"CLINICOBACTERIOLOGICAL PROFILE OF CHRONIC DACRYOCYSTITIS IN ADULT PATIENTS ATTENDING OPHTHALMOLOGY DEPARTMENT OF A TERTIARY EYE CARE HOSPITAL: A ONE YEAR CROSS SECTIONAL STUDY"

By

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Dissertation

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Endorsement by the Head Of Department, Principal/ Head of the institution

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LIST OF ABBREVIATIONS

AC	-	Anterior chamber
CF	-	Counting fingers
DCT	-	Dacryocystitis
HMCF	-	Hand Movements Close to Face
MIC	-	Minimum inhibitory concentration
NSAID	-	Non steroidal anti inflammatory drug
PL	-	Perception of light
PMN	-	Polymorphonuclear cells
SD	-	Standard deviation
MRSA	-	Methicillin resistant Staphylococcus aureus
ROPLAS	-	Regurgitation on pressure over lacrimal sac

ABSTRACT

Background and objectives

Dacyrocystitis is one of the most common diseases that bring patients to the ophthalmologist. Most often antibiotics are given empirically as prophylaxis as well as post operatively but the rising incidence of resistant infections as well as a significant increase in failure of open lacrimal sac surgery due to infection demand that more keen attention should be paid to the selection of antibiotics. This study attempts to evaluate the changing trend in bacteriology and antibiotic sensitivity of chronic dacryocystitis.

Methods

The clinicobacteriological profiles of 55 adult patients coming to Ophthalmology OPD of KLES Dr.Prabhakar Kore Charitable Hospital & MRC, Belgaum, diagnosed with chronic dacryocystitis between January 2013 and December 2013 were included in this cross sectional study .Sample fluid was collected by applying pressure over the lacrimal sac and allowing the fluid/purulent material to reflux through the lacrimal punctum or by irrigating the lacrimal drainage system with sterile saline and collecting the sample from the refluxing material. The samples were sent to microbiology department for Gram's staining and culture. Antibiotic sensitivity testing was done for the cultured bacterial growth by Kirby Bauer disc diffusion test.

Results

In our study 43.6% yielded aerobic growth on culture. The commonest aerobic bacteria in chronic dacryocystitis were Staphylococcus aureus (48%) followed by

coagulase negative staphylococci (26%). Among Gram negative bacteria Pseudomonas aeruginosa (7%) and Klebsiella pneumonia (7%) were common. Staphylococcus aureus was the most commonly isolated bacteria in mixed bacterial isolates. The Gram-positive isolates were most sensitive to Erythromycin followed by Ciprofloxacin. The gram negative isolates were most sensitive to Ciprofloxacin and Amikacin.

Conclusion and interpretation

There is an increase in risk of soft tissue infection after open lacrimal surgery without systemic antibiotic prophylaxis. Knowledge about bacteriology of chronic dacryocystitis contributes significantly to choice of prophylactic antimicrobial agents that act specifically on the causative organism and also prevents antibiotic resistance caused due to injudicious use of antibiotics.

Key words

Dacryocystitis, Gram positive, Gram negative, antibiotic sensitivity.

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INTRODUCTION

Dacyrocystitis is one of the most common diseases that bring patients to the ophthalmologist. Defined as inflammation of the lacrimal sac, it could be infective or sterile in nature. [1] It could present for the first time with an acute episode in the form of a tearful patient, with discharge, pain and swelling over the lacrimal sac area. More often, it presents as chronic dacryocystitis with unrelenting and often distressful watering and discomfort of eye, particularly in females. [1] Although most often chronic dacryocystitis behaves as an innocuous disease, it could lead to devastating complications if the infection takes firm hold and spreads. The most important complication is the formation of a reservoir of infection in the lacrimal sac. Despite medical therapy the infection is often fastidiously harbored in the sac and demands surgical treatment for eradication of infection. [1] The lacrimal sac is cradled between the orbit and the nose and hence chronic dacryocystitis can lead to complications in either of the adjacent structures.

Most often antibiotics are given empirically as prophylaxis as well as post operatively but the rising incidence of resistant infections as well as a significant increase in failure of open lacrimal sac surgery due to infection[2] demand that more keen attention should be paid to the selection of antibiotics.

There are comparatively few studies that have studied the bacteriology of chronic dacryocystitis and its antibiotic sensitivity in recent times. Also most of the existing studies are retrospective and have not taken into account whether the patient had received preoperative antibiotics and if so, for what duration. This could have had undue bearing on the results of antibiograms of these studies. There is also

documented variation in the trend of bacterial isolates obtained from samples from different geographic locations.[3] A study that describes the commonly occurring bacterial isolates in recent times, as well as studies their antibiotic sensitivity would be of immense value to the treating ophthalmologist in selecting the most appropriate antibiotic for his patients. Selecting an appropriate antibiotic and using it judiciously will go a long way in combating the menace of antibiotic resistant infections and in providing the best possible treatment to the patient.

OBJECTIVES

1. To determine current bacteriological profile of chronic dacryocystitis in adults and to determine antibiotic sensitivity for the same.

2. To clinically study chronic dacryocystitis with respect to age, gender, laterality, locality, etiology, symptoms and signs.

REVIEW OF LITERATURE

History

Time has stood testimony to the varied manifestations of dacryocystitis. The earliest description of this disease has been found in the Sushrutha Samhitha text in the Vedic ages. Here Sushrutha, often called the father of surgery has also given a brief note on the treatment of dacryocystitis.

The first accurate description of the anatomy of the lacrimal apparatus was probably given by Celcus. In the first two decades of the twentieth century Whitnal, Gnaldi, Vogt and a few others commented on deformities of the bony nasolacrimal canal as possible etiology for both congenital and adult dacryocystitis. In 1915, Harmer made a significant observation that mechanical obstruction in the nose could cause dacryocystitis. At about the same time sinus disease and conjunctivitis were first implicated as etiological factors in dacryocystitis.

For a long time, swelling near the medial canthus was considered as a soft tissue infection known as "Aegylops". George and Sehl in the 18^{th} century gave a determined account of how lacrimal obstruction and inflammation can lead to a swelling in the lacrimal sac area.

While the anatomical and clinical description of this disease can be found in ancient texts of Indian as well as European origin, the detailed study of bacteriology of dacryocystitis was only initiated in the early decades of the 20^{th} century. For several years Pneumococcus was described unanimously as the etiological agent by authors like Plank and Zelawski (1901), Casali (1923) and Rollet and Bussy (1923),

among others. However later trachoma, tuberculosis and actinomycosis were also described. That systemic infections like diphtheria, small pox and other exanthemata as well as influenza scarlet fever could cause inflammation of the lacrimal sac was proposed by Morgaillar and Moreuon in 1923. Other less common conditions like foreign body and chemical induced lacrimal sac inflammation also were described in the early decades of the twentieth century.

Embryology

The earliest evidence of nasolacrimal drainage system is in the form of a solid column of surface ectodermal cells buried in a cleft between the maxillary process and the nasal process at the 10mm stage of the embryo. This column is surrounded with mesodermal tissue. At the 15mm stage the epithelial cells at the upper end of the cord grow laterally into the lids to form the upper and lower canaliculi. Meanwhile the epithelial cells at the lower end grow downwards into the nose, forming the osseous nasolacrimal duct and finally meet the epithelial cells of the developing nasal cavity that form the membranous part of the nasolacrimal duct. Lysis of cells at the junction of these two columns of epithelial cells occurs at the sixth month of gestation.[4]

At the 25 mm stage of embryo (45 days of gestation) a solid cord of epithelial cells is formed from proliferating basal cells of conjunctiva. This cord is localized at the temporal region of the upper fornix. Mesenchymal neural crest cells condense around the tips of these cords and form acini of the gland. At 60 to 65 mm stage (3 months of gestation) vacuolation in these cords results in the formation of ducts. In this manner several buds are formed by growth and subsequent canalization of ectodermal cell cords into the mesenchyme at the superolateral end of the upper

fornix. Later the gland becomes divided into orbital and palpebral parts with the development of levator palpebrae superioris muscle. [1,5]

Anatomy

The lacrimal system consists of secretory and drainage portions. The secretory arm is formed by the lacrimal gland while the upper and lower lacrimal pathways together constitute the drainage system.[1]

Lacrimal gland

This serous gland is nested in the lacrimal fossa of the frontal bone, beneath the superotemporal margin of the orbit. It is divided by the tendon of the levator palpebrae muscle into a larger orbital part and a smaller palpebral part. The orbital part compises about two thirds of volume while the palpebral part contributes one third of the volume of the lacrimal gland. About 2 to 5 ducts from the orbital lobe and 6 to 8 ducts from palpebral lobe carrying secretions from this gland open into the superotemporal part of upper fornix, nearly 4 to 5 mm above upper border of tarsus.

Accessory glands of Krause and Wolfring located in the fornicial region and tarsal edge respectively are similar to the major lacrimal gland in structure, but on a smaller scale. There are about 20 glands of Krause in the upper fornix and about 8 of them in the lower fornix. These glands along with minor glands in the caruncle and plica play an important role in basal tear secretion. [5,6]

The lacrimal gland is tubuloacinar with tiny pinhead sized ill defined lobules. Each acinus consists of pyramid shaped secretory cells with their apices directed towards the central lumen. Myoepithelial cells lie in between the basal part of acinar cells and their basement membrane. Adjacent secretory cells within an acinus are

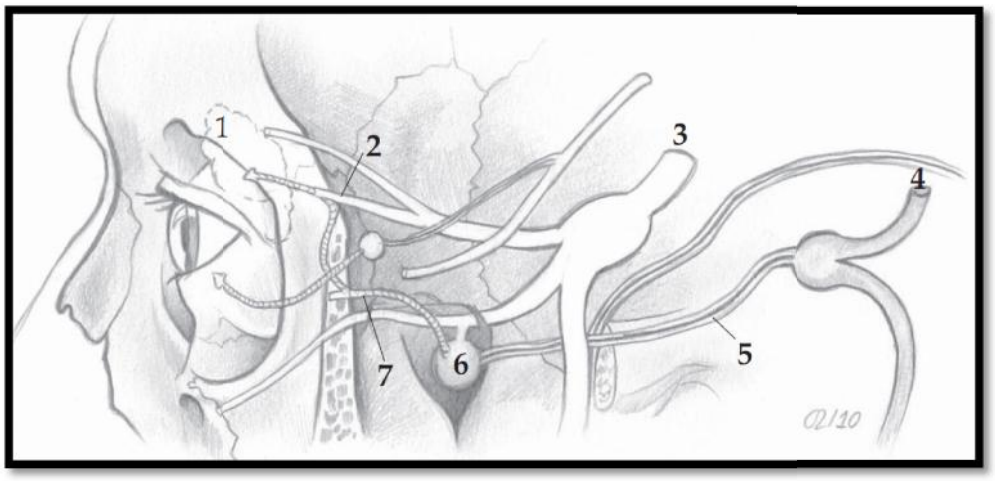
connected by junctional complexes near their luminal end. Projecting into the lumen are numerous apical microvilli, each 0.5 micron long. While the golgi bodies are scattered over the lateral and apical regions of secretory cells, the endoplasmic reticulum lies basally. The pyramidal cells abound in secretory granules that are denser at the apex than basally. Myoepithelial cells are elongated and contractile and function as pumps that aid in squeezing out secretions from the acini into the ducts. Microvilli of luminal cells project into the lumens of the duct.[5]

The lacrimal artery provides major arterial blood supply to the lacrimal gland. The lacrimal vein drains into the superior ophthalmic vein**.**[6]

Nerve supply of the lacrimal gland

The parasympathetic secretomotor nerve supply to the lacrimal gland takes origin from the superior salivatory nucleus in the medulla and travels as the nervus intermedius (nerve of Wirsberg). It synapses in the sphenopalatine ganglion. The greater petrosal nerve carries the post ganglionic fibers to the lacrimal gland. The sympathetic fibers originating in the superior cervical sympathetic ganglion course along the blood vessels to reach the lacrimal gland. The sensory innervation is derived from the lacrimal nerve.

Figure 1: Innervation of the lacrimal gland.



1. Lacrimal gland

2. Lacrimal nerve

3. Trigeminal nerve

4. Facial nerve

5. Greater petrosal nerve

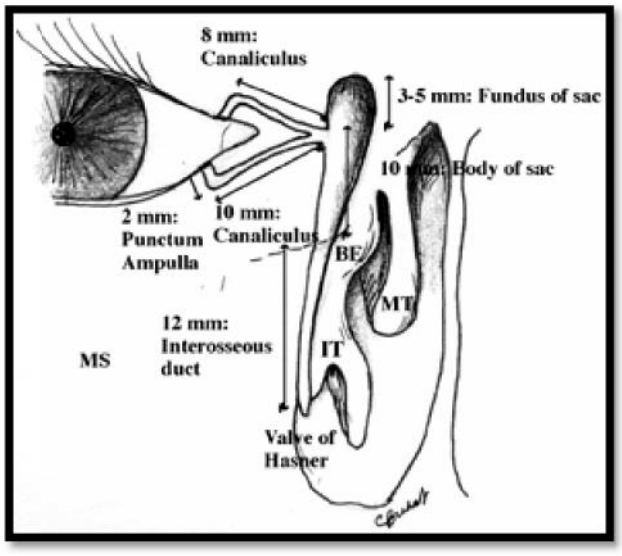
6. Sphenopalathine ganglion

7. Parasympathetic fibers

Lacrimal drainage system

The membranous lacrimal passage is encased partially within a bony passage. The upper lacrimal pathway includes lacrimal puncta and lacrimal canaliculi, whereas the lower lacrimal pathway consists of the lacrimal sac and the nasolacrimal duct.

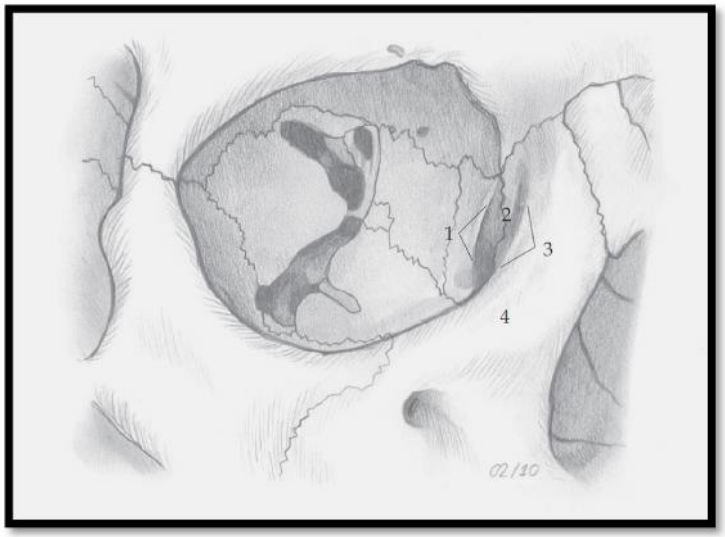
Figure :2 Anatomy of lacrimal drainage system



Bone anatomy in relation with the lacrimal passages Lacrimal fossa

It is a depression in the lower part of the medial wall of the orbit. It is sometimes called the lacrimal groove. It measures 10 to 17 mm vertically, 3 to 8 mm horizontally and about 2 to 4 mm anteroposteriorly. From its dimensions it is apparent that this fossa allows the lacrimal sac to fit snugly inside.

Figure 3: Anatomy of the lacrimal fossa



1. Posterior lacrimal crest **3**. Anterior lacrimal crest

2. Lacrimal fossa **4**. Frontal process

The fossa is bounded in front by an anterior lacrimal crest formed by frontal process of maxilla and is continuous with the inferior orbital margin. The medial palpebral ligament takes origin from the anterior lacrimal crest, which is an important surgical landmark. On the posterior aspect the fossa is bound by the posterior lacrimal crest formed by the lacrimal bone. It is continuous with the medial orbital margin. Thus the fossa is formed anteriorly by the maxilla while the lacrimal bone forms the posterior half. Superiorly there is no definite boundary and inferiorly the fossa

continues as the bony nasolacrimal canal. The fossa is deep inferiorly, gradually becoming shallow towards its upper end.[5]

The mean thickness of lacrimal bone is nearly 106 microns. However variations are common. While 67% patients have less than 100 microns, 4% have it more than 300 microns.[7] These anatomical variations assume significance when the bone has to be punched as in dacryocystorhinostomy.

Relations of lacrimal fossa

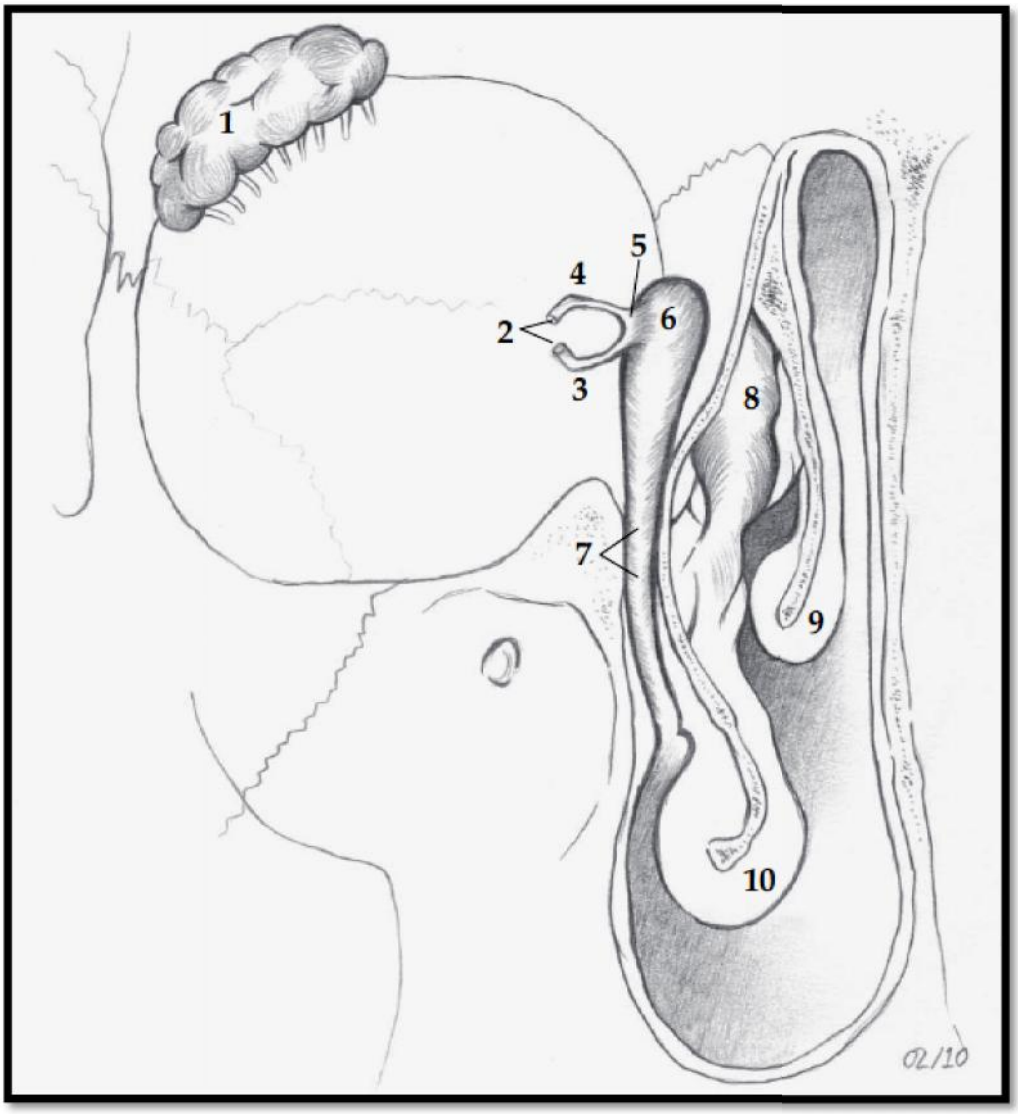
The lower half of the lacrimal fossa is related medially to the middle meatus of the nose. The upper half of the lacrimal fossa has a variable relation medially to the anterior ethmoidal air cells.[5]

Bony nasolacrimal canal

This canal runs downwards, backwards and laterally, its surface anatomy denoted with a line joining the midpoint of the medial palpebral ligament to the base of the alae nasi. It is about 12 to 18 mm long and 4 to 6 mm wide. The outer wall of this canal is formed by a groove in the maxilla called the lacrimal sulcus. The inner wall is formed when the lacrimal bone above articulates with lacrimal process of the inferior turbinate below. The upper orifice from where onwards the lacrimal sac continues as the nasolacrimal duct, is formed by the junction of the anterior one third and posterior two third of the roof of the inferior turbinate.

The applied anatomy is that a narrow bony nasolacrimal canal is more prone for obstruction and subsequent dacryocystitis. This explains the increased incidence of nasolacrimal duct obstruction in women as well as races where the skull shows high nasal index. A narrow nasolacrimal canal may also be inherited.

Figure 4: Anatomy and relations of the nasolacrimal duct



1. Lacrimal gland

2. Punctal openings

3. Inferior canaliculus

4. Superior canaliculus

5. Common canaliculus

6. Lacrimal sac

7. Nasolacrimal duct

8. Uncinate process

9. Middle turbinate

10. Inferior turbinate

Lacrimal puncta

There is a single small round or oval opening at the medial end of each of the upper and lower eyelids. It is situated on an elevation called the lacrimal papilla. The lower punctum is slightly larger in diameter (0.3mm) and drains almost 70% of tear outflow as compared with the smaller upper punctum of 0.2mm diameter that drains only 30%.[8] A ring of elastic connective tissue called corium surrounds these openings that appear paler than the surrounding area due to their relative avascularity.[6] The upper and lower puncta are respectively located about 6mm and 6.5mm laterally to the medial canthus.[9] Normally the position of the puncta is such that they remain buried in the tear lake, closely apposed to the globe. The valve of Bochdalek is located at the punctual opening.[5]

Lacrimal canaliculi

There is a canaliculus that is continuous with each of the upper and lower puncta. Each canaliculus is formed of a vertical portion of about 2mm length and a horizontal portion that is about 8 mm long in the upper lid and about 10 mm long in the lower lid.[10] At the junction of the horizontal and vertical portions the canaliculus dilates to form the ampulla, where the valve of Faltz is located.[5]

After passing behind the medial canthal tendon the upper and lower canaliculi unite to form a 2mm long common canaliculus in 94% of the population. In rest of the cases the superior and inferior canaliculi independently enter a diverticulum of the sac called the Sinus of Maier.[11] At the junction of the common canaliculus with the sac is a fold of mucus membrane called the valve of Rossenmuller.[5] Each of the canaliculi is surrounded by fibers of lacrimal portion of orbicularis muscle, commonly called

Horner's muscle. These fibers are responsible for the pumping action on the canaliculi with each blink.

The lumen of each canaliculus is lined with stratified squamous epithelium surrounded by elastic connective tissue.

Lacrimal sac

It is an elongated pear shaped reservoir of lacrimal fluid. Its dimensions range from 12 to 14 mm vertically, 4 to 8 mm anteroposteiorly and 2 to 4 mm in width. [12,13] It has a capacity of nearly 20 cubic mm. The sac is blind above while inferiorly it continues as the nasolacrimal duct. The surface landmark of the sac and the nasolacrimal duct is obtained by a line joining the medial canthus with the first molar tooth. Thus this line goes downwards and laterally. There is also a slight backward angulation.[1] The lacrimal sac sits in a bony depression called the lacrimal fossa.

Relations of lacrimal sac [5,9]

Anterolateral relations from superficial to deep

- Skin
- Palpebral fibers of orbicularis muscle
- Medial palpebral ligament (MPL)
- Lacrimal fibers of orbicularis muscle (Horner's muscle)
- Lacrimal fascia and few fibers of inferior oblique

The angular vein runs superficially over orbicularis muscle fibers and crosses the MPL about 8 mm medial to the medial canthus.

Posterior relations from superficial to deep are

- Lacrimal fascia
- Fibers of lacrimal part of orbicularis
- Septum orbitale, which separates the sac from orbital fat and check ligament of medial rectus.

Media relations: Anterior ethmoidal sinus in upper part and the middle meatus of nose in lower part.

Nasolacrimal duct[5]

It is a tube like downward continuation of the lacrimal sac. Its length ranges from 12 to 24 mm (average length 18mm) and has a lumen of about 3 mm diameter. It has 2 parts:

- Superior intraosseus part
- Inferior intrameatal part

The nasolacrimal duct is narrowest at the junction of these two parts. The intraosseus part that runs through the bony nasolacrimal canal is nearly 12.5mm long. The intrameatal part is buried under the mucus membrane of the lateral wall of the nose. It must be remembered that the nasolacrimal duct is directed downwards, backwards and laterally while performing probing of the lacrimal passages.

The mucous membrane of the nasolacrimal duct is thrown into numerous folds that form valve like structures in the lumen. Of most clinical importance is the valve of Hasner at the lower end of the duct. It prevents retrograde flow from the nose to the lacrimal sac, as for example during sneezing.[5]

Blood supply of lacrimal passage [5,6]

Arterial supply

Branches of the ophthalmic and maxillary artery supply various parts of the lacrimal passages.

- Superior and inferior palpebral arteries which are branches of ophthalmic artery supply the upper lacrimal pathway and upper part of the lacrimal sac.
- Infraorbital artery which is a branch of the maxillary artery supplies the lower part of the sac and upper part of the nasolacrimal duct.
- Lower part of the nasolacrimal duct derives its blood supply from the nasal branch of the sphenopalatine artery.

Venous drainage

The lacrimal passage drains into the angular and infraorbital veins from above and into the nasal vein from below. These veins in turn drain into the pterygoid plexus and maxillary vein.

Lymphatic drainage

The lymphatics from the sac drain into the submandibular nodes, while those draining the nasolacrimal duct drain into the submanibular and upper deep cervical group of lymph nodes.

Nerve supply of lacrimal passage

Sensory innervation: The nasociliary branch of the ophthalmic division of trigeminal nerve gives a branch called the infratrochlear nerve which innervates the lacrimal

canaliculi, sac and the upper part of the nasolacrimal duct. The lower part of the duct derives its sensory innervation from the anterior superior alveolar nerve which is a branch of the maxillary division of the trigeminal nerve.

Motor innervation: The orbicularis oculi muscle is supplied by the facial nerve.

Sympathetic nerve supply: Fibers derived from the sympathetic fibers accompanying the arterial supply of the orbit also innervate the lacrimal passages.

The fact that extirpation of the lacrimal sac leads to significant reduction of tear secretion points to a reflex relating the lacrimal gland and the lacrimal sac.

Histology of the lacrimal sac and nasolacrimal duct

A double layerd epithelium lines the lumen. The superficial non ciliated pseudostratified columnar epithelium also contains goblet cells. The deeper layer consists of flat cells. The epithelium lies on a basement membrane which in turn lies over a submucosal layer which is rich in lymphocytes. During infections there may be follicles formed by lymphocytes aggregated in this layer. There are abundant nerve endings here as well. A venous plexus and elastic fibers form an erectile tissue surrounding the sac which is continuous with a similar erectile tissue that lies under the nasal mucosa. This explains the congestion and obstruction of the nasolacrimal duct that accompanies conditions that cause congestion of the nasal mucosa.

Physiology of the lacrimal system

A film of fluid covers the ocular surface to form a moist envelope. Functions of this tear film are:

- Maintains an optically uniform corneal surface.
- Flushes cellular debris and foreign matter away from the surface of the cornea.

- Provides nutrition to the cornea.
- Diffusion of oxygen occurs through the tear film to reach the cornea.
- Protective barrier function due to its constituent antibacterial substances.

Tear elimination

Outflow of tears is accomplished by interplay of several factors such as capillarity, gravity, evaporation at the interface between air and the tear film. The contribution of evaporation to tear elimination varies with age, being nearly 10% in the young and increasing to 20% in older adults.

The predominant mechanism of tear elimination is the pumping effect due to contraction of the orbicularis muscle. Tear fluid collected at the lateral canthus passes through the lateral cul de sac where the effect of gravity causes the tears to fall and form the marginal tear strip. This fluid then runs along the ciliary margin of each eyelid and collects as lacus lacrimalis at the inner canthus. This is where the active pump mechanism of the orbicularis muscle comes into action.

When the eyelids are closed:

The siphon mechanism as proposed by Jones explains that the pretarsal fibers of orbicularis muscle contract and thereby compress the ampulla and shorten the canaliculi. This pushes the fluid present in the ampulla and the horizontal portion of the canaliculi towards lacrimal sac. *Jones lacrimal pump theory* further states that the simultaneous contraction of the preseptal fibers of orbicularis muscle pulls the lacrimal fascia and lateral wall of the sac laterally, thus causing a distension of the otherwise collapsed sac lumen. This leads to build up of negative pressure that the valve of Hasner helps in maintaining. While this negative pressure causes tears to be

sucked in through the canaliculi, air is prevented from being aspirated from the nasal end of the sac due to its firm closure by the tension on the lacrimal fascia.

When the eyelids are open:

The pretarsal fibers relax, thereby allowing the canaliculi to expand and open up. This draws the tears from the lacrimal lake into the canaliculi through the puncta. Meanwhile, relaxation of preseptal fibers of orbicularis allows the lacrimal sac to collapse, thus expelling fluid down to the lower end of the sac. The open valve of Hasner permits fluid to enter the upper end of the nasolacrimal duct. Further movement of fluid from nasolacrimal duct into the nasal cavity is explained by gravity and the to and fro movement of air currents. When the pressure in the nose rises (for example on blowing the nose), the valve of Hasner closes and prevents reflux into the sac.

Paulsen and coworkers hypothesized that the vascular plexus around the lacrimal sac function as a cavernous body with erectile property that could influence the opening and closing of the lower lacrimal passage.[14]

Etiopathogenesis of chronic dacryocystitis

A healthy lacrimal passage is inherently resistant to infective organisms due to the constant flushing action of tear flow and due to the bacteriostatic properties of tears.[15] For infective organisms to establish a hold over any part of the lacrimal passage there has to be stasis of contents of the sac and a source of infection that could be derived from conjunctival, nasal or paranasal sinus disease or organisms inoculated during trauma. Specific infections like tuberculosis, leprosy and syphilis should also be kept in mind.

Stasis of the contents of the lacrimal sac can be due to mucosal congestion but is most often due to obstruction of the nasolacrimal system. Stasis leads to irritation of the mucosa of lacrimal sac and is soon followed by inflammation. As the mucosa is thrown into several folds, a slight congestion due to inflammation could lead to obstruction of fluid outflow. The cavernous nature of the submucosal layer enriched with lymphatics causes it to form a steady site for congestion. Presence of obstruction anywhere along the lower nasolacrimal passage allows infection to flourish within the enclosed area of the lacrimal sac.

In the presence of stasis there is a fall in resistance of the nasal mucosa which lets the infection take a stronger hold and thus precipitates a vicious cycle where stasis is followed by infection, inflammation, obstruction and further stasis.

Thus the etiological factors leading to nasolacrimal duct obstruction as well as infection could be varied.

a) *Primary acquired nasolacrimal duct obstruction (PANDO):* Includes obstruction of unknown pathogenesis characterized by gradual inflammation and subsequent fibrosis of the nasolacrimal duct, which leads to increasing obstruction of the drainage system. [16,17] Several predisposing factors have been suggested, including cigarette smoking and midface trauma.
b) *Anatomical factors:* A narrow osseous canal can lead to duct obstruction at the slightest hint of edema.
c) *Infections of neighboring structures:*

i) Conjunctival infections

ii) Nasal diseases:[4]

- Inferior turbinate hypertrophy

- Deviated nasal septum
- Atrophic rhinitis
- Congestive and hypertrophic conditions of mucosa
- Inflammatory conditions that cause chronic nasal catarrh

iii) Sinus disease: spread of infection is through either venous or lymphatic drainage.

iv) Trauma and surgery[18]

- Mid facial injuries
- Nasoethmoid fractures
- Rhinoplasty
- Nasal and endoscopic sinus surgery
- Orbital decompression
- Orbital floor fracture with repair[19]

v) Foreign body in lacrimal sac

vi) Dacryolith

vii) Neoplasm: Primary lacrimal sac tumours, papilloma, squamous cell carcinoma, fibrous histiocytoma, lymphoma and others can compress the nasolacrimal duct and lead to stasis of secretion.

viii) Inflammatory diseases: Sarcoidosis, Wegener's granulomatosis.

ix) Excessive lacrimation: Atonicity of sac leads to stasis of secretions as well as tear overflow. This is followed by a sequence of chronic irritation, inflammation and infection.

x) General infection: Influenza, scarlet fever, diphtheria and chicken pox can cause infection of nasolacrimal passage.

Histopathology in chronic dacryocystitis

The inflammation of the nasolacrimal sac causes its walls to become edematous and nearly two to three times thicker than normal. The edema imparts a velvety texture to the mucosa. The mucosal folds become exaggerated and can sometimes form granulomatous masses or polyps. If severe, the lumen may be completely obliterated. The valves may become thickened and lead to stricture. Most common sites of stricture formation are the lower end of the sac and in the lower nasolacrimal duct.

In acute dacryocystitis the sac lumen is filled with pus. The epithelium is largely destroyed and desquamated cells are present in the pus. In contrast to acute dacryocystitis where submucosa is infiltrated with polymorphs and small lymphocytes, in chronic dacryocystitis the submucosal infiltration consists of mononuclear cells, eosinophils and endothelial cells.

In long standing cases fibroblast proliferation along with loss of elastic tissue occurs. Hence the sac becomes small, atrophic and distorted with several fibrous adhesions. If filled with mucus or pus, the lack of elasticity causes the sac to be dilated to form a mucocele or pyocele respectively.

At any time in the course of chronic dacryocystitis, acute inflammation can intervene. There is usually coexistent pericystitis and this can perforate anteriorly to form a subcutaneous abscess that may point over the skin overlying the sac. If the abscess bursts, epithelization can lead to the formation of a fistulous tract.

Classification of dacryocystitis

1. According to the age of onset[1]

a. Dacryocystitis neonatorum or congenital dacryocystitis.

b. Adult onset dacryocystitis or acquired dacryocystitis.

2. Etiological classification

a. Primary disease of nasolacrimal duct & lacrimal sac.

- Idiopathic - The most common type occurring in adults.
- Infective and Inflammatory type -

i) Non-specific

ii) Specific origin

- Obstructive type -

i) Mucous membrane valves and folds.

- Within the lacrimal sac
- Between the sac and nasolacrimal duct
- At the lower end of nasolacrimal duct, where it opens into the inferior meatus of the nose,

ii) Dacryoliths and foreign bodies rarely occur in around 10-20% of the patients with dacryocystitis.

iii) Neoplasms of the lacrimal sac: Squamous papillomas, squamous cell carcinoma, adenoid cystic carcinoma

b) Secondary to diseases of the lacrimal sac and /or nasolacrimal duct. Lacrimal sac can be involved secondarily to pathology in the neighbouring structures like:

i) Conjunctiva and canaliculi:

- Canalicular atresia
- Specific conjunctivitis and/or canaliculitis due to trachoma, syphilis, tuberculosis, zoster, actinomycosis and mycotic infections.

ii) Nose: Deviated nasal septum, inferior turbinate hypertrophy, nasal polyps, atrophic rhinitis, paranasal air sinus infection; especially ethmoidal sinusitis, inflammations and abscess of perilacrimal tissue.

iii) Trauma: Often there is an obstruction at the junction of the lacrimal sac and nasolacrimal duct in midfacial blunt injuries causing fractures of the nasoethmoidal region, intranasal operations, gunshot injuries. Various other injuries including inadvertent probing may result in dacryocystitis.

c) Clinical classification

i) Acute Dacryocystitis[1,20]

- Acute suppurative dacryocystitis with or without development of
  - internal lacrimal fistula
  - external lacrimal fistula
- Acute suppurative peridacryocystitis
- Acute gangrenous peridacryocystitis

ii) Chronic Dacryocystitis

- Catarrhal dacryocystitis
- With or without mucocele which may or may not be encysted.
- Hematocele of sac

iii) Chronic suppurative dacryocystitis

- Pyocele
- Internal lacrimal fistula (ethmoidolacrimal fistula)

iv) Chronic peridacryocystitis

d) Histopathological classification[21]

i) Suppurative dacryocystitis

ii) Non suppurative dacryocystitis

- Granulomatous dacryocystitis
- Non granulomatous dacryocystitis

  - Chronic Catarrhal type
  - Hyperplastic type
  - Dacryocystitis Pseudoglandularis
  - Follicular type
  - Fibrotic type.

e) Microbiological Classification[20]

i) Non-specific dacryocystitis

- Chronic dacryocystitis: Commonly due to Pneumococci and Staphylococcus species. Escherichia coli, Moraxella and Gonococci, Pseudomonas pyocynae, Neisseria catarrhalis, Proteus, Corynebacterium xerosis, F. fusiformis can also cause chronic dacryocystitis

- Sub-acute dacryocystitis: Commonly due to Pneumococci, Staphylococci or Moraxella.

- Acute suppurative dacryocystitis: Streptococci and Staphylococci with superimposed Pneumococcal infection.

- Suppurative peridacryocystitis: Frequently due to Streptococci, usually of nasal or paranasal origin.

ii). Specific dacryocystitis (Rare Types)

- Trachomatous dacryocystitis
- Tuberculous dacryocystitis

➢ Primary Tuberculous dacryocystitis

➢ Secondary Tuberculous dacryocystitis

➢ Fungating tuberculous dacryocystitis

➢ Atresic Tuberculous dacryocystitis

➢ Cold Abscess (purulent – Tuberculous dacryocystitis)

➢ Fibrous Tuberculous dacryocystitis.

- Leprotic dacryocystitis

- Syphilitic dacryocystitis –
  - Primary chancre of lacrimal sac
  - Secondary syphilis (Gumma of the lacrimal sac)
  - Tertiary syphilis of the lacrimal sac
  - Congenital syphilis.
- Glanders of the lacrimal sac
- Diphtheritic dacryocystitis
- Actinomycosis.
- Viral : Vaccinia, Infectious Mononucleosis, Herpes simplex, Herpes zoster.
- Mycotic: Sporotrichosis, Rhinosporidiosis, Candidiasis, Aspergillosis, Cephalosporidosis, Trichophytosis.
- Parasitic dacryocystitis- Ascaris lumbricoides

Demographic considerations

Age: While the etiopathogenesis of congenital nasolacrimal duct obstruction differs from that of adult dacryocystitis, even among adults there is increase in incidence of dacryocystitis with age, with peak in 5th decade. [22,23] Few studies have quoted people with age above 40 years as having increased incidence of dacryocystitis.[24,25]

Sex: There is overwhelming support to the increased incidence of this disease in females. Several studies have mentioned that females constitute between 70 and 80% of cases. [26,27,28] Few studies have documented female patients as comprising between 65 and 68% cases.[29,30] Narrow lumen of the bony canal and narrow angles in females

are implicated as causative factors. It is also hypothesized that females by habit blow the nose less heartily than males. All these factors can precipitate stagnation of tears. A contradicting conclusion is presented by Ghose et al who mention incidence of dacryocystitis to be double in males as compared with females.[31]

Laterality: Few studies say that unilateral dacryocystitis is more common on left side, the reason however remains unknown. [32,33] Dacryocystitis is bilateral in about 12% cases.[31]

Racial and geographic variation: A lower nasal index has been shown to have increased predisposition for nasolacrimal duct obstruction. Radiological examination in Negroes reveals a shortened, wider, less sinuous canal with large ostium. This could explain the rarity of this disease among Negroes compared with Whites.[1]

Heredity: An autosomal dominant transmission has been proposed.[1]

Socioeconomic variation: Increased incidence in patients belonging to low socioeconomic status is probably attributable to lower levels of hygiene.[22]

Evaluation of dacryocystitis

A patient of chronic dacryocystitis most often presents with tearing. Some patients with tearing symptoms truly produce more tears than the normal drainage system can handle, and some people may have conditions that cause more of a sensation of tearing than actual overloading of the drainage system. The blockage may occur at many sites in the tear drainage passage.

A patient presenting to an ophthalmologist with tearing should be evaluated in a systematic manner with logical sequence of examination and investigations in order to arrive at a diagnosis in the quickest, most efficient manner.

History

Diagnosis of chronic dacryocystitis is primarily clinical. The primary consideration for clinicians is to distinguish epiphora from hyperlacrimation.

History of intermittent redness of the eyes, mucous production or heavy lid crusting in the morning, pain or swelling in the region of the lacrimal sac, or prior episodes of acute dacryocystitis should be elicited. These symptoms may indicate chronic or intermittent dacryocystitis. Patients suffering from dacryolithiasis may have symptom free intervals in between episodes of watering. Patients with entropion or trichiasis, blepharitis, corneal abrasions, chronic conjunctivitis, or photophobia and iritis also frequently have hyperlacrimation symptoms. A history of facial nerve paresis, scleroderma or lid scarring may indicate a dysfunctional lacrimal pump mechanism.

It is also a good practice to ask for details of previous treatment .Chronic use of certain drugs like idoxuridine or prior cicatrizing conjunctivitis could have led to punctal stenosis. Repeated probing or instrumentation of the lacrimal canaliculi can result in severe canalicular stenosis. Patients should be questioned about a history of chronic allergies or sinusitis, previous nasal or sinus surgery, midfacial fractures or radiation therapy.

The age of the patient (child, adult, elderly) and the duration of the symptoms (acute, chronic) have an important bearing on the likely cause of the problem and thus greatly influence the choice of treatment.

External examination

A detailed and meticulous examination under slit lamp can offer several clues if not a clear cut diagnosis. Attention should be directed to the position of the puncta , eyelid movement with each blink, contour of the margin, trichiasis and abnormalities of lid position. External diseases of the eyelids and keratitis should be specifically looked for. Swelling and redness of the punctum in the canaliculus may indicate canaliculitis.

Pressure over lacrimal sac

Regurgitation on pressure over lacrimal sac (ROPLAS) is simple, quick confirmatory test for sac and nasolacrimal duct infection and probable obstruction. The sac may or may not be distended; however, regurgitation of mucus or pus through the canaliculus and puncta is indicative of dacryocystitis and obstruction.[4] The sensitivity and specificity of ROPLAS in detecting chronic dacryocystitis are about 93.2% and 99.3% respectively. The negative predictive value of the test according to an Indian study is 99.5%.[34]

Irrigation of canaliculus

Syringing saline into lacrimal passage through the puncta is an essential test not only to confirm the diagnosis but also to know the approximate site of obstruction (figure 5). The refluxed fluid could be sent for microbiological examination to detect the causative organism as well as its antibiotic susceptibility. Theoretically this procedure also has therapeutic value in relieving obstruction by dislodging mucous plugs.

On irrigating saline through the lower punctum if saline reaches the nose it indicates the absence of complete complete obstruction in the membranous passage of the lacrimal system (Figure 5a). It does not rule out an incomplete block or functional block.

Figure 5: Irrigation of nasolacrimal system

Figure 5a: Patent nasolacrimal passage

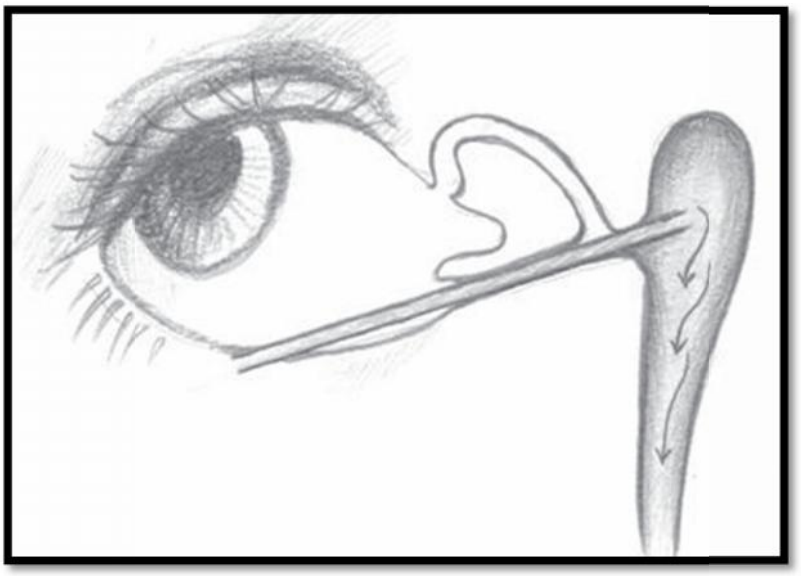


Figure 5b: Inferior canalicular obstruction

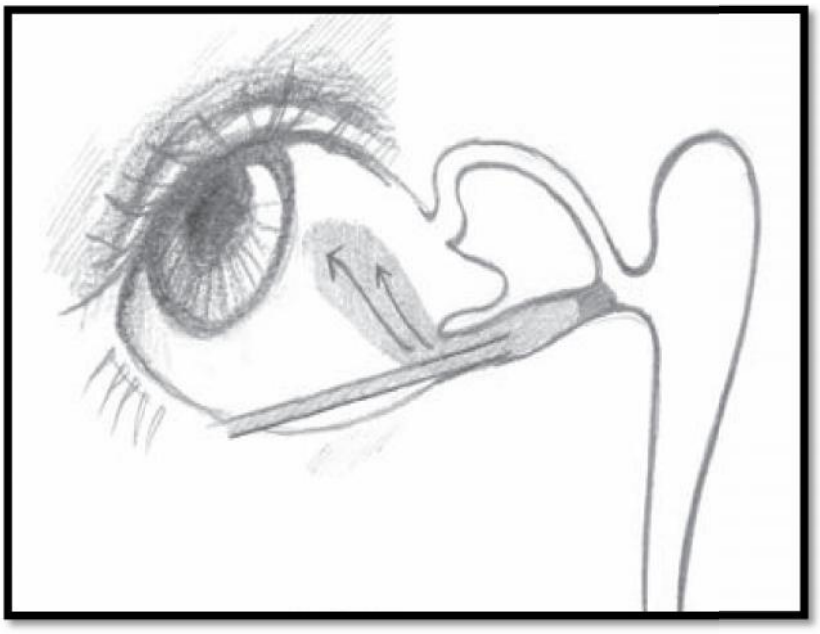


Figure 5c: Common canalicular obstruction

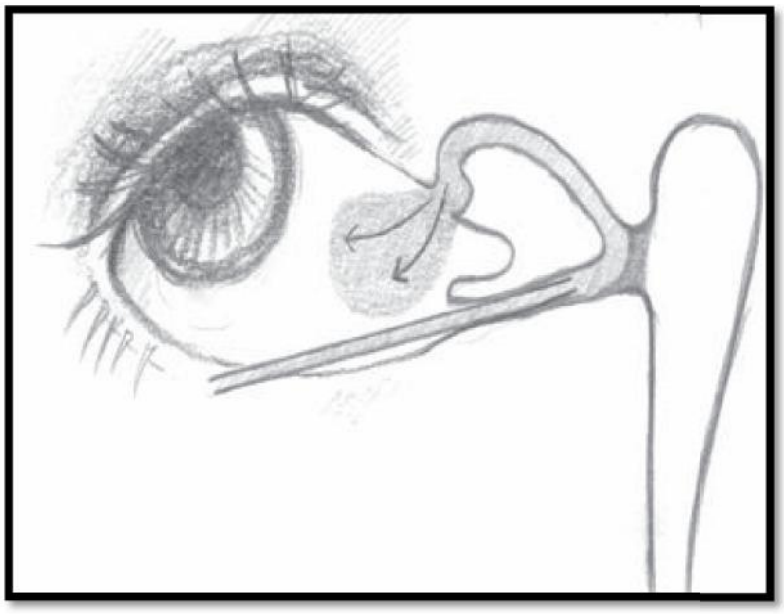
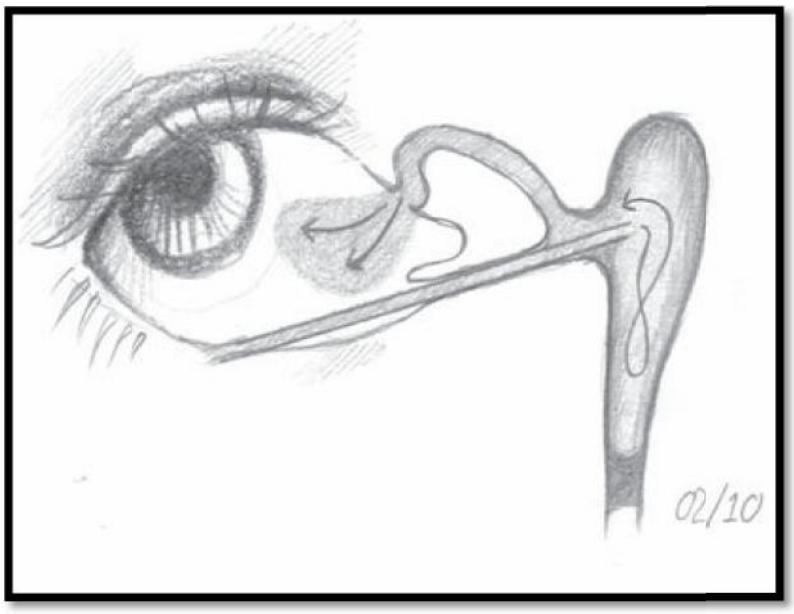


Figure 5d: Nasolacrimal duct obstruction



If saline irrigated through the lower punctum refluxes through the same punctum a lower canalicular block is diagnosed. However instead, if there is immediate reflux from the upper punctum, a common canalicular obstruction is diagnosed. A delayed reflux from the opposite punctum is often accompanied with a

slight swelling over the lacrimal sac area and indicates an obstruction of the nasolacrimal duct.

Probing

Probing is used only as a diagnostic measure in adults to determine the location of a stricture in the canalicular system. A hard stop occurs when the probe enters the sac and encounters resistance at the medial wall of the sac due to the lacrimal bone. A soft spot indicates a spongy feeling when the canula encounters some resistance at or proximal to the junction of the common canaliculus with the sac.

Dye (Fluorescein) tests

Dye tests are mainly useful in the differential diagnosis of epiphora occurring in patients having incomplete or functional blocks of the sac or nasolacrimal duct .

Dye disappearance test: To determine whether the tears are passing into the nose under normal physiologic pumping conditions, the precorneal tear film is stained by instilling 2% fluorescein solution. Normally little or no dye remains after 3 minutes. Prolonged retention is pathological.

Other tests for functional or incomplete blocks of the nasolacrimal duct are the dye disappearance tests[35] and the taste test with saccharin.[36]

Dye Disappearance Test[37]

The fluorescein dye disappearance test is a safe, simple, physiologic indicator of a patient's lacrimal outflow system. One drop of 2% sodium fluorescein is instilled in the lower conjunctival cul-de-sac. The dye disappearance test is graded at 5 minutes on a scale from 0 to 4+ . 0 represents no dye remaining and 4+ indicates that

virtually all of the dye remains. In evaluating unilateral tearing symptoms, it is often more helpful simply to compare the dye disappearance results of the patient's two eyes.

Jones dye test: These are performed when partial obstruction is suspected. Jones dye tests are of no value in the presence of total obstruction.

Jones primary test (Jones test I): It is performed to differentiate between watering due to partial obstruction of the lacrimal passages from that due to primary hypersecretion of tears. Two drops of 2 percent fluorescein dye are instilled in the conjunctival sac and a cotton bud dipped in 1 percent xylocaine is placed in the inferior meatus at the opening of nasolacrimal duct. After 5 minutes the cotton bud is removed and inspected. A dye-stained cotton bud indicates adequate drainage through the lacrimal passages and the cause of watering is primary hypersecretion, while the unstained cotton bud (negative test) indicates either a partial obstruction or failure of lacrimal pump mechanism. To differentiate between these conditions, Jones dye test-II is performed.

Jones secondary test (Jones test II): When primary test is negative, with the cotton bud placed in the inferior meatus, lacrimal syringing is performed. A positive test indicated by staining of swab with dye suggests that dye was present in the sac but could not reach the nose due to partial obstruction. A negative test where swab becomes wet with unstained saline indicates that dye did not enter the sac at all due to presence of lacrimal pump failure.[38]

Schirmer's test[39]

Pseudoepiphora is characterized by an actual deficiency of basic tear secretion with overcompensation of tear production from the main lacrimal gland, causing a watery eye. This must be differentiated from epiphora before further investigations to find the cause of lacrimal passage obstruction are pursued.

Intranasal examination

An intranasal examination is necessary in patients in whom an obstruction in the sac or nasolacrimal duct is demonstrated. After the intranasal cavity is sprayed with anesthetic and decongestant, a nasal speculum is introduced.

With a headlight the intranasal cavity is examined. Any septal deviation, turbinate disease, or polyposis is noted. An intranasal neoplastic process must always be kept in mind.

Conventional X- ray films: Plain films or computed tomography scans are helpful when paranasal sinus disease or tumors are suspected. Ethmoidal sinus enlargement such as ethmoidal mucocele as well as any erosion that may be caused by a neoplastic process may be detected.

Dacryocystography (Injection contrast radiography) [40]

Dacryocystography is a technique of anatomically displaying the lacrimal sac and ducts by radiopaque dye. Preliminary syringing of the lacrimal sac with saline before injection of the dye should be performed to cleanse the sac and make room for the dye. Radiopaque dye is forcibly injected into the lower canaliculus with a syringe, using a lacrimal cannula. Radiographs in the Caldwell and lateral views are taken.

Oblique views instead of lateral views should be obtained radiologically if both sacs are to be x-rayed simultaneously. Dacryocystography may be helpful in showing the size of the sac, the relationship of the ethmoidal air cells to the lacrimal sac, filling defects in the sac such as lacrimal casts or lacrimal sac tumors, diverticula and fistulas of the sac, and possibly the exact level of the stricture within the lacrimal sac or nasolacrimal duct. The 30-minute dacryocystogram dye retention study is useful in confirming a nasolacrimal duct obstruction. In this test, water-soluble contrast dye is irrigated through the lacrimal outflow system. A simple Waters' view roentgenogram is taken 30 minutes later. The presence of a significant amount of retained contrast dye in the lacrimal sac or nasolacrimal duct indicates a functional obstruction of the nasolacrimal duct. duct. Dacryocystography is not a test of function, because the dye is forcibly injected, hence it is of no value in diagnosing a functional block. It does not demonstrate the canaliculi as well. Dacryocystography can, however, be a useful adjunct for confirmation of a diagnosis of lacrimal sac or nasolacrimal duct obstruction.

A more precise instillation of the dye into the lacrimal system with x-ray subtraction techniques has been introduced, entitled *intubation microdacryocystography*. It has been suggested that more subtle abnormalities can be seen and functional block can also be demonstrated.[41]

Dacryoscintigraphy [41,42]

This test involves instillation of aqueous radioactive tracer (sodium pertechnetate) into the tear film by a dropper. By scanning the lacrimal area with a gamma camera with a 3-mm pinhole collimator, an examiner can follow the progress of the radioactive tracer in the tears into the canaliculi, the lacrimal sac, the

nasolacrimal duct, and the nose. Because the material is not injected, it identifies the tear progress and elimination under physiologic or normal circumstances. By using a gamma camera interfaced with a computer the transit time of the tracer through the canaliculi, the sac, and the nasolacrimal duct in a tearing patient is compared with that of a normal individual and thus quantitative lacrimal scintigraphy can be performed. This investigation has been shown to be a very sensitive for evaluation of canalicular function and of the adequacy of the lacrimal canaliculi pumping mechanism, but it is not as sensitive a test for the elimination of tears from the sac and nasolacrimal duct.[43]

Thus at the end of investigations, one must be able to diagnose and classify lacrimal outflow passage obstruction as a block in the upper system (lids, puncta, ampulla, canaliculi, or common canaliculus) or the lower system (lacrimal sac, nasolacrimal duct, or intranasal passages).In select patients, radiographic studies may be helpful in confirming the clinical diagnosis. In case of a suspected functional block, radionuclide dacryoscintigraphy may yield physiologic information about the canalicular pump and the entire lacrimal outflow system.

Complications of chronic dacryocystitis[1]

It is worth keeping in mind that this apparently innocuous disease can result in several complications, which could be the presenting complaints in patients.

- Stenosis of lacrimal passage with permanent epiphora
- Mucocele : swelling in lacrimal sac area with mucoid discharge
- Pyocele: swelling in lacrimal sac area with purulent discharge
- Internal lacrimal or ethmoidolacrimal fistula: Mucocele or Pyocele opens into lacrimal air cells and leads to relief of symptoms

- External fistula with mucus or pus discharging through skin
- Intractable chronic conjunctivitis
- Non healing corneal ulcer leading to corneal opacity or perforation
- Eczema and dermatitis of eyelid skin due to chronic irritation with tears
- Acute dacryocystitis with or without lacrimal abscess
- Orbital cellulitis

Normal bacterial flora of conjunctival sac and nasolacrimal passages

The conjunctival sac is sterile at birth, only to be colonized soon with microorganisms that then persist as normal flora. As is apparent from its anatomical relations the nasolacrimal sac can have flora derived from both the conjunctival sac and the nose. The normal bacterial flora is generally saprophytic but can turn pathogenic if there is a lapse in the defense mechanisms.[44]

Normal ocular flora can be divided into:

Resident ocular flora: Commensals.

- Staphylococcus epidermidis
- Diphtheroids
- Staphylococcus aureus
- Lactobacillus species
- Propionibacterium species

Transient ocular flora: These colonize the passages during specific infections

- Staphylococcus aureus
- Staphylococcus species other than Staphylococcus aureus

- Bacillus species
- Haemophilus species
- Branhamella catarrhalis
- Enterobacteriaceae: Escherichia coli, Klebsiella species, Enterobacter species.
- Pseudomonas aeruginosa

Bacteriology of chronic dacryocystitis

The basic etiopathogenic mechanism in chronic dacryocystitis is the stasis of lacrimal fluid and subsequent infection. A preexisting infection could have lead to obstruction of the nasolacrimal passage in the first place. In either case conjunctival and more often, nasal flora contribute as pathogenic organisms in chronic dacryocystitis.[45]

Staphylococcus has been shown to be the predominant species in the bacterial isolates of several studies all around the world. [46,47,48] Among the earliest documented reports is that of Huber-Spitzy V et al in 1992. They studied the microbiology and conservative therapy of acquired dacryocystitis in Austria where Staphylococcus species (50%) was predominant followed by Escherichia coli (11.7%).[49] DeAngelis D et al in 2001 concluded that in their study 78.5% Gram-positive bacteria and 21.5% Gram negative bacteria. Of the Gram-positive bacteria an overwhelming 76.5% were Staphylococcus species.[46]

In 1997 a study of 127 samples in 118 adult patients documented 84% samples with positive culture results. The most frequently cultured bacterial species was Staphylococcus epidermidis (27%) followed by Staphylococcus aureus (12.2%) and Haemophilus influenzae (3.8%).[26] In contrast to this study that found mixed cultures

in 48% of the samples, another study in 1993 recovered pure cultures consisting of a single organism in 71% samples with Gram-positive organisms accounting for 64.5% of the isolates. This study also found Staphylococcus as the major isolated bacterial species with Staphylococcus epidermidis contributing 27.3% and Staphylococcus aureus contributing 22.1% followed by Pseudomonas aeruginosa (8.7%).[50]

Much more recently, in 2005 Sun X et al investigated the microbiology of specimens from patients with chronic dacryocystitis. While the bacterial species that were most frequently found were Staphylococcus species (34.5%), this study differed from others in documenting a significant growth of Corynebacterium diphtheroids (15.5%). [48,50]

While the afore mentioned studies recorded Staphylococcus epidermidis as the predominant isolate, several studies have found Staphylococcus aureus making up a majority of bacterial isolates. Brook I et al in 1998 documented Staphylococcus aureus as the predominant organism followed by Staphylococcus epidermidis, Peptostreptococcus, Propionibacterium and Pseudomonas species. Polymicrobial infection was present in 45% [51,52]

Many studies carried out in the past decade have also mentioned Staphylococcus aureus as the most frequently isolated bacteria. Chaudhry IA et al in 2005 recorded that of the total samples that gave positive results on culture, a single microorganism was recovered from only 33.9% of the cultures.[30] This is in contrast to the study by Kundu PK et al in 2006 which mentions 82.5% cases having pure culture with lesser incidence of mixed cultures.[53] In both these studies majority of culture was Gram-positive organisms (70%) and Staphylococcus aureus was found primary pathogen in disease process.

Several studies, most of which were carried out in the last three decades of the twentieth century have documented Streptococcus pneumoniae as the most common bacterial isolate in dacryocystitis. Studies carried out in the period between 1970 and 1990 on adult as well as congenital dacryocystitis patients have revealed Pneumococci as the most commonly isolated bacteria.[54,55] These studies also mention Staphylococcus epidermidis as being more frequent than Staphylococcus aureus.

It is apparent from the results of recent studies in adult dacryocystitis, that there is a decrease in incidence of Pneumococci in the bacterial isolates with a rise in Staphylococcus species. However studies carried out on congenital dacryocystitis patients upto five years back have revealed that Streptococcus pneumoniae still dominates the culture reports.[56,57] This could reflect the difference in etiopathogenesis of primary and secondary nasolacrimal duct obstruction.

In recent years the reservoir of community-associated MRSA has been rapidly expanding. A rise in systemic infections caused by non–glycopeptide-susceptible *S. aureus* strains will be a very serious development indeed, leaving the clinician with very few therapeutic options. The lack of documentation of Methicillin resistant Staphylococcus aureus seems to be a lacuna in our current knowledge about the changing trends in antibiotic resistance among bacteria causing chronic dacryocystitis.[58]

The more recent studies also reveal a growing incidence of gram negative bacterial isolates. Most of them have described incidence of gram negative organisms in 20 to 25 % of the total isolates.[26,46,47] While most studies have found Haemophilus influenza as the most common gram negative bacterial isolate,[30,56,57] recent studies have documented other bacteria which are normally present neither in the conjunctiva

nor in the nose. Among these are Pseudomonas, E coli, Enterococci, Proteus and Citrobacter.[59] Several studies have quoted Pseudomonas as most frequent gram negative bacteria isolated with incidence varying from as low as 8% to as high as 22%.[47,50,51,59] This could signify a changing trend in the bacteriology of this disease.

Although pure culture isolates are majority, mixed infections have been documented as well. The documented incidence of mixed bacterial isolates varies from 18% to as high as 66% in different studies.[26,30,51,53] The varying antibiotic susceptibility of numerous possible combinations of bacterial species could have a bearing on the response to antibiotics.

Anerobic growth too has been documented in many studies with Hartikainen et al documenting a highest incidence of 20%. The presence of anerobic organisms as sole etiological agents could explain the negative aerobic cultures in several studies. [26,59,60,61]

Antibiotic sensitivity patterns of aerobic bacteria isolated in chronic dacryocystitis

With the changing trend in the microbiology of chronic dacryocystitis, the antibiotic sensitivity has also undergone alterations. Incidence of polymicrobial infections could also have an influence over the most effective antibiotic combination. Sensitivity tests in a study comprising a large sample size revealed that Levofloxacin and Amikacin were the most effective antibiotics.[48] In almost complete contrast another study revealed that Gram-positive organisms exhibited a high rate of sensitivity to Chloramphenicol, Vancomycin, and Ofloxacin.[57] The most effective single antibiotic against all organisms as recommended on the basis of another study

was Tobramycin (100%), followed by Gentamicin (97%) and Vancomycin (97%).[31] A relatively older study also mentions Erythromycin as an effective antibiotic against Gram positive bacteria in treatment for dacryocystitis.[55]

These studies strike a contrast with the results of a study comprising cases of congenital dacryocystitis where Ofloxacin and Tetracycline turned out to be the most effective single agents (84.9%) to all Gram-positive and Gram-negative isolates.[56]

A study published in 2005 revealed that Gram-negative isolates were sensitive to Ceftazidime in 95%, Ciprofloxacin in 86% and Cefuroxime in 50%, with a sensitivity of less than 30% to Cefalexin and Ampicillin. Pseudomonas aeruginosa were sensitive to Ceftazidime (100%) and Ciprofloxacin (86%), while its sensitivity was poor for Ampicillin (20%) and Cephalexin (14%).[59] Combination of Bacitracin and Neomycin has been quoted as an effective treatment in considerable number of cases.[56]

METHODOLOGY

The clinicobacteriological profile of adult patients coming to Ophthalmology OPD of KLES Dr.Prabhakar Kore Charitable Hospital & MRC, Belgaum, who are diagnosed with chronic dacryocystitis, was studied. 55 consecutive adult patients who were diagnosed with chronic dacryocystitis between January 2013 and December 2013 were included in this cross sectional study.

Sample size **:** 55

Duration **:** 1 year

Inclusion criteria **:** Patients diagnosed with chronic dacryocystitis, who are >15 years of age.

Exclusion criteria:

1. Acute dacryocystitis
2. Patients who have undergone lacrimal surgery in past one year.
3. Other co-existent ocular infections.

All patients included in the study underwent basic evaluation as mentioned in the standard proforma after obtaining written informed consent. Routine ophthalmic examination was conducted by the investigator, including slit lamp examination, paying special attention to the presence of discharge and epiphora. The presence of any anomaly of eye lids and other ocular adnexa were noted. Any coexistent ocular infection or inflammation was specifically looked for and cases excluded if did not meet the inclusion criteria. Routine ENT examination was also conducted, specifically to diagnose nasal pathology.

Collection of sample

The selected eye of the patient was painted with betadine and spirit. Sample fluid was collected by:

Applying pressure over the lacrimal sac and allowing the fluid/purulent material to reflux through the lacrimal punctum.

OR

Irrigating the lacrimal drainage system with sterile saline and collecting the sample from the refluxing material.

The samples were collected with 2 sterile cotton wool swabs, ensuring that the lid margins or the conjunctiva were not touched. No antibiotics, systemic or topical were used before sample had been collected. The samples were sent to microbiology department of JN Medical College.

One sample was used to prepare slide for Gram's staining. Using the other swab samples were cultured on the day of collection on to blood agar, chocolate agar and MacConkey agar and incubated aerobically. Antibiotic sensitivity testing was done for the cultured bacterial growth.

Procedure for Gram stain is as follows:[62]

Fixation of smear: place slide with the sample in methanol for 5-10 minutes. Allow to dry. Pass the slide through a flame, with the smear side facing up, two or three times. Allow cooling.

- Flood the slide with crystal violet stain. Allow to stand for 1 minute.

- Rinse gently with tap water.
- Flood slide with Gram's iodine solution. Allow to stand for 1 minute.
- Rinse gently with tap water.
- Using decolorizer solution, decolorize till color stops running from the smear.
- Rinse gently with tap water.
- Flood the slide with safranin stain. Allow to stand for 30 seonds.
- Rinse gently with tap water.
- Allow to dry.

Interpretation

Bacteria can stain positive (purple, blue) or negative (pink, red) with Gram stain. All smears were examined to identify bacteria. Empirical antibiotic treatment that was started after obtaining samples was given taking the bacteria identified on Gram stain into consideration. A note was also made regarding the presence of inflammatory cells and epithelial cells in the smear.

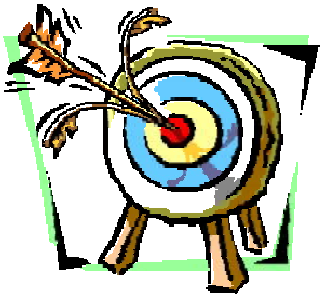
Bacterial isolates obtained from culture were identified by their morphology, cultural, biochemical and colony characteristics. Antibacterial susceptibility pattern was analyzed using Kirby Bauer disc diffusion test (United States, NCCLS method). This method utilizes commercially available filter paper discs, 6mm in diameter, charged with appropriate concentration of drugs, sensitivity to which is being analyzed. The discs are stored in a cold, dry place at 4ºC. A suitable dilution of broth culture or broth suspension of the test bacterium is flooded on the surface of a solid medium like nutrient agar. The plate is tilted to ensure uniform spreading of the broth and excess broth is wiped off. After inoculation with swabs the plates are dried at

37ºC for 30 minutes. Antibiotic discs are applied (either 4 or 7 per 10 cm plate) with sterile forceps. After overnight incubation, zones of inhibition of growth around the discs are measured and the degree of sensitivity of given bacteria to the tested antibiotics is determined. Growth around discs containing antibiotics to which the bacterium is susceptible is inhibited while growth remains unhindered around discs with antibiotics to which the bacterium is resistant.[63] The zone size breakpoints equivalent to defined MIC breakpoint have been established by regression analysis of the relationship of zone size to MIC by error minimization, by study of the distribution of susceptibility of different species and by clinical experience relating results of tests to the outcome of treatment.

Statistical Analysis

The analyzed results were expressed as percentage and proportions for the distribution of chronic dacryocystitis cases according to age, sex, nature of discharge, presenting complaints, correlation of ROPLAS test with findings of lacrimal syringing, bacteria isolated and their sensitivity to various antibiotics. The associations between the age and sex on the clinical type of dacryocystitis and the organisms isolated were tested. .A P (predictive) value of <0.05 were considered as a significant association between the variables tested.

Introduction



Objectives

Review of Literature

Methodology

Results

Discussion

Conclusion

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Bibliography

Annexure-I

Annexure-II

Annexure-III

Annexure-IV

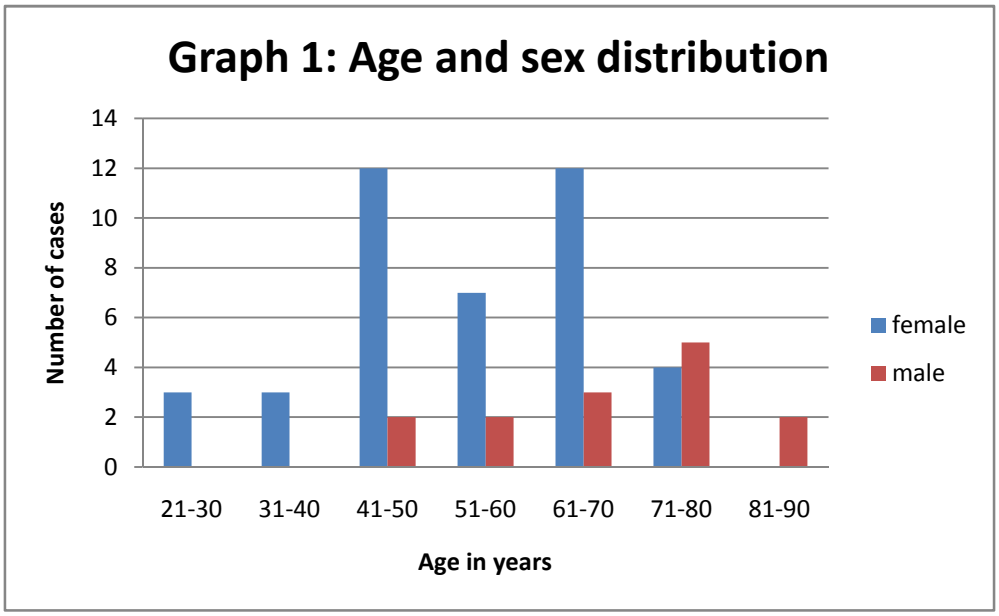
Annexure-V

RESULTS

Table 1: Age and sex distribution

Age group	Female	%	Male	%
21-30	3	7.3	0	0
31-40	3	7.3	0	0
41-50	12	29.3	2	14.3
51-60	7	17	2	14.3
61-70	12	29.3	3	21.4
71-80	4	9.8	5	35.7
81-90	0	0	2	14.3

Our study included 55 patients comprising of 41 females and 14 males contributing 74.6% and 25.4% respectively to the total sample size. The difference in incidence of this disease between males and females is statistically significant (p value 0.060). Among females the mean age at presentation was 54.5 years with SD of ±14.89. The mean age at presentation in males was 67.5 years with SD ±13.5. The peak incidence in females was in age groups of 41 to 50 years as well as 61 to 70 years (29.3% each). Among males the older age group of 71 to 80 years had peak incidence of 35.7%.


Graph 1: Age and sex distribution
14
12
10
8
6
4
2
0
Number of cases
21-30
31-40
41-50
51-60
61-70
71-80
81-90
Age in years
female
male

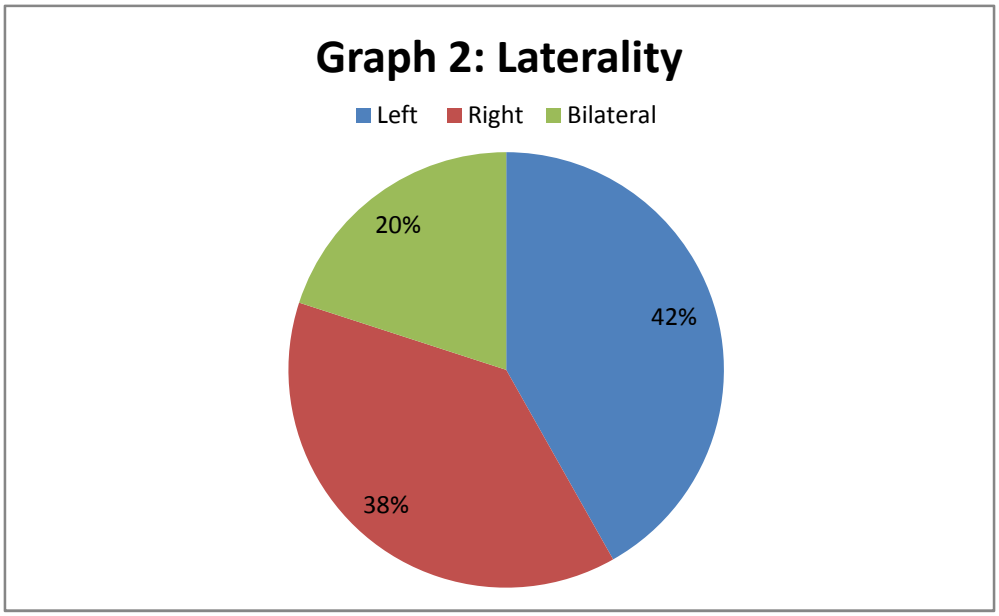

Graph 2: Laterality
Left
Right
Bilateral
20%
42%
38%

Table 2 Laterality

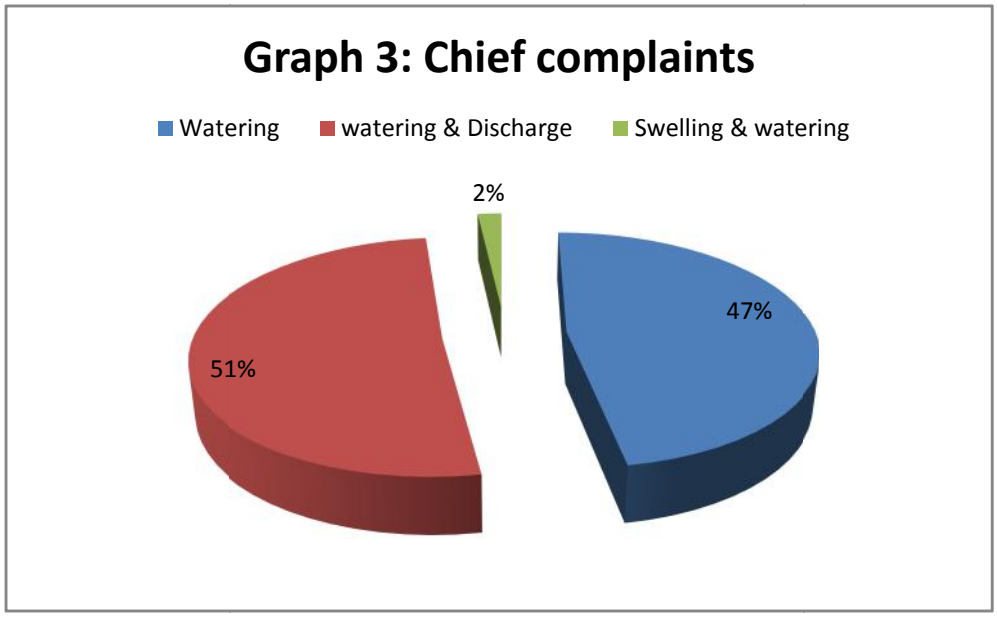
Laterality	Number of cases	%
L	23	42
R	21	38
Bilateral	11	20
Total	55	100

In our study 23 cases (42%) presented with left sided dacryocystitis, 21 cases (38%) presented with right sided dacryocystitis and 11 cases (20%) had bilateral disease at presentation.

Table 3: Chief complaint

Complaint	Number of cases	%
Watering	26	47
watering & Discharge	28	51
Swelling and watering	1	2
Total	55	100

The most frequent presenting complaints were watering and discharge from eyes (28 cases, 51%) and watering (epiphora) alone (26 cases, 47%).


Graph 3: Chief complaints
Watering
watering & Discharge
Swelling & watering
2%
47%
51%

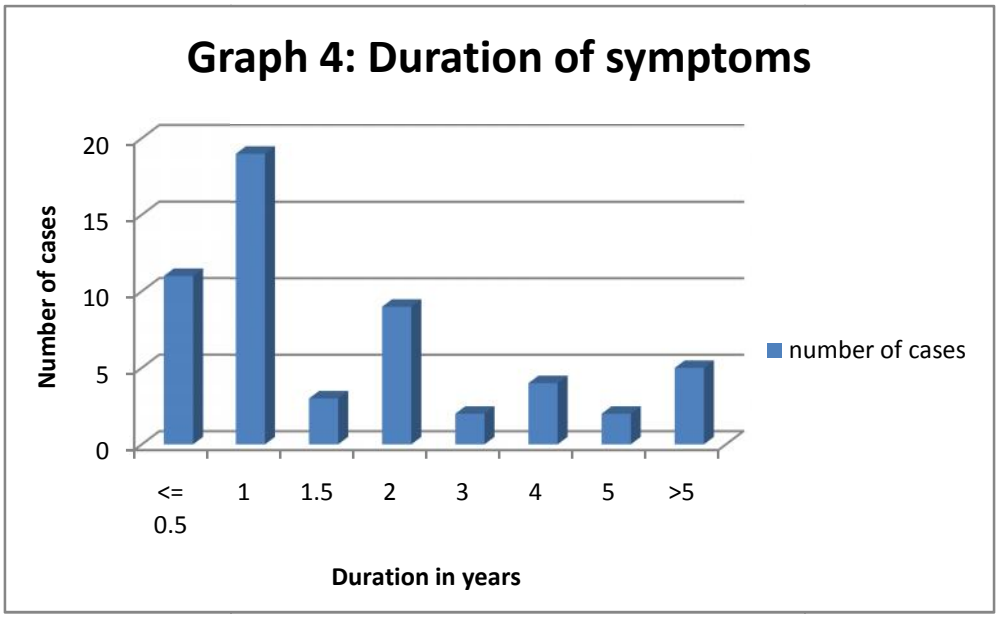

Graph 4: Duration of symptoms
Number of cases
20
15
10
5
0
<= 0.5
1
1.5
2
3
4
5
>5
Duration in years
number of cases

Table 4: Duration of symptoms

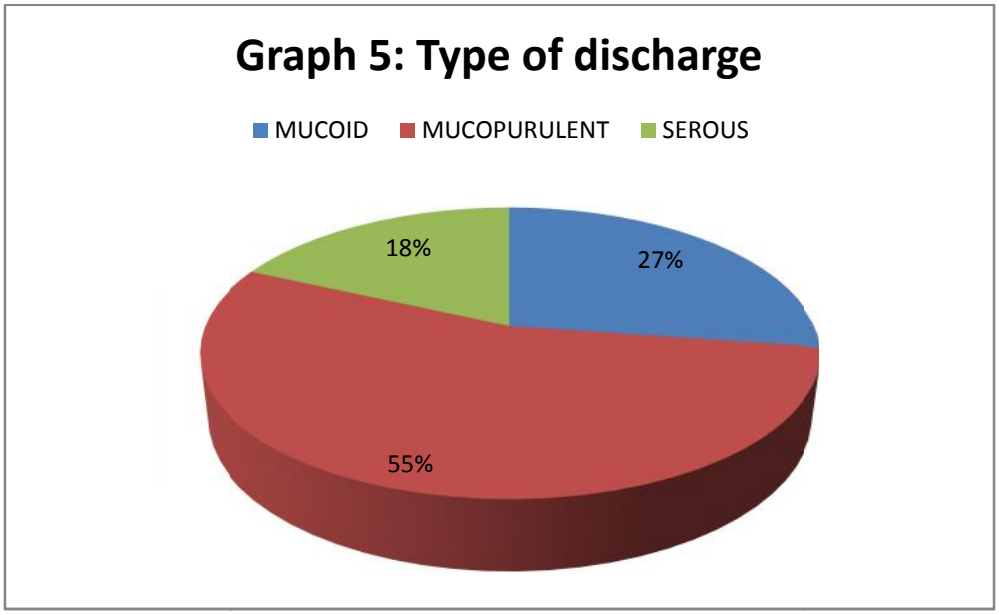
Duration (Years)	Number of cases	%
<= 0.5	11	20
1	19	34.5
1.5	3	5.5
2	9	16.4
3	2	3.6
4	4	7.2
5	2	3.6
>5	5	9

In our study 34.5% of patients had symptoms for duration of a year. About 20 % patients had symptoms for only 6 months or less while only 9% patients suffered from symptoms for over 5 years.

Table 5: Type of discharge

Type of discharge	Number of cases	%
MUCOID	15	27
MUCOPURULENT	30	55
SEROUS	10	18
Total	55	100

A majority of patients (55%) had mucopurulent discharge. Mucoid and serous discharge was noted in 27% and 18% of cases respectively.


Graph 5: Type of discharge
MUCOID
MUCOPURULENT
SEROUS
18%
27%
55%

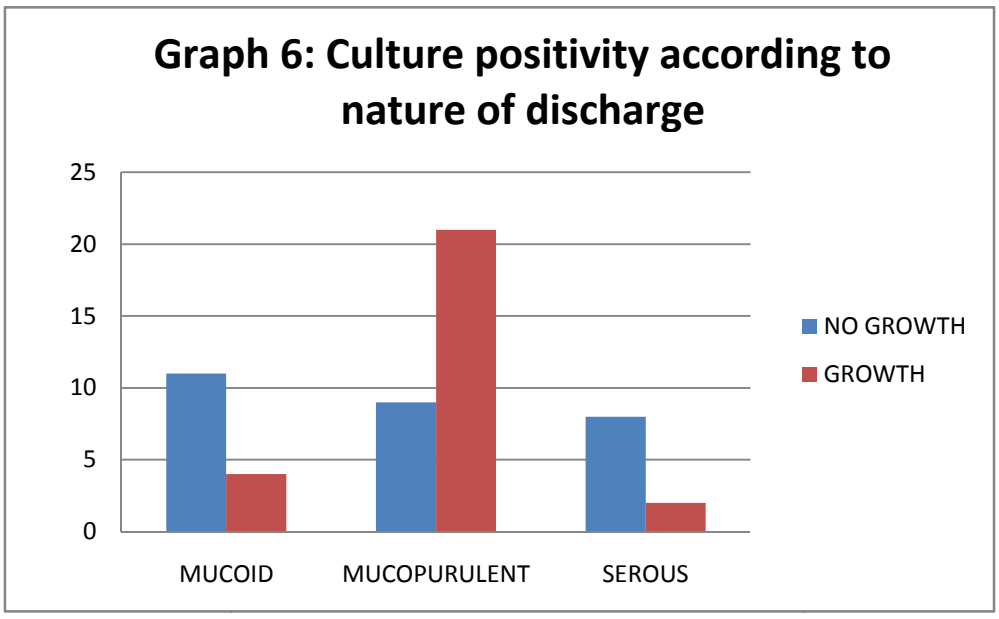

Graph 6: Culture positivity according to nature of discharge
25
20
15
10
5
0
MUCOID
MUCOPURULENT
SEROUS
NO GROWTH
GROWTH

Table 6: Culture positivity according to nature of discharge

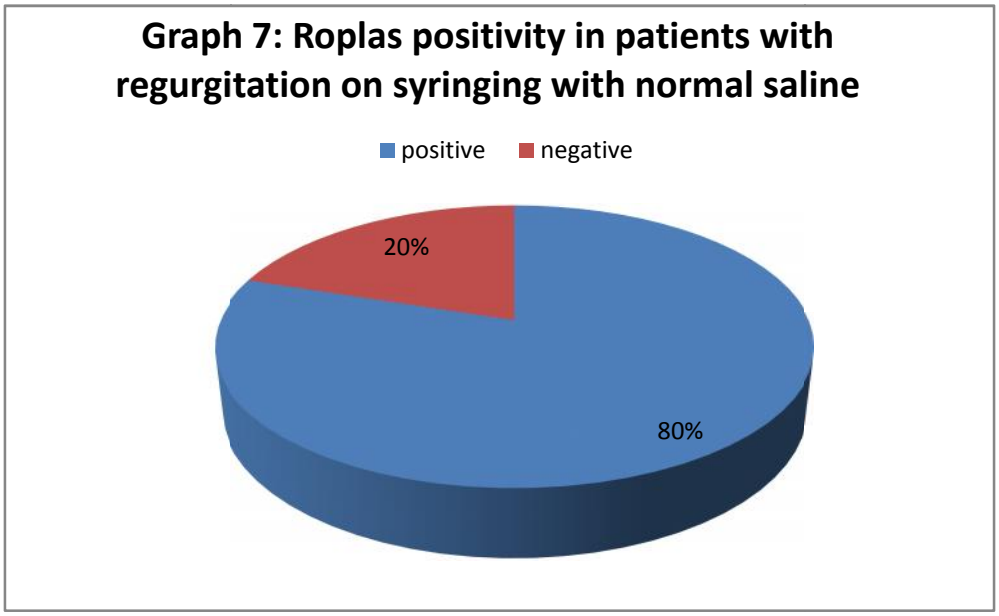
Regurgitation	Number of cases	NO GROWTH	%	GROWTH	%
MUCOID	15	11	73.3	4	26.7
MUCOPURULENT	30	9	30	21	70
SEROUS	10	8	80	2	20

Our study showed that 70% cases with mucopurulent discharge (n=21) had a positive growth on culture as compared with 26.7% cases with mucoid discharge (n= 4). In patients who had serous discharge 80% cases (n=8) showed no growth on culture.

Table 7: ROPLAS positivity in patients with regurgitation on syringing with normal saline.

ROPLAS	number of cases	%
positive	44	80
negative	11	20
total	55	100

Of the 55 patients in the study, 44 patients (80%) had regurgitation on pressure over lacrimal sac. The ROPLAS test was negative in 11 patients (20%).


Graph 7: Roplas positivity in patients with regurgitation on syringing with normal saline
positive
negative
20%
80%

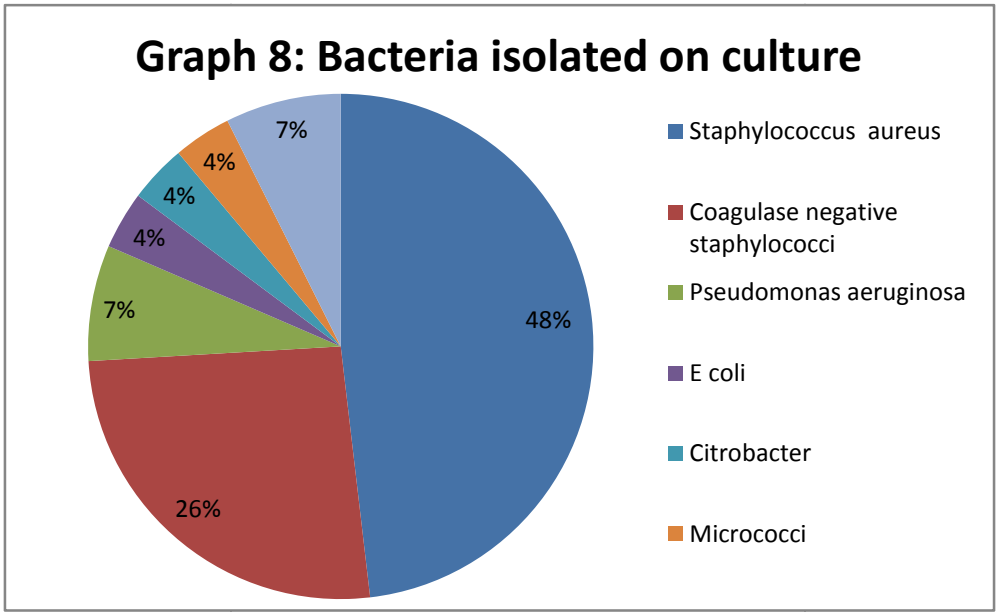

Graph 8: Bacteria isolated on culture
7%
4%
4%
4%
7%
48%
26%
Staphylococcus aureus
Coagulase negative staphylococci
Pseudomonas aeruginosa
E coli
Citrobacter
Micrococci

Table 8: Isolated organisms

Isolated organisms	Number of cases	%
Gram positive organisms	21	74
Staphylococcus aureus	13	48
Coagulase negative staphylococci	7	26
Micrococci	1	4
Gram negative organisms	6	26
Pseudomonas aeruginosa	2	7
E coli	1	4
Citrobacter	1	4
Klebsiella pneumonia	2	7

In our study of the total 55 samples, 24 (43.6%) yielded growth on culture. Thus 56.4% samples showed no growth. A majority of samples (74%, n=20) yielded growth of gram positive bacteria. Of these, 48% (n=13) showed growth of Staphylococcus aureus and 26% (n=7) yielded coagulase negative staphylococci (Staphylococcus epidermidis). 26% (n=7) of the cultures positive for growth yielded Gram negative organisms. Of these growth of Pseudomonas aeruginosa and Klebsiella pneumonia were obtained from 2 samples each. Single samples showing growth of each of E coli, Citrobacter and Micrococci were also obtained.

Table 9: Pure and mixed culture isolates

Bacterial isolates	Number of cases	%
Pure gram positive	19	79
Pure gram negative	2	8
Mixed isolates	3	13
Total	24	100

Mixed culture growths were obtained in 3 samples amounting to 12.5% of total culture growth positive samples. Two of these samples had mixture of Gram positive and Gram negative bacterial growths. One sample showed mixed growth of Staphylococcus aureus and Klebsiella pneumonia and the other had mixed growth of Staphylococcus aureus (which later turned out to be Methicillin resistant) and E coli. The third sample yielded mixed growth of Pseudomonas and Citrobacter. Pure culture growth of Gram positive and Gram negative organisms was noted in 18 samples (75%) and 3 samples (12.5%) respectively.

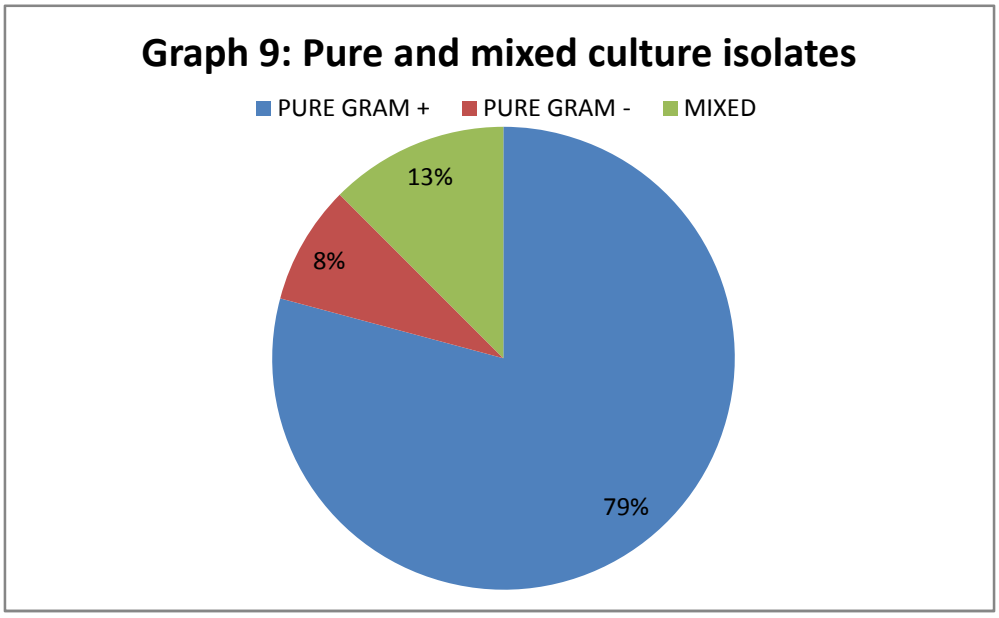


Table 10: Antibiotic sensitivity of Gram positive isolates

	Staphylococcus aureus		MRSA		Coagulase negative staphylococci		Micrococci	
Antibiotic	Number of sensitive cases(total cases)	Sensitivity rate %	Number of sensitive cases(total cases)	Sensitivity rate%	Number of sensitive cases(total cases)	Sensitivity rate %	Number of sensitive cases(total cases)	Sensitivity rate %
Penicillins								
Ampicillin	4(10)	40	1(3)	33.3	6(7)	85.7	0	0
Amoxicillin	2(10)	20	0	0	0	0	0	0
Cephalosporins								
Ceftazidine	1(10)	10	1(3)	33.3	0	0	1	100
Cefoxitin	2(10)	20	2(3)	66.7	0	0	0	0
Fluoroquinolones								
Ciprofloxacin	4(10)	40	0	0	5(7)	71.4	1	100
Macrolides								
Erythromycin	8(10)	80	2(3)	66.7	1(7)	14.3	1	100
Aminoglycosides								
Gentamicin	0	0	0	0	0	0	1	100
Amikacin	0	0	0	0	0	0	1	100
Others								
Cotrimoxazole	7(10)	70	1(3)	33.3	6(7)	85.7	0	0
Augmentin	3(10)	30	0	0	2(7)	28.6	0	0
Chloramphenicol	1(10)	10	1(3)	33.3	1(7)	14.3	1	100

Among samples showing growth of Staphylococcus aureus, 80% (n=8) were sensitive to Erythromycin and 70% were sensitive to Cotrimoxazole. The sensitivities to Penicillins and Cephalosporins were only between 20 to 30%. Only 40% were sensitive to Ciprofloxacin. In contrast all of the samples showing growth of Methicillin resistant Staphylococcus aureus (n=3) were resistant to Ciprofloxacin. 66.7% of these samples (n=2) were sensitive to Erythromycin as well as Cefoxitin. 33.3% samples showed sensitivity to Penicillins and Augmentin. As against these results, 85.7% (n=7) of Staphylococcus epidermidis (coagulase negative staphylococci) were sensitive to Ampicillin but all samples were resistant to Amoxicillin and only 28.6% (n=2) were sensitive to Augmentin. Unlike Staphylococcus aureus, only 14.3% (n=1) of Staphylococcus epidermidis were sensitive to Erythromycin. 71% (n=5) were sensitive to Ciprofloxacin. 85.7% (n=7) were sensitive to Cotrimoxazole. A single sample showed growth of Micrococci which was sensitive to Ciprofloxacin, Erythromycin, Gentamicin, Amikacin, Chloramphenicol and Ceftazidime but was resistant to Penicillin group.

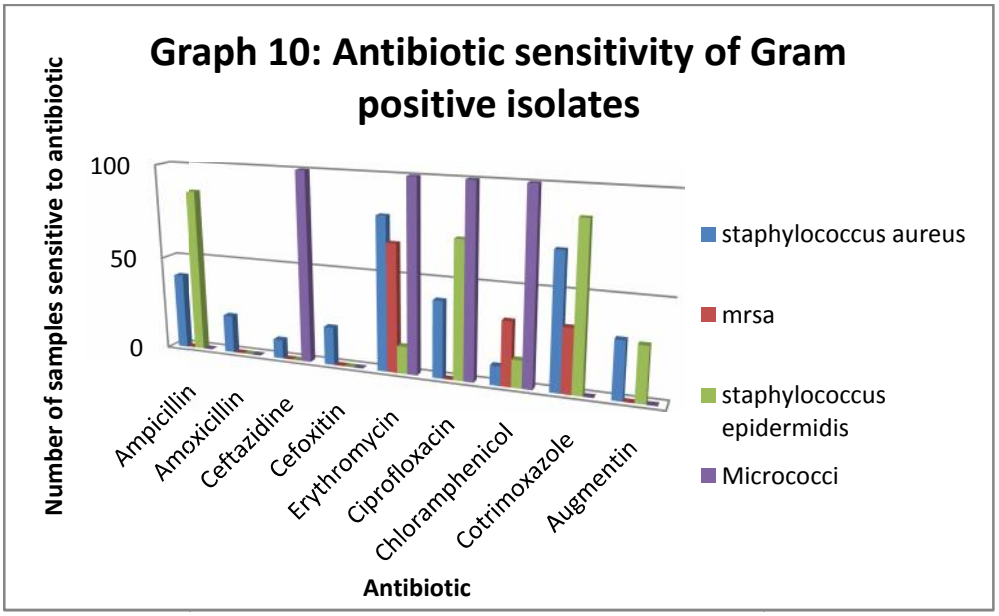
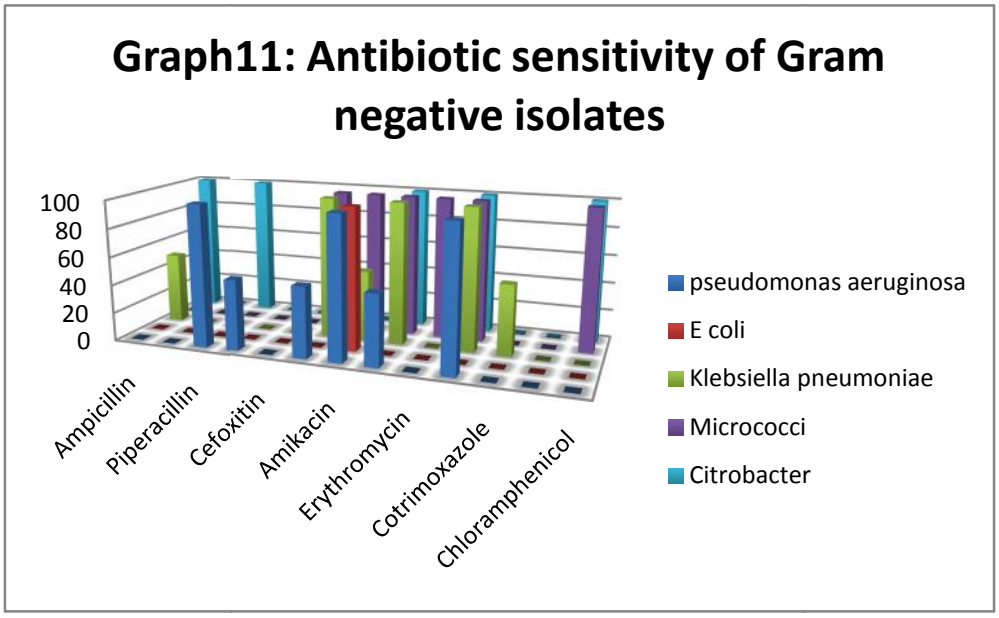
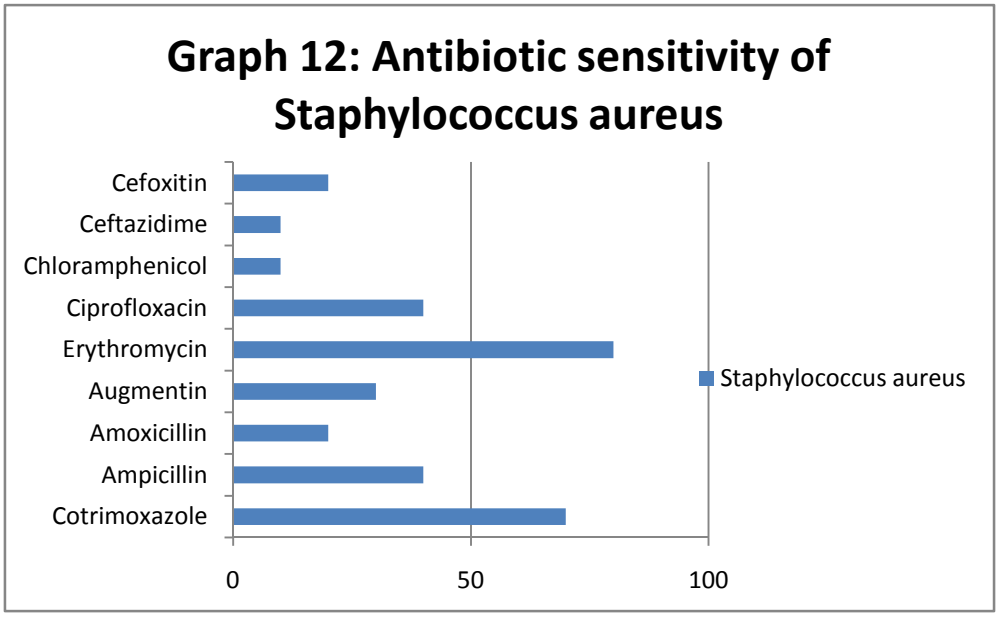


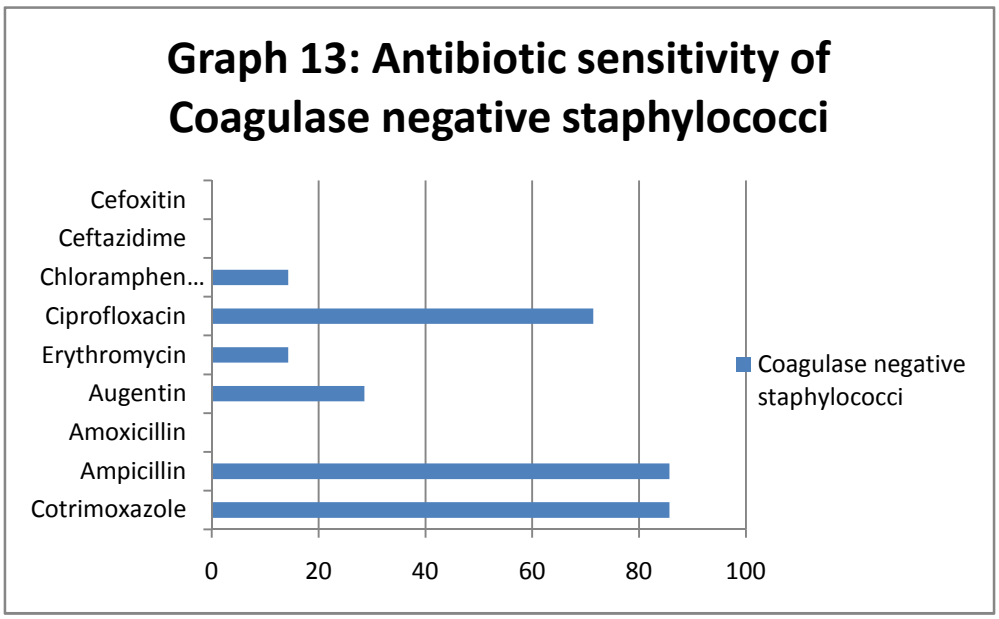
Table 11: Antibiotic sensitivity of Gram negative isolates

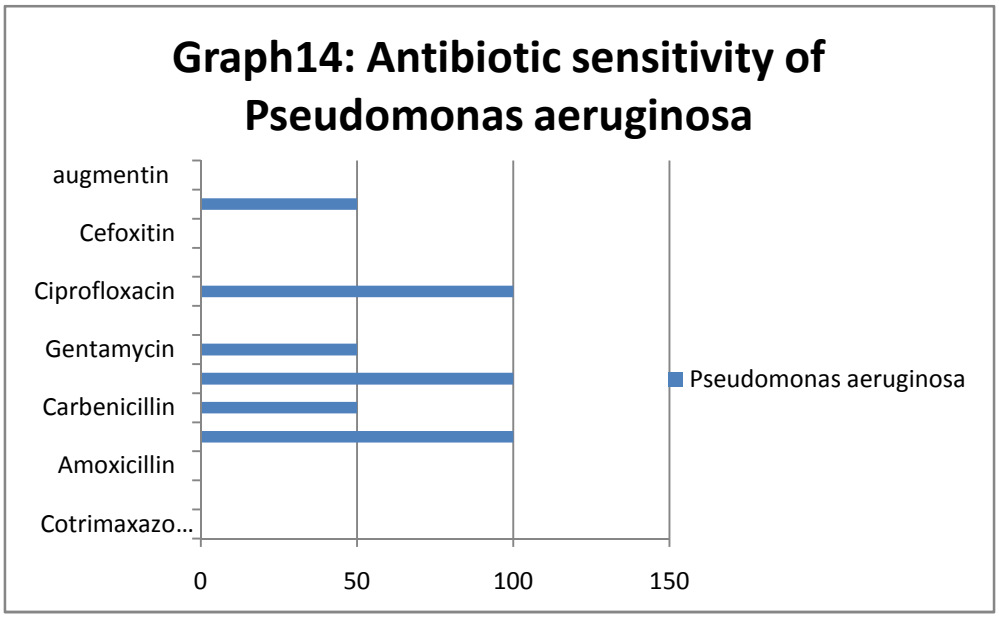
	Pseudomonas aeruginosa		E coli		Klebsiella pneumoniae		Citrobacter	
Antibiotic	Number of sensitive cases(total cases)	Sensitivity rate %	Number of sensitive cases(total cases)	Sensitivity rate %	Number of sensitive cases(total cases)	Sensitivity rate %	Number of sensitive cases(total cases)	Sensitivity rate %
Penicillins								
Ampicillin	0	0	0	0	1(2)	50	1(1)	100
Amoxicillin	0	0	0	0	0	0	0	0
Piperacillin	2(2)	100	0	0	0	0	1(1)	100
Carbenicillin	1(2)	50	0	0	0	0	0	0
Cephalosporins								
Ceftazidime	1(2)	50	0	0	2(2)	100	0	0
Cefoxitime	0	0	0	0	0	0	0	0
Fluoroquinolones								
Ciprofloxacin	2(2)	100	0	0	2(2)	100	1(1)	100
Macrolides								
Erythromycin	0	0	0	0	0	0	0	0
Aminoglycosides								
Gentamicin	1(2)	50	0	0	2(2)	100	1(1)	100
Amikacin	2(2)	100	1(1)	100	1(2)	50	0	0
Others								
Cotrimoxazole	0	0	0	0	1(2)	50	0	0
Augmentin	0	0	0	0	0	0	0	0
Chloramphenicol	0	0	0	0	0	0	1(1)	100

Our study showed that Ciprofloxacin sensitivity was 100% for Pseudomonas aeruginosa (n=2) and Klebsiella pneumonia (n=2) but E coli (n=1) was resistant. Gentamicin sensitivity was 100% for Klebsiella and 50% for Pseudomonas (n=1) while E coli was resistant. This differed from Amikacin sensitivity which was 100% for Pseudomonas as well as for E coli and 50% for Klebsiella. Pseudomonas showed 100% sensitivity to Piperacillin while Klebsiella and E coli were resistant. Klebsiella also showed 100% sensitivity to Ceftazidime while Pseudomonas was 50% sensitive. Citrobacter was isolated from a single sample which was sensitive to Ampicillin, Piperacillin, Ciprofloxacin and Gentamicin but was resistant to Amikacin.




Graph 12: Antibiotic sensitivity of Staphylococcus aureus
Cefoxitin
Ceftazidime
Chloramphenicol
Ciprofloxacin
Erythromycin
Augmentin
Amoxicillin
Ampicillin
Cotrimoxazole
0
50
100
Staphylococcus aureus


Graph 13: Antibiotic sensitivity of Coagulase negative staphylococci
Cefoxitin
Ceftazidime
Chloramphen…
Ciprofloxacin
Erythromycin
Augentin
Amoxicillin
Ampicillin
Cotrimoxazole
0
20
40
60
80
100
Coagulase negative staphylococci


Graph14: Antibiotic sensitivity of Pseudomonas aeruginosa
augmentin
Cefoxitin
Ciprofloxacin
Gentamycin
Carbenicillin
Amoxicillin
Cotrimaxazo...
0
50
100
150
Pseudomonas aeruginosa

DISCUSSION

Dacryocystitis, or inflammation of lacrimal sac has been known to be a common disease of the eye worldwide. This study attempts to evaluate the changing trend in bacteriology and antibiotic sensitivity of chronic dacryocystitis. 55 consecutive adult patients diagnosed with chronic dacryocystitis between January 2013 and December 2013 were included in this cross sectional study.

Our study included 55 patients comprising of 41 females and 14 males contributing 74.6% and 25.4% respectively to the total sample size. The difference in incidence of this disease between males and females is statistically significant (p value 0.060) with a female: male ratio of 2.93:1. This is in agreement with several other studies that have documented increased incidence of this disease in females.[3,64] A study carried out in similar geographic location as our study gave a female: male ratio of 3.9: 1.[3] Preponderance for obliteration due to relatively narrow lumen of nasolacrimal passage has been implicated.[65]

Among females the mean age at presentation was 54.5 years with SD of ±14.89. The mean age at presentation in males was 67.5 years with SD ±13.5. The peak incidence in females was in age groups of 41 to 50 years as well as 61 to 70 years (29.3% each). Many studies have found this disease to have peak incidence in 4th and 5th decades of life.[32,50,60,66] Our study however showed that among males the older age group of 71 to 80 years had peak incidence of 35.7%. This appears to be different from the aforementioned studies.

In our study 23 cases (42%) presented with left sided dacryocystitis, 21 cases (38%) presented with right sided dacryocystitis and 11 cases (20%) had bilateral

disease at presentation. Few studies mention left sided disease as being more frequent.[32,33] Our study found a higher incidence of bilateral chronic dacryocystitis that most of the others.[64]

The most frequent presenting complaints were watering and discharge from eyes (28 cases, 51%) and watering (epiphora) alone (26 cases, 47%). Our study documented more cases with complaints of watering as well as discharge than with epiphora alone, when compared with other studies.[32]

A majority of patients (55%) had mucopurulent discharge. Mucoid and serous discharge was noted in 27% and 18% of cases respectively. Our study showed that 70% cases with mucopurulent discharge (n=21) had a positive growth on culture as compared with 26.7% cases with mucoid discharge (n= 4). This is statistically significant at a p value of <0.05. In patients who had serous discharge 80% cases (n=8) showed no growth on culture. However when compared with samples of mucoid and mucopurulent discharge that showed no growth, this difference is not statically significant.

Of the 55 patients in the study, 44 patients (80%) had regurgitation on pressure over lacrimal sac. The ROPLAS test was negative in 11 patients (20%). As per an Indian study the sensitivity and specificity of ROPLAS in detecting chronic dacryocystitis are 93.2% and 99.3% respectively. Thus the sensitivity of this test as per our study is much lower (80%) than previous studies.[34]

In our study of the total 55 samples, 24 (43.6%) yielded growth on culture. Thus 56.4% samples showed no growth. Anerobic growth too has been documented in many studies with Hartikainen et al documenting a highest incidence of 20%. The

presence of anerobic organisms as sole etiological agents could explain the negative aerobic cultures in several studies.[26,59,60,61]

A majority of samples (74%) yielded growth of gram positive bacteria. Of these, 48% showed growth of Staphylococcus aureus and 26% yielded coagulase negative staphylococci (Staphylococcus epidermidis). Micrococci were isolated from one sample. One study has documented Gram positive bacteria 62% samples. The most frequently cultured bacterial species was Staphylococcus epidermidis, representing 27% of the isolates.[26] Staphylococcus has been shown to be the predominant species in the bacterial isolates of several studies all around the world.[46,47,48] Many studies carried out in the past decade have also mentioned Staphylococcus aureus as the most frequently isolated bacteria.[55,67] Contrary to many older studies our study did not find Staphylococcus pneumonia in any of the growths.[3,66]

In our study 26% of the cultures positive for growth yielded Gram negative organisms. Of these, growth of Pseudomonas aeruginosa and Klebsiella pneumonia were obtained from 2 samples each. Single samples showing growth of each of E coli, Citrobacter and Micrococci were also obtained. Varied results have been obtained by different studies regarding the incidence of Gram negative bacterial isolates, with incidence ranging from 20% to nearly 60%.[3,26,64] Most of them have described incidence of gram negative organisms in 20 to 25 % of the total isolates.[26,46,47] While most studies have found Haemophilus influenza as the most common gram negative bacterial isolate,[30,56,57] recent studies have documented other bacteria which are normally present neither in the conjunctiva nor in the nose. Among these are Pseudomonas, E coli, Enterococci, Proteus and Citrobacter.[59] Several studies have

quoted Pseudomonas as most frequent gram negative bacteria isolated with incidence varying from as low as 8% to as high as 22%.[47,50,51,59]

The documented incidence of mixed bacterial isolates varies from 18% to as high as 66% in different studies.[26, 30,50,51,53] In our study mixed culture growths were obtained 12.5% of total culture growth positive samples. Two of these samples had mixture of Gram positive and Gram negative bacterial growths. One sample showed mixed growth of Staphylococcus aureus and Klebsiella pneumonia and the other had mixed growth of Staphylococcus aureus (which turned out to be Methicillin resistant) and E coli. The third sample yielded mixed growth of Pseudomonas and Citrobacter. This agrees well with another study that mentions Staphylococcus aureus as the most frequent bacterial isolate in mixed growths.[66]

Among samples showing growth of Staphylococcus aureus, 80% were sensitive to Erythromycin. The high sensitivity to Erythromycin has been documented in fewer studies. The sensitivities to Penicillins and Cephalosporins were only between 20 to 30%. Only 40% were sensitive to Ciprofloxacin. In contrast all of the samples showing growth of Methicillin resistant Staphylococcus aureus were resistant to Ciprofloxacin. 66.7% of these samples were sensitive to Erythromycin as well as Cefoxitin. 33.3% samples showed sensitivity to Penicillins and Augmentin. Our results are similar to most of the recent studies that have shown widespread resistance to the Penicillin group.[64,67] Unlike other studies however the sensitivity to Chloramphenicol was much lower (15-30%).[66]

As against these results, 85.7% of Staphylococcus epidermidis were sensitive to Ampicillin but all samples were resistant to Amoxicillin and only 28.6% were sensitive to Augmentin. Unlike Staphylococcus aureus, only 14.3% of Staphylococcus

epidermidis were sensitive to Erythromycin. 71% were sensitive to Ciprofloxacin. These findings match those of other studies.[68]

Our study showed that Ciprofloxacin sensitivity was 100% for Pseudomonas aeruginosa and Klebsiella pneumonia but E coli was resistant, as was seen in other studies.[3] Gentamicin sensitivity was 100% for Klebsiella and 50% for Pseudomonas while E coli was resistant. This differed from Amikacin sensitivity which was 100% for Pseudomonas as well as for E coli and 50% for Klebsiella. Pseudomonas showed 100% sensitivity to Piperacillin while Klebsiella and E coli were resistant. Klebsiella also showed 100% sensitivity to Ceftazidime while Pseudomonas was 50% sensitive. Citrobacter was isolated from a single sample which was sensitive to Ampicillin, Piperacillin, Ciprofloxacin and Gentamicin but was resistant to Amikacin. These findings are congruent with the results of several other studies.

CONCLUSION

The present study included 55 cases clinically diagnosed with chronic dacryocystitis.

Following are the relevant findings in the study.

- Chronic dacryocystitis more often affected females in and above the 4th decade of life.
- Left eye was involved more than right eye.
- Majority of patients had mucopurulent type of discharge. Among cases with mucopurulent discharge the percentage of samples that yielded positive growth on culture was higher as compared with cases with mucoid discharge. Majority of cases who had serous discharge showed no growth on culture.
- The ROPLAS test was 80% sensitive in diagnosing dacryocystitis.
- The commonest aerobic bacteria in chronic dacryocystitis were Staphylococcus aureus followed by coagulase negative staphylococci. Among Gram negative bacteria Pseudomonas aeruginosa and Klebsiella pneumonia were common.
- Staphylococcus aureus was the most commonly isolated bacteria in mixed bacterial isolates.
- The Gram-positive isolates were most sensitive to Erythromycin followed by Ciprofloxacin. However Staphylococcus aureus was especially resistant to Ciprofloxacin.
- Maximum resistance was shown to Penicillin.
- The gram negative isolates were most sensitive to Ciprofloxacin and Amikacin.

SUMMARY

55 consecutive adult patients diagnosed with chronic dacryocystitis were included in this cross sectional study. After obtaining a written informed consent all the subjects underwent baseline evaluation.

Sample fluid was collected by applying pressure over the lacrimal sac and allowing the fluid/purulent material to reflux through the lacrimal punctum or by irrigating the lacrimal drainage system with sterile saline and collecting the sample from the refluxing material. The samples were sent to microbiology department for Gram's staining and culture. Antibiotic sensitivity testing was done for the cultured bacterial growth by Kirby Bauer disc diffusion test.

In our study 43.6% yielded aerobic growth on culture. Anerobic organisms could have been responsible in many cases that yielded no growth in our study. The commonest aerobic bacteria in chronic dacryocystitis were Staphylococcus aureus followed by coagulase negative staphylococci. Among Gram negative bacteria Pseudomonas aeruginosa and Klebsiella pneumonia were common. Staphylococcus aureus was the most commonly isolated bacteria in mixed bacterial isolates. The Gram-positive isolates were most sensitive to Erythromycin followed by Ciprofloxacin. However Staphylococcus aureus was especially resistant to Ciprofloxacin. The gram negative isolates were most sensitive to Ciprofloxacin and Amikacin.

The treatment of lacrimal duct obstruction in adults is surgery,. Some studies have reported a fivefold increase in risk of soft tissue infection after open lacrimal surgery without systemic antibiotic prophylaxis. Knowledge about bacteriology of

chronic dacryocystitis contributes significantly to choice of prophylactic antimicrobial agents that act specifically on the causative organism and also prevents antibiotic resistance caused due to injudicious use of antibiotics.

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ANNEXURE -I

CONSENT FOR PARTICIPATION IN RESEARCH STUDY

I.D. NO. ☐☐☐

Mr/Mrs/Ms_____

You are invited to participate in our research study titled **"**CLINICOBACTERIOLOGICAL (AEROBIC) PROFILE OF CHRONIC DACRYOCYSTITIS IN ADULT PATIENTS ATTENDING OPHTHALMOLOGY DEPARTMENT OF A TERTIARY EYE CARE HOSPITAL : A ONE YEAR CROSS SECTIONAL STUDY, conducted by Post Graduate student in M.S. Ophthalmology,

Respected Sir/Ma'am we request you to enroll yourself in our study as you are eligible for participation. Your participation in research is voluntary. If you decide to participate you are free to withdraw at any time.

Purpose of the Study: Chronic dacryocystitis is inflammation of lacrimal sac. It is one of the most common diseases in ophthalmology. Its treatment is primarily surgical. An appropriate coverage with antibiotics is necessary to prevent failure of surgery due to infection.

The objective of this study is to study the bacteriology of chronic dacryocystitis and study the antibiotic susceptibility of the organisms, which will enable us to select the appropriate antibiotic.

Procedure Involved: If you agree to enroll yourself in this study, you will be asked your present, past and family history. You will be clinically examined and relevant investigations will be done. Anaesthetic drops will be instilled in both eyes. Pressure will be applied to collect regurgitant fluid and/ or sterile saline will be injected through a cannula into lacrimal puncta of both eyes, and regurgitant fluid will be collected.

Risks and Benefits: There are no potential risks involved with the procedure. However, if there is any sudden movement by the patient, there could be injury to lacrimal drainage system. However utmost care will be taken to avoid the same, and with subject's cooperation, risk is minimal.

Alternatives: If you are not willing to participate you will be treated according to the existing protocol & it will not affect your relationship with this hospital.

Costs for participating in this research: There will not be any extra cost incurred by you. You will, however, have to pay for the investigations which are part of the existing management protocol for the condition. There is no commitment for any reimbursement or any other compensation.

Privacy and Confidentiality: Your privacy is guaranteed. However, your medical records can be directly accessed and reviewed by authorized individuals or by the ethics committee. Records, which could reveal your identity, will be kept confidential. Personal data will remain anonymous if data is being published or written as a dissertation.

Authorization to Publish Results: When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity.

Compensation: In the event of injury related to the study, treatment will be made available through KLESDr.PrabhakarKore Hospital & MRC, Belgaum. There is no compensation or payment for such medical treatment by law. The doctors and the staff will provide facilities and medical attention to you.

Questions

If you have any questions about the research you may please contact:

1. Investigator, _____ Post Graduate student, Department of Ophthalmology, JNMC, Belgaum.
2. Guide, _____ Professor, Department of Ophthalmology, JNMC, Belgaum
3. _____ Principal, JNMC, Belgaum and Chairman, Institutional Ethics Committee.

Consent for participation in research trial

I, Mr./Ms./Mrs _____ voluntarily agree for the participation as a subject of this study. By signing this consent form, I am not giving up any of my legal rights. I may withdraw from the study at anytime. I am signing the consent form after having read or been read for me in my own vernacular language, including the risks and the benefits and having all my questions answered.

Subject Name : _____

Signature or the Left Thumb Print of Subject : _____

Witness Name :_____

Signature of Witness:_____

InvestigatorsName: _____

Signature of Investigator: _____

Name of the guide: _____

Signature of the guide: _____

Date:

Place:

ANNEXURE -II

DATA COLLECTION INSTRUMENT

		I D No.

Name (in capital letters)

(First name)	(Middle name)	(Last name)

Age (in | | | yrs)

Sex : | | (1=Male; 2=Female)

								O.P/I.P.No.

Address:

															Occupation:

Telephone | | | | | | | | | | | | | | | No.

Date of visit to OPD : | | | | | | | | |

Refractive Error:

Spherical Correction:

Cylindrical Correction:

Inclusion Criteria: | | (1=Met; 2=Not met)

Informed consent: | | (1=Taken; 2=Not taken)

Chief Complaints (1=Yes; 2=No)

Watering from eyes ☐

Discharge from eyes ☐

Diminution of vision ☐

Redness of eyes ☐

Discomfort of eyes ☐

Swelling of eyes ☐

History of present illness:	RE	LE
(1= yes; 2=no)		
History of diminution of vision:	☐	☐
History of pain : Mild	☐	☐
Moderate	☐	☐
Severe	☐	☐
History of redness:	☐	☐
History of watering:	☐	☐
History of discharge:	☐	☐
History of itching:	☐	☐
History of ocular irritation:	☐	☐
History of photophobia:	☐	☐
History of nose block	☐	☐
History of nasal discharge	☐	☐

Other complaints: (if present):

Past History (1=Yes; 2=No)

History of conjunctivitis ☐ ☐

History of surgery for watering of eyes ☐ ☐

History of nose block ☐ ☐

History of nasal discharge ☐ ☐

History of nasal surgery ☐ ☐

History of chemical injury to eyelid ☐ ☐

History of mechanical injury to eyelid ☐ ☐

Other past history (if present):

Medical History (1=Yes; 2=No)

Diabetes	
Hypertension	
Others	

Other medical history (if present):

Family History ☐ (1=Significant; 2=Insignificant)

If 1, specify:

Personal History ☐ (1=Significant; 2=Insignificant)

If 1, specify:

General Physical Examination

Vitals

- Pulse (per min) ☐☐☐
- Blood Pressure (systolic/diastolic)(mm of hg) ☐☐☐☐☐☐
- Temperature ☐ 1=Febrile; 2=Afebrile)

- Respiratory Rate (per min) | | | |

(1=Yes; 2=No)

Pallor		Clubbing	
Icterus		Lymphadenopathy	
Cyanosis		Oedema	

Systemic Examination (1=Normal; 2=Abnormal)

C V S If 2, specify	
R S If 2, specify	
C N S If 2, specify	
P / A If 2, specify	

Ocular Examination

- Head posture | | (1=Erect; 2=Tilted)
- Facial symmetry | | (1=Symmetrical; 2=Asymmetrical)
- Visual axes | | (1=Parallel; 2=Deviated)
- Extra-ocular movements | | (1=Normal; 2=Restricted)
  - Uniocular RE | | LE | |
  - Binocular
- Vision (1=6/6 - 6/12; 2=6/18 - 6/36; 3=< 6/36)

	RE	LE
Unaided		
Pin-hole		
BCVA		

- Refraction

	RE				LE			
	Sphere	Cylinder	Axis	Vision	Sphere	Cylinder	Axis	Vision
Distance								
Near								

Anterior segment examination

	RE	LE
Adnexa (1=Normal; 2=Abnormal) Skin Lid margin Punctum Tarsal conjunctiva Bulbar conjunctiva Lashes Swelling in region of lacrimal sac		
Conjunctiva		
Cornea (1=Clear{other than conj. Mass}; 2=edematous; 3=other) If 3, specify		
Sclera (1=Normal; 2=Abnormal) If 2, specify		
Anterior chamber (1=Normal depth; 2=shallow; 3=deep)		
Iris (1=Normal; 2=Atrophic patches; 3=other) If 3, specify		
Pupil • Size		

(1=normal; 2=constricted; 3=dilated) • Reactions: o Direct o Indirect (1=present; 2=absent; 3=sluggish)		
Lens (1=Clear; 2=Cataract) (If 2: 1=immature; 2=mature; 3=hypermature)		

Fundus

	RE	LE
Glow (1=Good; 2=Faint; 3=Absent)		
Media (1=Clear; 2=Hazy)		
Disc • Size (1=Normal; 2=small; 3=large) • Margins (1=Normal; 2=Abnormal) • VCDR (1=0.2; 2=0.3; 3=0.4; 4=0.5; 5=0.6; 6=0.7; 7=0.8; 8=0.9; 9=1.0) • NRR (1=Normal; 2=Thin)		
Blood vessels (1=Normal; 2=Abnormal)		
Background (1=Normal; 2=Tessellated; 3=Other)		
Macula (1=Normal; 2=Abnormal)		

Investigations

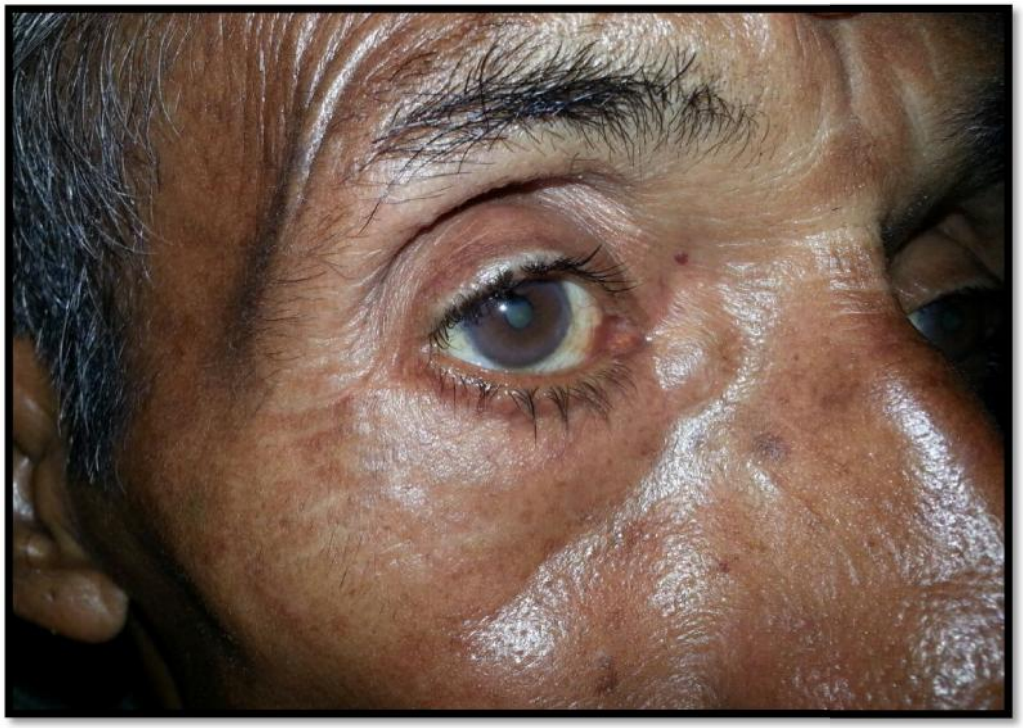
- Regurgitation test
- Lacrimal sac syringing
- Anterior rhinoscopic examination
- Random blood sugar
- Grams stain smear
- Culture:

  Blood agar
  Chocolate agar
  MacConkey agar

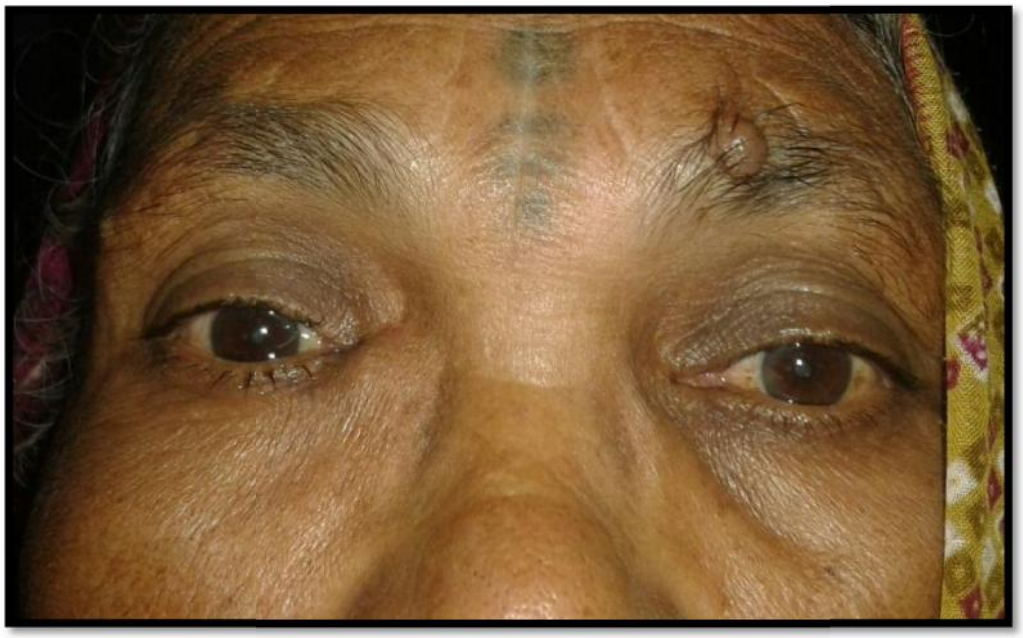
  Antibiotic susceptibility

DIAGNOSIS:

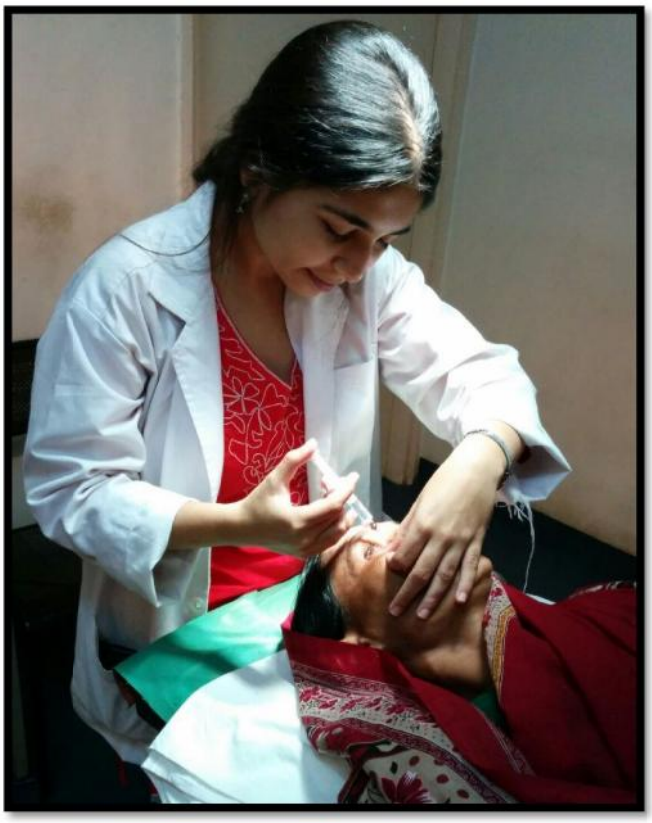
ANNEXURE III – PHOTOGRAPHS



PATIENT WITH RIGHT CHRONIC DACRYOCYSTITIS WITH MUCOCELE



PATIENT WITH RIGHT CHRONIC DACRYOCYSTITIS

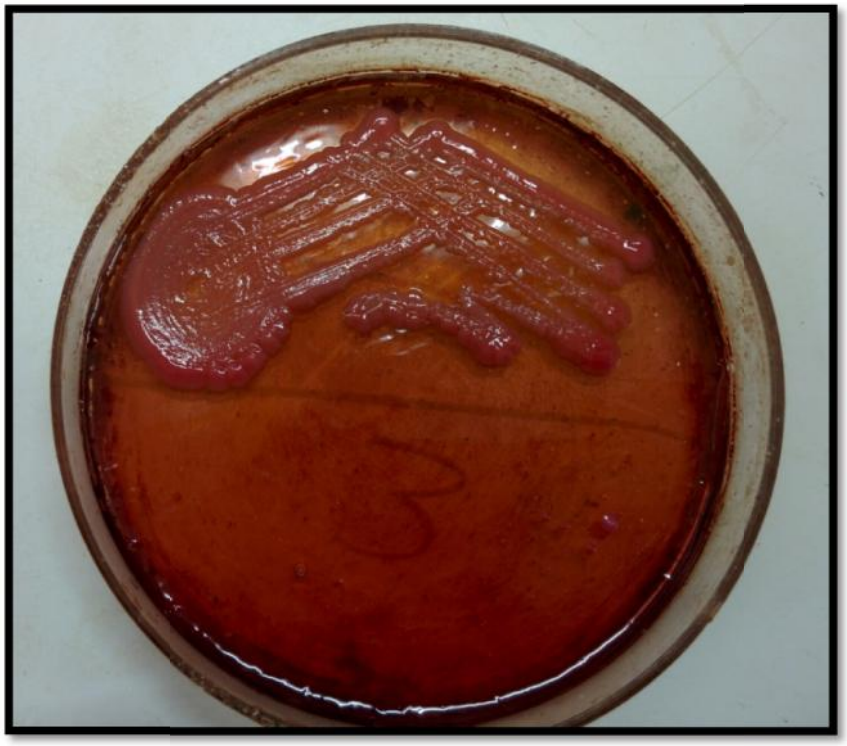


COLLECTION OF SAMPLE

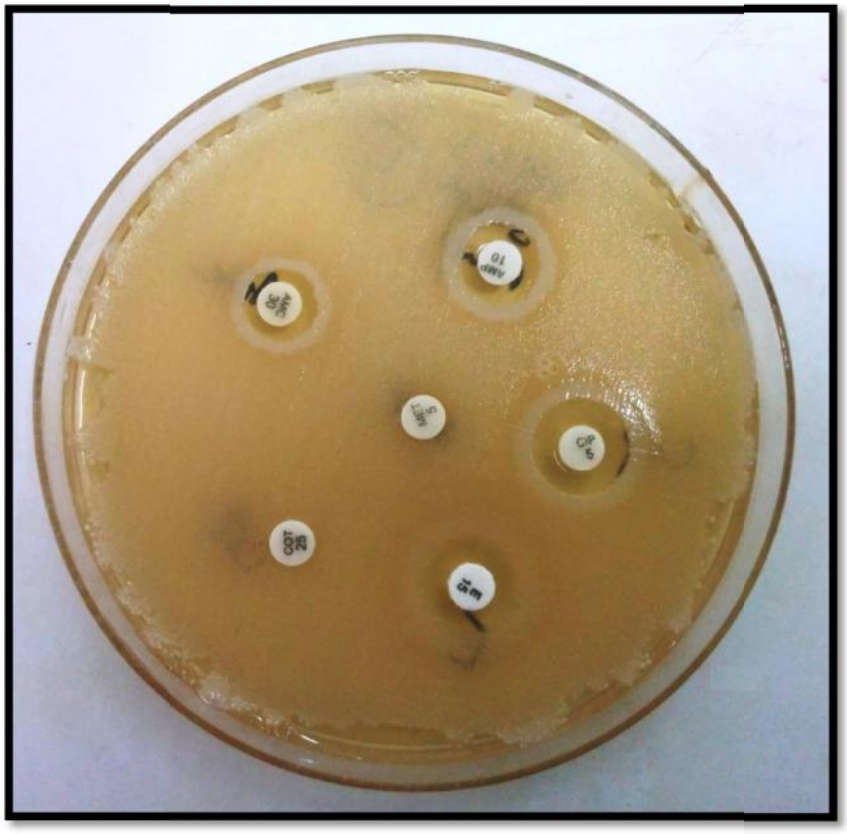
STERILE CULTURE SWABS

MICROSCOPIC EXAMINATION OF GRAM STAINED SMEAR

E COLI COLONIES



KLEBSIELLA COLONIES



MRSA KIRBY BAUER DISC DIFFUSION METHOD

P no	IP NO	AGE	SEX	RELIGION	C/O	DUR	LAT	ENT	SWELLING	ROPLAS	DIS	GRAMS STAIN				CULTURE	AB SENSITIVITY											
												INFL	GPC	GNB	EPITH		COT	AMPI	AMO	AMOC	ERY	AMI	GENTA	CIP	CHL	CEFTA	CEFOX	PIPE	CAR
1	2219143	21	F	H	S, W	1Y	L		PO	NEG	M	PO	PO	NEG	PO	NO	NA											
2	571063	45	F	M	W,D	1Y	L		PO	NEG	M	PO	PO,CLU	NEG	NEG	NO	NA											
3	2375995	65	F	H	W,D	1Y	L		NIL	PO	MP	PO	NEG	NEG	NEG	S.aureus	S	R	S	N	S	S	N	R	N	N	S	
4	2346798	42	M	H	W	1Y	L		NIL	PO	MP	PO	NEG	NEG	NEG	NO	NA											
5	509100	47	M	H	W,D	1.5Y	R		NIL	PO	MP	PO	NEG	NEG	NEG	S.aureus	S	R	N	S	S	N	N	S	N	N	S	
6	2530404	60	F	H	W	6Y	BL		NIL	PO	M	PO	PO,CLU	NEG	NEG	COMMEN	NA						NA					
7	512677	70	F	H	W	4Y	R	R DNS	NIL	PO	MP	PO	PO,CLU	NEG	NEG	NO	NA						NA					
8	2297996	74	M	H	W	2.5Y	L		NIL	NEG	M	PO	PO,CLU	NEG	NEG	COMMEN	NA						NA					
9	511939	70	F	H	W	3Y	R		NIL	NEG	S	PO	PO,CLU	NEG	NEG	COMMEN	NA						NA					
10	2356210	42	F	H	W	1Y	L		NIL	PO	S	NEG	PO,CLU	NEG	NEG	NO	NA						NA					
11	2412010	55	M	H	W,D	2Y	BL		NIL	PO	MP	PO	PO,SI	PO	NEG	CNS	S	S	R	N	R	N	N	S	N	N	N	
12	2410289	28	F	H	W	1.5Y	R	R DNS	PO	PO	S	PO	NEG	NEG	NEG	NO	NA						NA					
13	2409590	60	F	H	W	2Y	L		NIL	PO	M	NEG	NEG	NEG	NEG	CNS	S	S	R	N	R	N	N	S	N	N	N	
14	1748574	76	F	H	W	1Y	R		PO	PO	M	NEG	NEG	NEG	NEG	NO	NA						NA					
15	2400594	44	F	H	W,D	2Y	L		PO	PO	MP	PO	PO	NEG	NEG	KLB	S	R	N	N	N	S	S	S	N	S	N	
16	2426004	45	F	H	W	5Y	R		NIL	PO	S	PO	PO,SI	NEG	NEG	NO	NA						NA					
17	2418009	72	M	H	W,D	5Y	BL		PO	PO	MP	NEG	PO,PAIR	NEG	NEG	S.aureus	S	R	N	R	R	N	N	R	N	N	N	
18	516028	65	F	M	W,D	2Y	BL		NIL	PO	MP	NEG	PO,SI	PO	NEG	CNS	S	S	N	R	S	N	N	S	N	N	N	
19	2423006	63	F	M	W,D	1Y	BL		NIL	PO	MP	PO	PO,SI	NEG	NEG	S.aureus	R	S	R	N	S	N	N	R	N	N	N	
20	2369871	66	M	H	W,D	1Y	L		PO	PO	MP	PO	PO,SI,CLU	NEG	NEG	CNS	S	R	R	N	R	N	N	R	N	N	N	
																KLB	S	N	N	N	N	N	S	S	N	R	N	S	S
21	2451681	40	F	M	W	1.5Y	R		NIL	PO	MP	PO	PO	NEG	NEG	NO												
22	518413	78	M	H	W	2Y	R		NIL	NEG	M	PO	PO,CLU	NEG	NEG	NO												
23	2457596	85	M	H	W	1Y	L		NIL	PO	MP	PO	PO,SI,PAIF	NEG	NEG	S.aureus	R	S	R	N	S	N	N	S	S	S	N	N	N
24	2450327	80	F	H	W	4Y	L		NIL	PO	M	PO	PO,SI,CLU	NEG	NEG	CNS	S	S	R	R	R	N	N	S	S	R	N	N	N
25	519467	85	M	H	W,D	1Y	R		NIL	PO	MP	PO	PO,SI,PAIF	NEG	NEG	NO	S	S	S	S	S	N	N	S	S	N	N	N	N
26	2466965	65	F	H	W,D	15Y	L		NIL	PO	MP	PO	O,SI,CH,CL	NEG	NEG	S.aureus	S	S	R	S	S	N	N	R	N	N	N	N	N
27	2467451	50	F	H	W,D	1Y	L		NIL	PO	MP	PO	NEG	PO	NEG	NO	NA						NA					
28	2467582	52	F	H	W,D	2Y	R		NIL	PO	MP	PO	PO,SI,PAIF	NEG	NEG	NO	NA						NA					
29	2488520	56	M	H	W	1Y	R		NIL	PO	S	PO	PO,SI	NEG	NEG	MICRO	N	N	N	N	S	S	S	S	S	S	N	N	N
30	2479820	65	F	H	W	1Y	L		NIL	PO	S	NEG	NEG	NEG	NEG	NO	NA						NA					
31	2497440	35	F	H	W,D	0.5Y	L		NIL	PO	M	PO	PO,SI	NEG	NEG	NO	NA						NA					
32	2497461	75	M	H	W	10Y	BL		NIL	NEG	M	NEG	PO,SI,PAIF	NEG	NEG	NO	NA						NA					
33	1761982	60	F	H	W,D	2Y	R		NIL	PO	MP	PO	PO,SI,PAIF	NEG	NEG	NO	NA						NA					
34	2522041	50	F	H	W,D	0.5Y	L		NIL	PO	M	NEG	NEG	NEG	NEG	NO	NA						NA					
35	2505083	80	F	H	W,D	0.5Y	L		NIL	NEG	S	NEG	NEG	NEG	NEG	NO	NA											
36	2511737	42	F	H	W,D	0.5Y	R		NIL	NEG	MP	NEG	PO,SI	NEG	NEG	MRSA	S	R	R	R	S	N	N	N	N	N	N	N	N

P no	IP NO	AGE	SEX	RELIGION	C/O	DUR	LAT	ENT	SWELLING	ROPLAS	DIS	GRAMS STAIN				CULTURE	AB SENSITIVITY											
												INFL	GPC	GNB	EPITH		COT	AMPI	AMO	AMOC	ERY	AMI	GENTA	CIP	CHL	CEFTA	CEFOX	PIPE	CAR
37	2528237	61	M	H	W	0.5Y	L	DNS, IT	PO	PO	S	PO	PO,PAIRS	NEG	NEG	NO	NA												
38	2523605	43	F	H	W	8Y	BL		NIL	PO	S	PO	NEG	NEG	NEG	NO	NA												
39	550860	50	F	H	W,D	1Y	R		NIL	NEG	MP	PO	PO,SI,PAIF	NEG	NEG	CNS	N	S	N	S	R	N	N	S	N	N	N	N	N
40	531078	60	F	H	W	2Y	R		NIL	PO	MP	NEG	NEG	PO	NEG	NO	NA												
41	2550762	45	F	H	W	1Y	R		NIL	NEG	MP	NEG	PO,PAIRS	PO	NEG	S.aureus	S	S	R	R	S	N	N	R	N	N	N	N	N
																KLB	R	S	N	R	N	N	S	S	N	S	N	N	N
42	532290	66	F	H	W	4Y	BL		NIL	PO	M	PO	PO,PAIRS	NEG	NEG	NO	NA												
43	534430	61	F	H	W,D	2Y	BL		NIL	PO	MP	PO	PO,CLU	NEG	NEG	CNS	S	S	N	S	N	N	R	R	N	N	N	N	N
44	2541124	60	F	H	W,D	6Y	R		NIL	PO	M	NEG	NEG	NEG	NEG	NA													
45	2246758	40	F	H	W,D	0.5Y	L	L DNS	PO	PO	MP	PO	PO,PAIRS	NEG	NEG	S.aureus	S	R	N	R	R	N	N	R	N	N	N	N	N
46	2498112	21	F	H	W,D	0.5Y	L		NIL	PO	MP	NEG	NEG	NEG	NEG	PSE	N	R	N	N	N	S	N	S	N	S	N	S	S
47	2405785	60	F	M	W	1Y	R		NIL	PO	M	PO	NEG	NEG	NEG	NA													
48	557742	79	M	H	W,D	0.5Y	BL		NIL	PO	MP	PO	NEG	NEG	NEG	CIT	N	S	R	R	N	N	S	S	S	N	N	S	N
																PSE	N	N	R	R	N	S	S	S	N	N	N	S	N
49	2763201	70	M	H	W,D	0.5Y	R		PO	NEG	MP	PO	PO,CLU	NEG	NEG	S.aureus	S	R	R	N	S	N	N	S	N	N	N	N	N
50	2550762	45	F	H	W	1Y	L		NIL	PO	M	NEG	NEG	NEG	NEG	NA													
51	2394283	48	F	H	W,D	1Y	L	DNS, R	NIL	PO	MP	PO	PO,PAIRS	NEG	NEG	MRSA	R	R	N	N	S	N	N	R	S	R	N	N	N
52	566158	65	F	H	W	4Y	R		NIL	PO	S	PO	NEG	NEG	NEG	NA													
53	567799	70	F	H	W,D	1Y	BL		NIL	PO	MP	NEG	PO,CLU	NEG	NEG	S.aureus	N	N	S	S	S	N	N	S	N	N	N	N	N
54	2798035	75	F	H	W,D	0.5Y	L		NIL	PO	MP	PO	PO,CLU	PO	NEG	MRSA	N	N	R	R	R	N	N	R	N	N	N	N	N
																ECOLI	N	N	R	R	N	S	R	R	N	N	N	N	N
55	2798010	65	F	H	W	0.5Y	R		NIL	PO	MP	NEG	NEG	NEG	NEG	NA													

ANNEXURE-V

KEY TO MASTER CHART

PO	:	POSITIVE
NEG	:	NEGATIVE
S	:	SEROUS
M	:	MUCOID
MP	:	MUCOPURULENT
GPC	:	GRAM POSITIVE COCCI
GNB	:	GRAM NEGATIVE BACILLI
INFL	:	INFLAMMATORY CELLS
EPITH	:	EPITHELIAL CELLS
LAT	:	LATERALITY
BL	:	BILATERAL
R	:	RIGHT
L	:	LEFT
COT	:	COTRIMOXAZOLE
CIP	:	CIPROFLOXACIN
AMPI	:	AMPICILLIN
AMOC	:	AMOXICILLIN PLUS CLAVULANIC ACID

GENTA: GENTAMYCIN

AMO : AMOXICILLIN

AMI : AMIKACIN

CEFTA: CEFTAZIDIME

CEFTR: CEFTRIAXONE

CHL : CHLORAMPHENICOL

OFL : OFLOXACIN

PIPE : PIPERACILLIN

CARB : CARBENICILLIN

S.aureaus: STAPHYLOCOCCUS AUREUS

CNS : COAGULASE NEGATIVE STAPHYLOCOCCI

KLB : KLEBSIELLA PNEUMONIAE

ECOLI: ESCHERICHIA COLI

CIT : CITROBACTER

MICRO: MICROCOCCI

PSE : PSEUDOMONAS

MRSA : METHICILLIN SENSITIVE STAPHYLOCOCCUS AUREUS