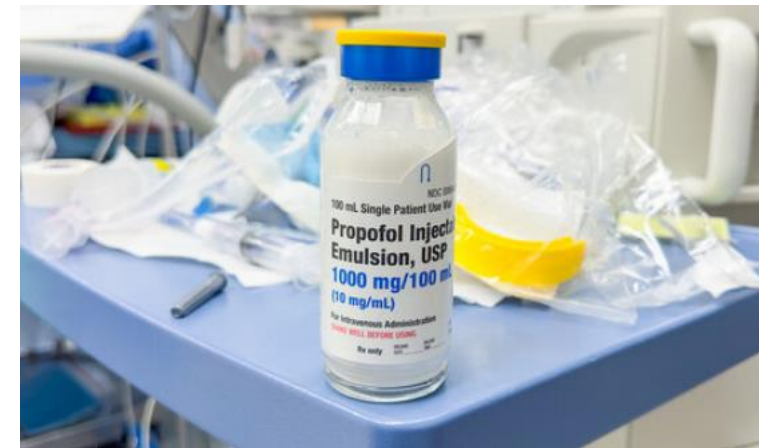
- salivary secretion ↓↓
    - less efficient in preventing reflex bradycardia – especially in children



# Narcotics – intravenous (i.v)

- **Propofol**

- induction, maintenance: fast onset, fast awakening
- ∅ analgesic effect
- antiemetic
- dose-dependent respiratory depression – transient apnea after induction



Al-Khrasani Mahmoud: Általános érzéstelenítők és perianesztetikus medikáció. Tantermi előadás, Semmelweis Egyetem 2020.

<https://stock.adobe.com/pl/images/providence-ri-usa-june-19-2023-propofol-bottle-stands-as-a-symbol-of-sedation-medical-intervention-and-anesthesia-embodiment-both-calm-and-vulnerability/614911905>

# Narcotics - inhalation

- **Sevoflurane**

- depth of anesthesia is well-controlled
- fast awakening
- ideal for pediatric surgery
- induction and maintenance – for children

- **Isoflurane** - maintenance

- **Desflurane** - maintenance



Al-Khrasani Mahmoud: Általános érzéstelenítők és perianesztetikus medikáció. Tantermi előadás, Semmelweis Egyetem 2020.

<https://www.alternup-medical.com/en/icu-and-anesthesia-ventilators/3224-sevoflurane-anesthesia-gaz-vaporizer.html>

<https://www.medicalexpo.com/prod/cm-cc/product-99462-643488.html>

<https://www.henryschein.com/us->

[en/Shopping/ProductDetails.aspx?productid=1182098&cdivId=dental&CatalogName=B\\_DENTAL&name=Isoflurane%20Liquid%20Inh%20OD%2099.9%20100mL/Bt&did=dental&ShowProductCompare=true&FullPageMode=true](en/Shopping/ProductDetails.aspx?productid=1182098&cdivId=dental&CatalogName=B_DENTAL&name=Isoflurane%20Liquid%20Inh%20OD%2099.9%20100mL/Bt&did=dental&ShowProductCompare=true&FullPageMode=true)

# Narcotics - inhalation

- **Halothane**

- induction, maintenance
- post-op. shivering
- bronchodilator
- muscle relaxation
- complication: "halothane hepatitis"



Al-Khrasani Mahmoud: Általános érzéstelenítők és perianesztetikus medikáció. Tantermi előadás, Semmelweis Egyetem 2020.

<https://www.indiamart.com/proddetail/halothane-bp-250ml-2848984464730.html>

<https://med-equip.ca/product/drager-vapor-2000-halothane/>

# Postoperative medication

- **analgesia**

- opioids

- cannot be given if it was part of the premedication protocol
    - if necessary: nalbuphine (Nubain)

- NSAIDs – algopyrin, diclofenac, ibuprofen, paracetamol

- local anesthetics

# Personnel and material requirements of GA

- anesthesiologist, certified registered nurse anesthetist
- trained pediatric dentist and dental assistant
- patient fit to narcosis– preliminary pediatric examination
- written and signed consent



- operating room
- anesthesia machine
- EKG monitor, BP, HR
- pulse oximeter, capnography
- dental instruments, aspirator
- resuscitation equipment and drugs



Coté CJ, Wilson S; AMERICAN ACADEMY OF PEDIATRICS; AMERICAN ACADEMY OF PEDIATRIC DENTISTRY. Guidelines for Monitoring and Management of Pediatric Patients Before, During, and After Sedation for Diagnostic and Therapeutic Procedures. Pediatrics. 2019 Jun;143(6):e20191000. doi: 10.1542/peds.2019-1000. PMID: 31138666.

# Discharge criteria

- CV function and airway patency are satisfactory and stable
- easily arousable and protective airway reflexes are intact
- can talk
- alert– responds according to their mental level and age
- proper muscle tone – can sit up unaided
- no nausea
- no fever
- state of hydration is adequate
- with an accompanying person



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