6. Diseases of the Lacrimal System

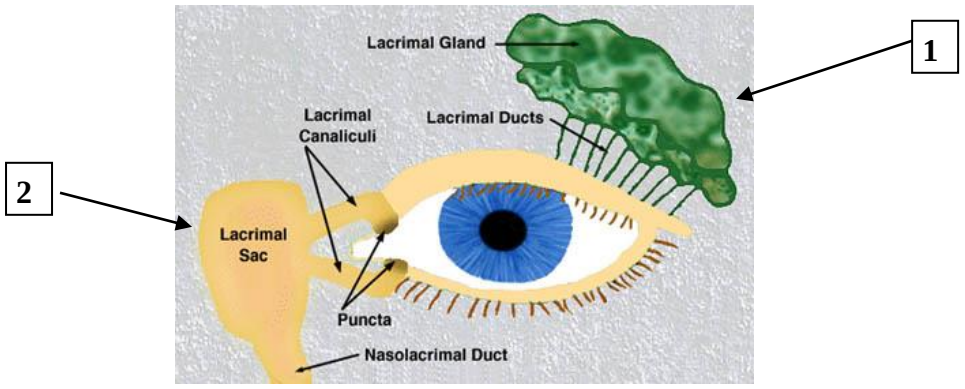
Q Give an account on the anatomy of the lacrimal drainage system

Answer

The lacrimal system consists of 2 main divisions:

(1) ***Lacrimal Secretory system*** (Main & accessory lacrimal glands)

(2) ***Lacrimal Drainage system*** (puncta, canaliculi, L. sac, NLD)

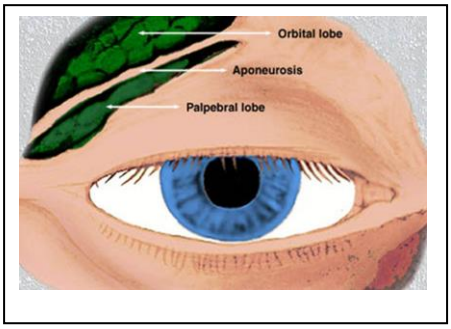


(1) Applied Anatomy of the Lacrimal Secretory System

A. Lacrimal Gland

1. ***Gross Anatomy***

(1) Site: Lies in the upper-outer-anterior corner of the orbit in the lacrimal fossa.
(2) Parts:
a) Orbital (superior) part.
b) Palpebral (inferior) part.



N.B.1:
The lateral horn of the aponeurosis of the levator muscle separates the larger orbital part from the palpebral part.
N.B.2:
The palpebral part is seen if the upper lid is everted.

2. ***Minute Anatomy***

1. **Acini:** Lined by 2 layers of epithelium:
   a. **Inner layer:** Columnar cells ***(secretory).***
   b. **Outer layer:** Flat myoepithelial cells ***(contractile).***
2. **Ducts:** 10-12 ducts which arise from the orbital part and pass
3. through the palpebral part to open into the outer part of the upper fornix.

N.B.:
Excision of the palpebral part of the lacrimal gland prevents (cuts) the secretion of the whole gland.

Blood Supply:

(1) Arteries: Lacrimal artery (from the ophthalmic artery).
(2) Veins: Lacrimal vein (drains into the superior ophthalmic vein).

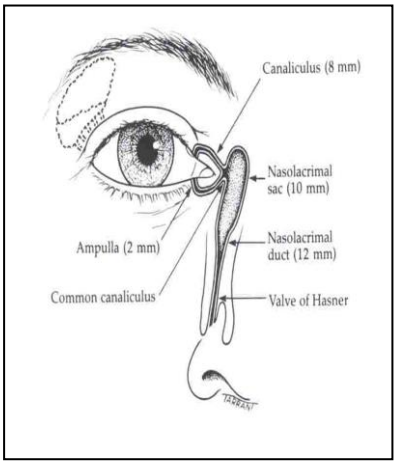
Nerve Supply:

(1) Secretory (parasympathetic) supply: Via the greater superficial petrosal nerve of the facial nerve which relays in the sphenopalatine ganglion and reaches the gland via the lacrimal nerve.
(2) Vasomotor (sympathetic) supply: From the superior cervical ganglion.
(3) Sensory supply: Lacrimal nerve.

Lymphatic Drainage: Preauricular lymph glands.

B. Accessory lacrimal glands of Krause and Wofring (Conjunctiva)

(2) Applied Anatomy of the Lacrimal Drainage System (Puncti, canaliculi, lacrimal sac, NLD)



● ***Consists of the following:***

(1) *The Puncti:*
- Are located near the medial end of each eyelid.
- Normally, they face in a slightly posterior direction and can be inspected by everting the medial aspect of the eyelid.

(2) *The Ampula (vertical canaliculi):*
- Are about 2 mm long and form the most proximal part of the lacrimal drainage system.

(3) *The horizontal canaliculi:*
- Are about 8 mm long
- In about 90% of persons, the upper & lower canaliculi form the common canaliculus which opens into the lateral wall of the lacrimal sac.
- In the remainder 10%, each canaliculus opens separately into the sac.
- A small flap of mucosa (*valve of Rosenmuller*) overhangs the entrance of the common canaliculus and prevents reflux of tears from the sac into the canaliculi.

(4) The lacrimal sac is about 10 mm long and lies in the lacrimal fossa between the anterior and posterior lacrimal crests.

(5) *The nasolacrimal duct*:
- It is about 12 mm long and is the continuation of the lacrimal sac.
- It passes downwards, slightly medially, and posteriorly to open into the inferior nasal meatus, lateral and below the inferior turbinate.
- The opening of the duct is partially covered by a mucosal fold **(*valve of Hasner*).**

Q Where the nasolacrimal duct and ducts of lacrimal gland open?

The nasolacrimal duct opens in the anterior part of the inferior meatus of the nose, while the ducts of lacrimal gland open in the outer part of the superior conjunctival fornix.

Q Give a short account on precorneal tear film.

Answer

● ***The precorneal tear film consists of 3 layers:***

1. **Outer lipid layer**
2. **Middle aqueous layer**
3. **Inner mucin layer**

(1) Outer lipid layer
- It is secreted by the Meibomian glands and glands of Zeis
- ***It has the following functions***:

1. To retard the evaporation of the aqueous layer.
2. To increase surface tension of tear film, so that, the tear meniscus does not overflow the lid margin.
3. To lubricate the eyelids as they pass over the surface of the globe.

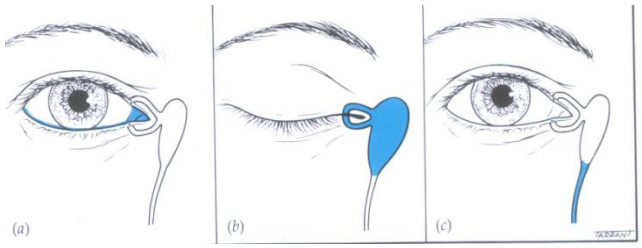
(2) Middle aqueous layer

- It is secreted by the main lacrimal gland & the accessory glands of Krause and Wolfring
- ***It has the following functions:***
  1. To supply atmospheric oxygen to the avascular corneal epithelium.
  2. Antibacterial function
  3. To wash away debris
  4. To cover any minute irregularities of the anterior corneal

(3) Inner mucin layer

- It is secreted by the conjunctival goblet cells, the crypts of Henle and glands of Manz

Q What is the lacrimal pump? Mention its role in drainage of tears.



Answer

c. Tears flow along the upper and lower marginal streps and enter the upper and lower canaliculi by capillarity and also by suction.
d. About 70% of the tears drain through the lower canaliculus and the remainder through the upper one **(fig.a).**
e. With each blink, the superficial and deep heads of the pre-tarsal orbicularis muscle compress the ampullae, shorten the horizontal canaliculi, and move the punta medially **(fig.b)**
f. Simultaneously, the deep heads of the preseptal orbicularis muscle " which are attached to the fascia around the lacrimal sac" contract and expand the sac → creating a –ve pressure which sucks the tears from the canaliculi into the sac.
g. When the eyes open, the muscles relax, the sac collapses, and a +ve pressre is created which forces the tears down the NLD into the nose **(fig.c);** the puncti move laterally, the canaliculi lengthen and become filled with tears.
h. Gravity also plays an important role in sac emptying.

Q What are the commonest organisms of dacryocystitis?

Pneumococci for ***chronic*** and staph. aureus and streptococci for ***acute*** dacryocystitis

Q Give an account on acute dacryocystitis (Aetiology, clinical picture, and treatment)

Answer

Definition: Acute inflammation of the lacrimal sac.

Aetiology

1) Sources of infection:
a. Conjunctiva, nose or blood stream.
b. On top of chronic dacryocystitis or following probing.

2) Causative organisms: Pneumococci, staphylococci or streptococci.

Clinical Picture:

(1) Symptoms:

1. Fever, headache and malaise.
2. Severe pain over the sac (radiating up and down).
3. Watering of the eye (epiphora).

(2) Signs:

1. swelling:

- Between the inner canthus and the nose.
- Skin over it is red and oedematous.

2. Regurgitation test: Negative (due to closure of the canaliculi by oedema).

Complications:

(1) Lacrimal abscess and fistula: Under the medial palpebral ligament.

(2) Orbital cellulitis and cavernous sinus thrombosis: Rare.

Treatment:

(a) Medical treatment:

1. Antibiotics (systemic and local)
2. Analgesics
3. Warm compresses.
4. Vasoconstrictor nasal drops.

(b) Surgical treatment:

1***) If abscess is formed*** → incise and drain, later excise the sac; or DCR is done after subsidence of inflammation

2) ***If Lacrimal fistula results***: Excision of the fistula and the lacrimal sac (fistulectomy with dacryocystectomy), after subsidence of inflammation.

Q Give an account on chronic dacryocystitis in adults (aetiology, clinical picture, and ttt)

Answer

Definition: Chronic inflammation of the lacrimal sac in adults.

Aetiology:

(1) Obstruction of the lacrimal passages (with stasis of tears): Is the predisposing factor.

(2) Infection (of stagnant tears): Is the precipitaing factor:

a) Sources of infection: Conjunctiva, nose or blood stream.

b) Causative organisms:

i. Specific: Tuberculosis, syphilis or trachoma.

ii. Non-specific: Pneumococci (common), staphylococci, streptococci or Morax-Axenfeld diplobacilli.

***Clinical Picture*:**

(a) symptoms:

1) Watering of the eye (epiphora).
2) Swelling (at the site of lacrimal sac).
3) MP discharge (+ve regurge test).

(b) Signs:

i. Swelling between the inner canthus and the nose: Below the medial palpebral ligament.

ii. Regurgitation test: +ve (mucopurulent discharge).

Treatment:

(1) Medical treatment:

1) Antibiotics (local and systemic).
2) Vasoconstrictor nasal drops.

(2) Surgical treatment

a. Dacryocystectomy: ***OR***

b. Dacryocystrohinostomy (DCR): it is the ideal operation if done in a properly selected case.

a. ***Dacryocystectomy*:

Indications:

1. Long standing chronic dacryocystitis with destruction of the sac structure
2. Contraindication to DCR e.g. atrophic rhinitis
3. If there is associated resistant corneal ulcer
4. If the cause is T.B. or trachoma
5. If there is external lacrimal fistula: → define the fistulous tract by a probe and excise it with the sac

b. ***DCR*:

Indications:

1. Chronic dacryocystitis, of short duration, with good sac wall, in a young patient, without nasal contraindication, with a permanent NLD obstruction
2. Mucocele with a patent lower canaliculus

Q What are the complications of chronic dacryocystitis?

1. **Chronic onjunctivitis.**
2. **Corneal ulcer:** Hypopyon ulcer due to pneumococci usually.
3. **Cicatricial ectropion:** Due to epiphora → eczema → ectropion (vicious circle).
4. **Danger of endophthalmitis:** After intraocular operation.
5. **Lacrimal mucocele:** Distended lacrimal sac with mucous **below** the medial palpebral ligament (MPL)

N.B. (**DD**: from ***nasal dermoid cyst*** in which the swelling is **above** MPL, with no epiphora and -ve fluorescein test).

6. **Acute dacryocystitis:** With abscess formation (Lacrimal abscess).
7. **Lacrimal fistula:** Follows opening of a lacrimal abscess below MPL ***(External lacrimal fistula).***

Q What is the DD. Of acute dacryocystitis?

Answer

1. Septic sebaceous cyst: The ***passages are patent***, no general malaise.

2. Cellulitis in the skin over the sac:

- No localized point of tenderness over the sac

- ***Patent passages***

3. Acute ethmoiditis:

- The site of pointing is above the MPL
- ***Patent passages***
- X-ray sinuses

4. Osteomyelitis or acute periostitis of the maxilla:

- The child is severely ill
- ***Patent passages***

- Marked edema of cheek, lids, root of nose

Q Write short notes on infantile dacryocystitis (aetiology, clinical picture, DD., and ttt)

Answer

***Aetiology*:** usually results from congenital obstruction of the NLD due to either: -

(1) Incomplete canalization or
(2) By a membrane at its lower end.

***Clinical picture*:**
As in chronic dacryocystitis in adults (watering of the eye, +ve regurgitation of mucus, swelling over the sac), but acute dacryocystitis is uncommon.

Differential Diagnosis

- **Acute conjunctivitis** → Red eye and -ve regurge test.

Treatment:

(1) Conservative treatment: should be tried for at least the first 6 months of age. It consists of:
- Antibiotic eye drops and ointment.
- Frequent pressure (Massage) of the sac towards the nose (5 times /day) aiming to rupture the occluding membrane by raising the pressure inside the sac. If successful → it will cure the condition.

(2) Probing: If the conservative treatment failed. Dilatation of the lacrimal passages by lacrimal probes of gradually increasing calibre (should not be done before the age of 6 months to avoid the formation of a false passage).

(3) Dactyocystorhinostomy: At the age of 3-4 years, if the above measures failed.

Q How can you differentiate between lacrimal Mucocele and ethmoidocele?

Answer

Lacrimal mucocele is ***below*** the medial palpebral ligament with obstructed lacrimal passages, while ***ethmoidocele*** is ***below*** the ligament with patent lacrimal passages (+ x-ray findings)

Q What are the causes of watering of the eye?

Answer

● **Causes**

*The **3 main causes** of excessive watering of the eye are:*

1. Excessive lacrimation: by reflex over-production of tears from stimulation of the trigeminal nerve by irritation of the cornea or conjunctiva.

2. Obstructive epiphora: is caused by mechanical obstruction of lacrimal drainage system.

3. Lacrimal pump failure: occurs 2ry to lower lid laxity or weakness of the orbicularis muscle (e.g. in facial nerve palsy).

Q How can you evaluate (investigate) a case of epiphora?

Answer

● ***Evaluation of epiphora***

(1) Clinical examination
(2)

(a) General inspection, palpation & compression

■ ***Inspection*** of the eyelids for presence of LL ectropion, trichiasis, eversion of the lower punctum.

■ ***Palpation*** below the medial canthal tendon for enlargement of the lacrimal sac e.g. due to a mucocele.
■ ***Compression*** of the lacrimal sac may cause reflux of MP material in case of chronic dacryocystitis (+ve regurgitation test indicative of NLD obstruction). →

(b) *Slitlamp examination*
■ Examination of the puncti for malposition, stenosis, or obstruction by a foreign body or eyelash.
■ Expression of pus or concretions by compressing the canaliculi with a cotton-tipped applicator is characteristic of canaliculitis.
■ Examination of the marginal tear strip.
■***Fluorescein disappearance test*** is performed by instilling fluorescein drops into the conjunctival sac. Normally, no or very little dye remains after 2 minutes. A prolonged retention of dye is indicative of inadequate lacrimal drainage and can be graded from 1 to 4.

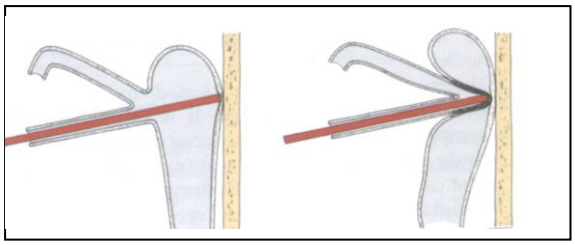
(c) Regurge test: a +ve regurge is a definite proof for NLD obstruction

(3) <u>Probing & Syringing</u>:

● **Principle:** A drop of topical anesthetic is instilled into the conjunctival sac and a straight ***lacrimal cannula*** on a 3-ml saline-filled syringe is inserted into the lower canaliculus. As the cannula is inserted deeper, it will face either a ***hard stop*** or ***soft stop***

Hard stop (A)
A hard stop occurs if the cannula touches the medial wall of the lacrimal sac and the lacrimal bone

What is the clinical significance?
It indicates that the lacrimal sac has been entered, and so, excludes lower or common canaliculus obstruction
(Patent canalicular system).



A B

Soft stop (B)
A soft stop is a spongy feeling as the cannula presses the common canaliculus and the lateral wall of the sac against the medial wall
(Canalicular obstruction)

What is the clinical significance?
This indicates that the cannula is prevented from entering the lacrimal sac by an obstruction in the canalicular system.

(4) <u>Jones dye testing</u>
- Indication: suspected partial obstruction of NLD (No value in total obstruction)

- Types:
a. Primary Jones dye test: fluoresscein drops is instilled into the conjunctival sac
- Results:

Fluorescein is recovered from nose (+ve test) ↓ Patent drainage system

Not recovered (-ve test) ↓ Partial obstruction or Lacrimal pumup failure.

-ve primary test
↓

b. Secondary Jones dye test : → Saline irrigation

- Results: either →

i. fluorescein – stained saline is recovered from the nose
(+ve test)
↓
Partial obstruction of NLD

ii. Unstained saline is recovered from the nose
(-ve test)
↓
Partial obstruction of upper drainage system (punctum, canaliculi)

or
Lacrimal pump failure

-

(5) Contrast dacrocystography:
- Radiograph with Lipidol.

1- Detection of anatomical obstruction and its site.
2- Diagnosis of diverticula,fistulae, filling defects (stone, tumors)

Q What is the difference between dacyocystectomy and dacryocystorhinostomy (DCR)?

Answer

- Dacyocystectomy means excision of the lacrimal sac

- DCR means anastomosis between the mucous membrane of the sac and the nasal mucosa (at the middle meatus of the nose) is done after making a bone hole in the floor of the lacrimal fossa

Q What is more preferable procedure for treatment of chronic dacryocystitis: dacyocystectomy or DCR?

DCR is the best because there is no postoperative epiphora as after dacryocystectomy

Q What is the surgical principle of DCR?

Answer → see before

Q What is the difference between lacrimation and epiphora?

Lacrimation: means excessive secretion of tears in the presence of patent lacrimal passages

Epiphora means excessive secretion of tears due to lacrimal drainage system obstruction, or failure of lacrimal pump

Q How can you verify the patency of lacrimal drainage system?

Answer → see befor

Q Give an account on congenital epiphora (causes, clinical picture, ttt)

Answer

- **Cause:** it is caused by delayed canalization of the lower end of the NLD at birth

- **Clinical features**
  - **Presentation** is within few weeks with watering (excessive lacrimation) of the eye.
  - **Signs**

- Examination shows excessive lacrimation of one eye which may be associated with redness (eczema) of the skin of the LL.
- Gentle pressure over the lacrimal sac region at the inner canthus may → reflux of MP material from the puncti (if associated with dacyocystitis).

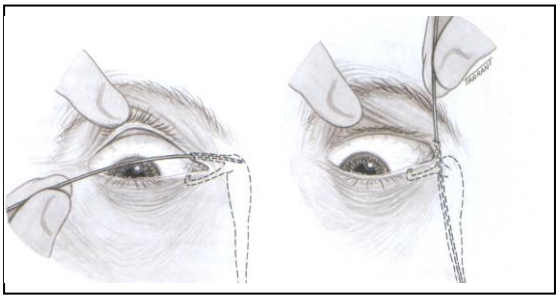
● **DD. :** It is important to rule out (R/O) congenital glaucoma in all infants with congenital epiphora**.**

● **Treatment**

The following are the therapeutic measures for congenital epiphora which should be done in the same sequence.

1. Massage of the NLD.
- 10 strokes of massage with index finger each time, repeated 4-5 times/day.
- Massage usually results in improvement of the case in > 95% of cases.
- Topical antibiotic eye drops and ointment may also be prescribed if there is 2ry infection.

2. Probing & Syringing
- It should not be performed until the age of 9 months to give chance for spontaneous canalization.
- About 90% of children are cured by the first probing and further 6% by the 2nd.



3. Intubation

If the condition is not cured despite 2 technically satisfactory probings, insertion of silicone tube for 3-6 months is indicated.

4. DCR

If all the previous measures failed, dacryocystorhinostomy (DCR) is necessary between the age of 3 and 4 years.

Q What is keratonjunctivitis sicca (Dry eye syndrome). Mention its causes, clinical picture, evaluation, and ttt.

■ ***The 3 factors required for effective re-surfacing of the tear film are:***

1. Normal blink reflex
2. Congruity between the external ocular surface and eyelids
3. Normal corneal epithelium.

■ **Causes of dry eye**

● ***Dry eye syndrome can result from:***

1. A deficiency in any of the 3 layers of the precorneal tear film.
2. Abnormalities in the external ocular surface which prevents the normal contact between the lid and globe e.g. 2ry to limbal lesions.
3. Absence of blinking reflex e.g in Bell's palsy.

● **Keratoconjunctivitis Sicca (KCS)** is primarily resulting from aqueous tear deficiency. ***The following are the main causes:***

(1) ***Atrophy and fibrosis of lacrimal tissue*** which may occur in 2 clinical situations:

a. **Pure KCS** in which only the lacrimal gland is damaged by infiltration with mononuclear cells.
b. **SjÖgren's syndrome** which is an autoimmune disease characterized by the presence of hypergammaglobulinemia (50% of cases), rheumatoid arthritis (70-90% of cases), and antinuclear antibody (80% of cases). It may be 1ry or 2ry:
▪ ***Primary SjÖgren's syndrome*** (sicca complex) consists of KCS and a dry mouth due to involvement of salivary glands (xerostomia).
▪ ***Secondary SjÖgren's syndrome*** which consists of 'sicca complex' and connective tissue disease (usually rheumatoid arthritis).

(2) ***Blockage of the excretory ducts of the lacrimal gland*** as a result of severe conjunctival scarring
(3) ***Destruction of lacrimal tissue by***:
▪ Granuloma (e.g. sarcoidosis)
▪ Tumor
▪ Chronic inflammation (e.g. orbital inflammatory pseudotumor)
(4) ***Absence of the lacrimal gland*** (congenital or surgical excision of a tumor)
(5) ***Meibomian gland dysfunction*** which → instability of the tear film.
(6) ***Neurological lesions***.

● **Clinical features**

■ ***Symptoms***

(a) Common

1. Irritation
2. Foreign body sensation
3. Burning
4. Stringy mucous discharge

(b) Less common

1. Itching
2. Photophobia
3. Heavy or tired eyelids
4. Resistant conjunctivitis

■ ***Signs***

(a) Tear film abnormalities

1. Contains excess mucus and debris
2. Marginal tear strip is thin or absent

(b) Corneal abnormalities

1. Punctate epithelial erosions (PEE) involving the inferior cornea
2. Filamentary keratopathy
3. Mucous plaques.

● **Diagnosis (special tests)**

1. Tear film break-up time (BUT): it is the interval between the last blink and the appearance of the first randomly distributed dry spots. It is < 10 seconds (normally is > 10 sec)

2. Rose bengal stain is a dye with an affinity for the dead and devitalized epithelial cells and mucus. It stains the interpalpebral conjunctiva (fig.) and the filaments.

3. Schirmer's test is useful when KCS is suspected. It is < 5 mm in 5 min (normally is 10-15 mm).

● **Treatment**

(1) Tear conservation

Preservation of the existing tears may achieved through:

1. Reduction of room temp. (Air humidifiers)
2. Use of protective spectacles
3. Lateral tarsorrhaphy to reduce the surface area for evaporation.

(2) Tear substitutes (artificial tears)

Eye drops are used during the day and eye ointment at bedtime.

(3) Reduction of the tear drainage

1. **Temporary** with plugs or rods
2. **Permanent** with cautery to the proximal canaliculi in severe cases.

Q Write short notes on aetioligy, clinical picture & treatment of acute dacryoadenitis

Answer

Definition:

Acute inflammation of the lacrimal gland.

Aetiology:

1. **Local infection:** In the eye lid, forehead or orbit.
2. **Systemic infection:** As mumps, influenza and measles.

Clinical Picture

(1) Symptoms:

a. Fever, headache and malaise.
b. Pain over the lacrimal gland.

(2) Signs:

a. Upper lid: Redness and oedema.

b. Lacrimal gland:-

i. Enlarged, tender and displaces the globe down and in.
ii. Mechanical ptosis and S-shaped deformity of the upper lid margin.

Treatment:

1. **Treat the cause:** of infection.
2. **Medical treatment:**
    a. Analgesics.
    b. Antibiotics (systemic and local).
    c. Warm compresses.
3. **Surgical treatment:** Drainage by skin or conjunctival incision if suppuration occurs.

Q What is the DD of acute dacryoadenitis?

Answer

A) Palpebral lobe inflammation: DD from lid abscess, hordeolum, acute purulent conjunctivitis (The tender swelling of lacrimal gland)

B) Orbital lobe inflammation: DD from orbital cellulitis & abscess (orbital CT)

Q What are the causes of enlarged lacrimal gland?

Answer

The most common causes of lacrimal gland enlargement include:

1. ***Congenital causes*** e.g. dacryocele
2. ***Inflammatory causes*** e.g.
    - Dacryoadenitis (acute & chronic)

- Inflammatory orbital pseudotumor (Chronic non-specific orbital inflammation may involve lacrimal gland

3. ***Neoplastic* causes** e.g.
   - Benign mixed lacrimal gland tumor
   - Malignant mixed lacrimal gland tumor
   - Lymphoma