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Inflammatory diseases of the dental pulp

- The dental pulp has dynamic functions and reactivity, which allows protection and recovery in various external and internal influences.

- Knowledge of inflammatory diseases is especially important for accurate diagnosis, the correct choice of treatment method and the necessary medications and treatments.
Etiology of inflammatory diseases of the dental pulp

- **Mechanical causes** - traumatic damage during caries treatment (collisio pulpae), crown fractures, root fractures, traumatic occlusion

- **Thermal causes** - with sharp and chronically acting temperature irritations of vital teeth with metal crowns or amalgam restorations.
Thermal causes

- Exothermic reaction during materials hardening (phosphate cements, plastics, resin composites).
- Preparation of vital teeth for prosthetic purposes.
- Polishing of amalgam restorations without water-air cooling.
Thermal causes

- During the healing process, the biological tolerance of the pulp depends on:
  - Concentration of water-air stream in small area.
  - The pressure of the bur.
  - The size and material of the bur (large steel burs heat more than small carbide burs).
  - The thickness of the over-pulp dentin.
Chemical causes

- Medications and materials used in the treatment of deep caries (Caries profunda):
  - Cleansing substances - H₂O₂, 70° alcohol,
  - Desinfection substances - Paramonochlorophenol (chlorphenol-camphora),
  - Cavity liners and bases - Zinc phosphate cement, Zinc oxide eugenol,
  - The residual monomer of fast-curing plastics,
  - Permanent restorative materials - Composite materials (monomer, catalysts, acid treatment).
Allergic causes

- The medicines for treating caries can become antigens. Antibodies are formed in the dental pulp during altered body reactivity.

- The allergic reaction in the pulp is characterized by massive hemorrhages, perineural infiltration, albumin-antibody reaction.
Electric causes

- Physiotherapy procedures in the area of vital teeth that have a metal crown or amalgam obturation without a base.
- Overdose of electrical current during electrical pulp test, diathermocoagulation, electrocautery, electrophoresis.
Osmotic causes

- Osmotic causes - action of hypertonic irritants on exposed dentin.

- Sudden change in atmospheric pressure - at very low (flyers) or high pressure (divers, in barochambers).
Microbial irritants

- Microorganisms (Streptococci, Lactobacilli, Actinomyces spp.) and their toxins reach the dental pulp:
  - due to **caries, tooth fracture, abrasion, erosion, preparation of the tooth surface for crown, Collisio pulpa**, etc.
  - **Retrograde** through the apical foramen or through the lateral canals in periodontal diseases.
  - Through **inflammatory processes affecting adjacent teeth**.
  - By **lymphatic** route.
  - Through the bloodstream in cases with **bacteriaemia**.
Pathogenesis of the inflammatory process in the dental pulp

- **Tooth decay** is the most common cause of pulpitis.
  - The progression of dental caries in the dentin opens the dentin tubules, the pulp pressure pushes the dentin fluid to the periphery, and from there acids, bacterial toxins, microorganisms can enter.
  - Early response of the pulp to caries – focal accumulation of inflammatory cells – macrophages, lymphocytes, and plasma cells.
Pathogenesis of the inflammatory process in the dental pulp

- In the dental pulp occurs:
  - displacement of the odontoblastic cells, their number decreases, the nuclei are aspirated, and hyperemia in the subodontoblastic layer with the migration of other cellular elements can occur.
  - These changes in the dental pulp are transient and are terminated after removal of the irritant.
Pathogenesis of the inflammatory process in the dental pulp

- Under the influence of microorganisms and their toxins, hyperemia occurs, which is transient.
- Biologically active substances - mediators of inflammation (serotonin, histamine, bradykinin, prostaglandins, substance P) are released.
- They act directly on the walls of blood vessels, alter their permeability and cause active irritation (arterial hyperemia).
Pathogenesis of the inflammatory process in the dental pulp

- Vasodilation of the arterioles and capillaries occurs.
- In the perivascular space blood proteins and exudate can be observed which increases the pulp pressure (provoking short-term pain mainly from cold irritants).
- The patient has no spontaneous pain in this stage.
Pathogenesis of the inflammatory process in the dental pulp

- When the stasis deepens (stagnation of blood flow in dilated blood vessels), active hyperemia transitions into **passive hyperemia** (intravenous).
- **Exudation** is intensifying.
- The **hydrostatic and osmotic pressure** in the dental pulp increases.
- There is a vascular collapse.
Pathogenesis of the inflammatory process in the dental pulp

- The accumulated non-pulp substances irritate the sensory nerve fibers located along the periphery of the pulp tissue and angio-receptors, resulting in spontaneous short-term pain.

- The pain is flat, with short duration, has a neurotic characteristics, and may occur at night.
Pathogenesis of the inflammatory process in the dental pulp

- **Serous inflammation** - is characterized by a more extensive presence of albumins, globulins, fibrin, polymorphonuclear (segmented) leukocytes, and later of monocytes and lymphocytes.
  - A serous exudate is formed.
  - Segmented leukocytes phagocytize the bacteria in the initial stages of inflammation and die themselves.
Pathogenesis of the inflammatory process in the dental pulp

- Due to hypoxia, anaerobic digestion of carbohydrates occurs with the formation of lactic acid and a decrease in pH.

- The dental pulp responds with spontaneous pain. The process becomes irreversible. A clinical picture of acute serous pulpitis (Pulpitis acuta serosa) develops.
Pathogenesis of the inflammatory process in the dental pulp

- As the process progresses, there is an increase of exudation, cellular and tissue disintegration. Purulent inflammation develops due to invasion of staphylococci.

- A pulp abscess develops from the transition from serous to purulent inflammation. This is a result of the higher protective capabilities of the pulp and less virulent microorganisms in it.
The abscess is localized in the coronary pulp, while phlegmonous inflammation covers the entire pulp.

The localized and generalized form of purulent inflammation are fast transient from one form to another.
Acute pulpitis (Pulpitis acuta)

- They develop when the pulp chamber is closed.
- The processes of alteration and exudation prevail over the proliferative ones.
- There is increased pulp pressure and severe provoked spontaneous pain.
Diagnosis of acute pulpitis

- Pulpitis acuta serosa partialis
- Pulpitis acuta serosa totalis
- Pulpitis acuta purulenta partialis
- Pulpitis acuta purulenta totalis
- Pulpitis acuta gangraenosa
Pulpitis acuta serosa partialis

- **History** - the patient complains of *provoked pain from cold*, *spontaneous pain, which occurs in periods*. Pain periods are shorter than the duration of remission.

- The pain is pulling, shooting. Localized (the patient can determine the tooth).

- Periods of spontaneous *pain occur at different times of the night*.

- Pain is affected by analgesics.
Pulpitis acuta serosa partialis

- The coronary pulp is involved by an acute serous inflammatory process.

- **Initial stage** - transition between hyperemia and pulpitis. Spontaneous, short-term pain up to 5 min and long periods of remission (8-12 h).
Pulpitis acuta serosa partialis

- **Advanced stage** - longer period of pain than initial stage - 15-20 min. Shorter remissions - 4-5 hours.
- The pain is provoked by cold irritants.
- The heat relieve the pain due to vasodilation of blood vessels and elimination of metabolic products.
Pulpitis acuta serosa partialis

- **Status localis intraoralis**
- Examination - presence of carious lesion, obturated tooth with secondary caries or vitally drilled tooth for crown.
- **Probing** - an acute dentinal reaction without communication with the pulp chamber.
- **Percussion** - normal percussion tone
- **EPT** - in the initial stage 2-4 µA, in the advanced stage - 15-25 µA (below 35 µA).
- **Radiography** – no changes
Pulpitis acuta serosa partialis

Differential diagnosis with:

- **Hyperaemia pulpae**
- **Pulpitis acuta serosa totalis**

**Similarities**: acute dentinal reaction, spontaneous pain, provoked by cold, recurrent, pulling pain, vital tooth, general etiology.

**Differences**: the duration of the pain is longer, the remissions are shorter - 20-30 minutes, the patient cannot indicate the tooth, irradiating pain, it is difficult to respond to analgesics. Percussion pain, EPT -40-60 µA.
Differential diagnosis of Pulpitis acuta serosa partialis

- **Pulpitis acuta purulenta partialis**

- **Similarities** - etiologic factors, spontaneous, localized, night pain.

- **Differences** - dull dentinal reaction, provoked pain by hot, throbbing, slightly affected by analgesics.
Differential diagnosis of Pulpitis acuta serosa partialis

- Pulpitis chronica exacerbata

  - Similarities - spontaneous, periodic pain, localized.
  
  - Differences - presence of communication with the pulp chamber in exacerbated pulpitis.

**Treatment of Pulpitis acuta serosa partialis** - biological methods (indirect/direct pulp capping), vital amputation, vital extirpation.
Pulpitis acuta serosa totalis

- The coronary and radicular pulp are covered by serous inflammation.

- **History** - spontaneous, neuritic, periodic, irradiating pain (to the ear and the angle of the jaw - from the lower molars. From the upper - to the temple).

  *Intensity* – moderate to severe.

  *Provoked pain from cold*, and in the advanced stage-from hot.

  Analgesics have a reduced effect. Short periods of remission 20-30 min.
Pulpitis acuta serosa totalis

- Status localis intraoralis

- **Examination** - vital tooth, deep carious lesion, obturated tooth with secondary caries, tooth with failed biologic treatment, vitally drilled teeth for crown.

- **Probing** - dull dentinal reaction, closed pulp chamber.

- **Percussion** - usually no pain, but in the advanced stage - pain is present when pressed the tooth.

- EPT- 40-60 µA

- Radiography – no changes
Differential diagnosis of **Pulpitis acuta serosa totalis**

- **Pulpitis acuta serosa partialis**

- **Pulpitis acuta purulent a totalis**

  - **Similarities** - spontaneous, periodic, irradiating, night pain, vital tooth, closed pulp chamber, pain during vertical percussion.

  - **Differences** - throbbing pain, pain provoked by hot irritants, almost no dentinal reaction. Analgesics have reduced effect. Purulent pulpitis quickly passes into pulpoperiodontitis. EPT – about 80 µA.
Differential diagnosis of **Pulpitis acuta serosa totalis**

- **Pulpitis chronica exacerbata**
  - **Similarities** - spontaneous pain, slight enlargement of the apical periodontium established radiographically.
  - **Differences** - communication with the pulp chamber for Pulpitis chronica exacerbata.
Differential diagnosis of *Pulpitis acuta serosa totalis*

**Periodontitis acuta serosa**

- **Similarities** - spontaneous, pulling pain, presence of percussion pain.
- **Differences** - devitalized tooth, no dentinal reaction, localized pain, persistent pain, presence of percussion pain, tooth feeling higher than others, patient may indicate the problem tooth.

**Treatment of Pulpitis acuta serosa totalis** - vital extirpation.
Pulpitis acuta purulenta partialis

- **History** - spontaneous, throbbing pain, exacerbated by hot and at night. Periodic pain for about 30 minutes and 5-6 hours without pain. It is weakly affected by anesthetics.

- **Status localis intraoralis**
  - Examination - acute carious process with a soft consistency, unchanged tooth color.
  - Probing - dull or missing dentinal reaction
  - Percussion - normal percussion tone, no pain
  - EPT - 50-70 μA
Differential diagnosis of **Pulpitis acuta purulenta partialis**

- **Pulpitis acuta serosa partialis**
- **Pulpitis acuta purulenta totalis**

**Similarities** - periodic, spontaneous, throbbing, night pain, exacerbated by hot irritants, dull or missing dentinal reaction, vital teeth.

**Differences** - irradiating, almost continuous pain, percussion pain.

**Treatment** of **Pulpitis acuta purulenta partialis** - emergency endodontic treatment through vital extirpation
Pulpitis acuta purulenta totalis

- **History** - very strong, spontaneous, periodic, night, irradiating, throbbing pain. Remissions are very short. The patient cannot identify the diseased tooth. Pain is not affected by analgesics. Cold relieve the pain.

**Intraoral status:**

- Inspection – acute deep caries, obturated tooth with secondary caries.
- Probing - soft carious tissue, without communication with the pulp chamber. Low or no dentinal reaction.
- Percussion - a clear percussion tone, the presence of pain.
- EPT - 60-80 μA.
Differential diagnosis of Pulpitis acuta purulenta totalis

- Pulpitis acuta serosa totalis

- Pulpitis acuta purulenta partialis

- Pulpitis acuta gangraenosa – differences in the type of exudate after opening of the pulp chamber (presence of bubbles, pus and gangrenous odor).
Differential diagnosis of Pulpitis acuta purulent a totalis

- **Periodontitis acuta purulent a** - non-vital tooth, constant pain, the patient can point the diseased tooth, painful regional lymph nodes, changed general condition with fever.

- **Similarities** - irradiating, throbbing, pain is not affected by analgesics.

Treatment of **Pulpitis acuta purulent a totalis** - emergency endodontic treatment through vital extirpation.
**Pulpitis acuta gangraenosa**

- Purulent inflammation of the pulp, as separate sections are gangrenously disintegrated.
- History - severe, throbbing pain with short periods of remission. Irradiating, throbbing pain is exacerbated by hot, cold relieve the pain.
- Examination - tooth with deep caries or restoration.
- Probing - no dentinal reaction, painless pulp roof.
- Percussion – positive reaction in vertical percussion.
- EPT- 80-90 µA.
Differential diagnosis of **Pulpitis acuta gangraenosa**

- **Pulpitis acuta purulenta**

- **Periodontitis acuta purulenta** – non-vital tooth, severe, constant pain, the tooth feels taller than the other teeth. Analgesic is ineffective.

- **Pulpitis acuta gangraenosa** - after opening of the pulp chamber, a drop of pus mixed with bubbles fills the cavity.

Treatment of **Pulpitis acuta gangraenosa** - emergency endodontic treatment through vital extirpation.
Pulpitis chronica

- Chronical pulpitis progress slowly, with low clinical symptoms, under the influence of continuous low irritants and well-defined protective forces of the body. The pulp chamber usually is open.

- Chronic pulpitis with a closed pulp chamber are one of the causes of the so-called retrograde caries (Resorptio idiopathica interna).
Pulpitis chronica ulcerosa

- **History** - provoked pain from mechanical irritants, when the food getting into a deep caries defect. Pain from chemical and thermal irritants. The patient reports acute pain and night pain, pain in the suction of the tooth.

- **Intraoral status:**
  - Examination - carious tooth or fractured tooth.
  - Probing - provokes a dentinal reaction, acute pain and bleeding by touching the ulcer.
Pulpitis chronica ulcerosa

- Percussion - normal percussion tone.
- EPT - 25-60 µA
- Three stages of **Pulpitis chronica ulcerosa** - early, advanced and late.

**Pulpitis chronica ulcerosa incipiens** - early stage.

- **Characteristics of the ulcer** - after removal of carious dentin, a small pink ulcer (0.5-1mm) is established at the level of the dentinal wound surrounded by normal dentin. Without hemorrhage, with superficial location.

*Do not probing in the ulcer!*

- EPT - 35 µA.
Pulpitis chronica ulcerosa

Advanced stage - longer case history.

- **Characteristics of the ulcer** - larger ulcers (greater than 1 mm) at or below the level of the dentinal wound. The surface of the ulcer has a livid or greyish color. Probing causes bleeding. The surrounding dentine is discolored and its consistency is altered. EPT - over 35 µA.

- When the ulcer is below the level of the dentinal wound above it there is a necrotizing pulp. Deep probing provokes bleeding.
Pulpitis chronica ulcerosa incipiens
Pulpitis chronica ulcerosa

- **Late stage** - scarce subjective complaints. EPT - above 60-90 µA.
- Pulpitis chronica ulcerosa ascendens (for the upper teeth) or Pulpitis chronica ulcerosa descendens (for the lower teeth).
- Radiographic - apical extension of the periodontium is possible.
Diagnostic radiography 36 - presence of deep carious lesion and normal periapical structure (Pulp.chr.ulc.)
Diagnostic radiography 47 - presence of deep carious lesion and altered periapical structure (Pulp.chr.ulc.)
Differential diagnosis of **Pulpitis chronica ulcerosa**

1. **Caries profunda**

- **Similarities** - vital tooth, preserved dentinal reaction, provoked pain.

- **Differences** - provoked tooth suction pain, presence of communication with the pulp chamber, EPT - over 30 µA.
Differential diagnosis of **Pulpitis chronica ulcerosa**

2. **Collisio pulpaee** - harder to distinguish with Pulp. chr. ulc. incipiens when the dentin around the ulcer is normal and hard.

3. **Pulpitis chronica granulomatosa**
   - **Similarities** - deep caries defect, soreness when probing, communication with the pulp chamber.
   - **Differences** - presence of granulomatous pulp polyp with heavy bleeding on tooth suction or mechanical irritants.
Differential diagnosis of **Pulpitis chronica ulcerosa**

4. **Gangraena simplex aperta**

- **Similarities** - open pulp chamber, specific smell of infected necrotic tissue, lack of percussion reaction.

- **Differences** - no dentinal reaction, non-vital tooth with discoloration, EPT values above 100µA, dull percussion tone

**Treatment of Pulpitis chronica ulcerosa:**

**Early stage** - biological treatment or vital amputation.

**Advanced stage** - vital extirpation.
Pulpitis chronica granulomatosa

- It is observed mainly in young people when there is a communication with the pulp chamber. Rare pathology in adults.

- **History** - the patient reports pain when chewing on solid foods, bleeding on suction or mechanical irritation.

**Status localis intraoralis:**

- Examination - an extensive carious lesion filled with pulp polyp, slightly painful on probing and bleeding.

- Percussion - painless

- EPT- 30-60 μA
Pulpitis chronica granulomatosa
Differential diagnosis of Pulpitis chronica granulomatosa

- Pulpitis chronica ulcerosa
- Polyps with different origin – Polypus gingivae, Polyp from bi- and tri-furcation of molars.

Treatment of Pulp. chr. gr. – vital extirpation
Pulpitis chronica granulomatosa clausa (Resorbtio idiopathica interna)

- Rare pathology.
- **History** - acute or chronic trauma. Scarce symptoms - numbness, discoloration, more often in single rooted teeth.
- **Status localis intraoralis**
  - Inspection - intact tooth, tooth with discoloration
  - Percussion - different sensation in comparative study
  - EPT - up to 80 µA
  - Differential diagnosis - Fractura radicis dentis, Resorbtio externa

**Treatment** - vital extirpation (MTA, Ca (OH)2 in the root canal
Resorción idiopática interna
## Reversible and irreversible pulpitis

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<th>Pulpitis reversibilis</th>
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<td><strong>Provoked pain</strong> from cold irritants, single spontaneous pain</td>
<td><strong>Spontaneous pain</strong> Night pain Periodic pain Provoked pain</td>
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<tr>
<td><strong>Treatment</strong> – indirect, direct pulp capping, vital amputation</td>
<td><strong>Treatment</strong> – vital extirpation</td>
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<tr>
<td><strong>Diagnosis</strong> : Hyperaemia pulpae Pulp.chr.ulc.incipiens Collisio pulpae, Pulp.traumatica (up to 6h, under 1mm ulcer) Pulp.ac.ser.part.</td>
<td><strong>Diagnosis</strong> : Pulp.ac.ser.totalis Pulp.ac. pur. part. et totalis Pulp. chr.ulc. Pulp. chr. ex.</td>
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Pulpitis reversibilis
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