Review article:

Physiology of lacrimal passage: review

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Abstract:

The optical integrity and normal function of the eye are dependent upon adequate supply of tear fluid covering its surface. The maintenance of such a moist layer is dependent upon proper secretion, distribution and drainage of tear fluid. It has been pointed out that 25% of tears secreted is lost by evaporation. The remainder leaves the conjunctival sac through the lacrimonasal excretory system. Epiphora is most common mode of clinical presentation in patients with lower lacrimal passage obstruction, where the site of obstruction being lacrimal sac and nasolacrimal duct. Any pathology involving these structures can lead to obstruction of nasolacrimal duct. The conditions can either be primary or secondary to some other conditions. The causes of the lower lacrimal passage obstruction can be classified in to those involving sac and nasolacrimal duct. Clinically, chronic dacryocystitis remains the most common cause for obstruction of the lower lacrimal passage system, where the obstruction site is at the bony rim where sac joins the nasolacrimal duct.

Keywords: lacrimal passage system , nasolacrimal duct

Introduction:

The optical integrity and normal function of the eye are dependent upon adequate supply of tear fluid covering its surface. The maintenance of such a moist layer is dependent upon proper secretion, distribution and drainage of tear fluid. It has been pointed out that 25% of tears secreted is lost by evaporation. The remainder leaves the conjunctival sac through the lacrimonasal excretory system.[1]

The tears secreted through the upper temporal fornix are conducted to the lacrimal puncta in three ways:

1) At the lateral canthus, tears fall by gravity to form the lower tear strip. The lower canaliculus is said to collect four times as much of tear flow as the upper canaliculus. However studies suggest that as many as 45% of patients have greater outflow through upper canaliculus.
2) Capillary attraction plays a role in conducting the tears into the punctum and the vertical limb of canaliculus.
3) Lid movements play an important mechanism in the transport of tears to the puncta by an act of blinking. Blinking spreads the tear strips over the eye as a film and also moves the tears towards the puncta with each blink. The nasally directed movement of the tears results from the fact that the orbicularis muscle is more firmly fixed at its nasal attachment, thus moving the temporal part of the orbicularis ring in a nasal direction during the act of blinking;

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also, the temporal end of the palpebral aperture closes more rapidly in blinking.

As the tears enter the lacrimal puncta, they are propelled through the canaliculi into the tear sac by the same blinking movements. Each canaliculus has a short vertical and a longer horizontal segment. At the junction of the two segments the canaliculus widens in an ampulla. Orbicularis fibers are intimately disposed around the punctum and the canaliculus, so when this muscle contracts in blinking, the punctum is drawn nasally, the ampulla is compressed, and the horizontal limb of the canaliculus is shortened, thus driving tears into the lacrimal sac.

Jones demonstrated that fibers of the upper preseptal portion of the muscle insert into the fascia overlaying the muscle of the lacrimal sac. He concluded that in blinking contraction of orbicularis draws the lateral wall of the sac laterally, thus creating a negative pressure and aspirating tears into the sac, which are forced along the canaliculus by the same orbicularis contraction. When the orbicularis relaxes, the sac collapses and drives the accumulated tears into the nasolacrimal duct. This mechanism of pumping action due to alternate negative and positive pressure in the lacrimal sac is described by Jones as "lacrimal pump".

Finally, the contraction of orbicularis also tends to invert the lower lid, thus ensuring that the punctum dips into lacus lacrimalis. Negative pressure in the nose during inhalation and gravity also matters in emptying the sac.

Anatomy of lateral nasal wall:[2]

It is marked by 3 scrolls like bony projections called turbinates or conchae, from below upwards they are inferior, middle, and superior, sometimes a fourth turbinate concha suprema is also present. Below and lateral to each turbinate is the corresponding meatus.

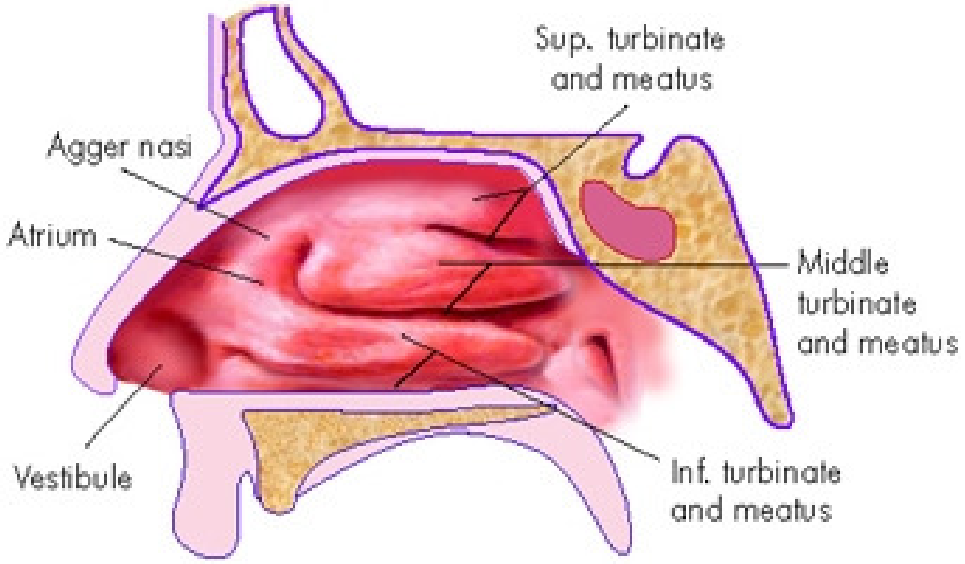

Fig 3: Anatomy of lateral nasal wall[11]

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1. **Inferior meatus:** It runs along the whole length of the lateral wall, it is the largest meatus, which ranges from 1.6 to 2.3 cm in adults. The nasolacrimal duct opens into the inferior meatus just anterior to its highest point. It can be identified in life by gentle massage of the lacrimal sac at the medial canthus.
2. **Middle meatus:** It runs only in posterior half of the lateral wall. It shows a rounded bulge called bulla ethmoidalis which is the largest anterior ethmoidal air cell. In front, there is a sickle shaped 'uncinate process'. Between uncinate process and bulla ethmoidalis, there is a semilunar gap called hiatus semilunaris which leads into a funnel shaped space called ethmoidal infundibulum.
3. **Superior meatus:** It is limited to only the posterior third of the lateral wall; Posterior ethmoidal sinuses open into it.
4. **Sphenoethmoidal recess:** It lies above the superior turbinate and receives the opening of sphenoid sinus.

Blood supply of the lateral nasal wall:[3]

From the internal carotid system, the two branches of ophthalmic artery arises,

a) Anterior ethmoidal artery
b) Posterior ethmoidal artery

From external carotid system, the two branches of the spheno-palatine artery arises,

a) Posterior nasal lateral branches
b) Greater palatine artery

The other two branches are from infra orbital branch of maxillary artery namely,

a) Nasal branch of anterior superior dental artery
b) Branches of facial artery to nasal vestibule

Etiology of lower lacrimal passage obstruction:

Epiphora is most common mode of clinical presentation in patients with lower lacrimal passage obstruction, where the site of obstruction being lacrimal sac and nasolacrimal duct. Any pathology involving these structures can lead to obstruction of nasolacrimal duct. The conditions can either be primary or secondary to some other conditions. The causes of the lower lacrimal passage obstruction can be classified in to those involving sac and nasolacrimal duct.[3,4]

1) Lacrimal sac obstruction[13] include

- Trauma
- Tumors in the sac or skin involving sac
- Dacryoliths
- Granuloma
- Fibrosis Secondary to infection
- Lymphoma and Leukemia

2) Nasolacrimal duct obstruction 4

A) Congenital obstruction
B) Acquired causes
   a) Primary Acquired Nasolacrimal duct obstruction
   b) Infection
   c) Trauma-mid facial fractures
   d) Sinus surgeries
   e) Nasal polyps
   f) Hypertrophied inferior turbinate
   g) Atrophic rhinitis
   h) Radiation therapy

Clinically, chronic dacryocystitis remains the most common cause for obstruction of the lower lacrimal passage system, where the obstruction site is at the bony rim where sac joins the nasolacrimal duct.

Classification of Dacryocystitis:[5]

Dacryocystitis can be classified as follows-

1) Dacryocystitis in infants

2) Primary or Idiopathic Dacryocystitis in adults

3) Secondary dacryocystitis or acquired obstruction at any time of life due to trauma or disease.

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