A world wide web based informational reference source for ocular diseases using bacterial conjunctivitis as a template

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A world wide web based informational reference source for ocular diseases using bacterial conjunctivitis as a template

Abstract

Introduction: The project consists of a World Wide Web (WWW) site that can be accessed by all interested individuals knowledgeable in WWW operating protocol. The design is of an informational reference source to aid the practicing clinician and the optometric student in gathering cross-referenced information regarding a particular ocular disease. This project did not develop the entire reference base for all ocular disease conditions, but rather developed a generic template using bacterial conjunctivitis as an example. Using the established protocol, additional ocular disease conditions will be added in the future to complete the site.

Methods: Microsoft Frontpage 97 was used to create a World Wide Web (WWW) site consisting of six separate but interrelated pages. The six main sections of the ocular disease web site include; pathology and disease conditions, diagnostic techniques, differential diagnosis, causative agents, pharmacology, and references. Information on each topic section was derived from multiple reference sources including current text books, journal articles and class notes. Each page has detailed text information, full color images of the various conditions, as well as helpful visual information to reinforce text information. Crossed reference links were built to allow the user to easily access related information contained in the other topic pages. Even though this project is self contained, it has built-in links to various optometric and related medical information sites.

Results: The project was presented to local practitioners where it received positive praise. The web site was uploaded to the Pacific University College of Optometry home page. Testing and evaluation of the performance is currently being conducted.

Discussion: Use of the World Wide Web as a source of information IS still in its infancy. The potential for practitioners of Optometry to access this vast wealth information in a rapid and efficient manner is just beginning to be realized The strength of this format is the ability to access all related information contained in any other page by simply clicking a button.

Degree Type
Thesis

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A WORLD WIDE WEB BASED
INFORMATIONAL REFERENCE SOURCE
FOR OCULAR DISEASES USING
BACTERIAL CONJUNCTIVITIS AS A TEMPLATE

by

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MONTY SNELL, B.S.

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May, 1997

Faculty Advisor:

Kenneth Eakland, O.D.
Signature Page

A World Wide Web based informational reference source for ocular disease using bacterial conjunctivitis as a template

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Biographies

George W. Hertneky is a candidate for an O.D. degree at Pacific University College of Optometry in May of 1997. He earned his B.S. in Aerospace Engineering from the University of Colorado at Boulder in 1988. While at PUCO he was active as the class equipment representative during his first and second years and for the student body during his third year. He participated in Amigos trips to Baja, Mexico and Bandung Indonesia. He plans to purchase a private practice in Brush Colorado upon licensure.

Monty Snell is a third year optometry student. He graduated from Rutgers University in 1988 with a degree in Electrical Engineering and has worked in the fields of engineering and medical diagnostics. He is a recipient of an Armed Forces Health Professions Scholarship and plans to practice optometry for the Army upon graduation.
Abstract

Introduction: The project consists of a World Wide Web (WWW) site that can be accessed by all interested individuals knowledgeable in WWW operating protocol. The design is of an informational reference source to aid the practicing clinician and the optometric student in gathering cross-referenced information regarding a particular ocular disease. This project did not develop the entire reference base for all ocular disease conditions, but rather developed a generic template using bacterial conjunctivitis as an example. Using the established protocol, additional ocular disease conditions will be added in the future to complete the site.

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Key words

World Wide Web, WWW, optometry, ocular disease, and bacterial conjunctivitis.
Acknowledgments

The authors would like to thank Dr. Kenneth Eakland for giving us the idea for this project, for taking the time to proofread, and for offering suggestions.

Also, the authors would like to thank Mike Geraci and Tracy Walstead for their help with technical problems, general World Wide Web knowledge, and putting the project on the Web.
Introduction

Advancements occurring in technology and communications are creating new methods for efficiently obtaining a wide range of information. The World Wide Web (WWW) allows people from all around the globe the opportunity to access educational information in a highly organized and rapid manner. This project provides optometry with an informational reference source on ocular disease that is accessible through the WWW. The informational reference source was designed for practicing optometrists and optometric students who are either trying to acquire this information for the first time or who are just trying to strengthen their existing knowledge. This reference source will be different from other existing sources due to the unique properties of the WWW. Ease of access, availability, interactiveness, updatability and multimedia aspects highlights the inherent features of this medium. This project did not attempt to develop the entire informational reference source covering all topics of ocular disease, but rather the design of a generic template using bacterial conjunctivitis as an example. This template will serve as the basic design layout for future topics in ocular disease. The template designed includes such topics as; disease conditions, treatment, etiology, epidemiology, subjective findings, objective findings, differential diagnosis, prevention, sources of infection, natural defense mechanisms, pharmacology (including indications, contraindications, administration, and precautions), diagnostic techniques (including when to culture, media types, identification tests, and how to take samples of the cornea, eyelid and conjunctival tissue), classification of the causative organisms, and references. Incorporated into the template design are illustrations and graphics to aid in visual learning. Links to both related topics as well as to WWW search engines that allow access to related articles on the subject are contained within the template. All topics are cross referenced allowing the user to gather more information with greater ease than currently available via standard reference sources.
Methods

Text information was first gathered and organized using Microsoft Word 5.1. Pictures and graphics were gathered and scanned using a Nikon Coolscan color scanner. Images were stored and edited using Adobe Photoshop. Text, pictures, and graphics were then merged together using Microsoft Frontpage 97.

The bacterial conjunctivitis information reference source World Wide Web (WWW) site consists of six separate but interrelated pages. The six main sections of the ocular disease web site include; pathology and disease conditions, diagnostic techniques, differential diagnosis, causative agents, pharmacology, and references. Information on each topic section was derived from multiple reference sources including current text books, journal articles and class notes. Each page has detailed text information, full color images of the various conditions, as well as helpful visual information to reinforce text information. Crossed reference links were built to allow the user to easily access related information contained in the other topic pages. Even though this project is self contained, it has built-in links to various optometric and related medical information sites.

This completed product was then uploaded to the Pacific University College of Optometry Web site.

Discussion

The web site can be accessed from either the Pacific University College of Optometry home page or by typing the URL www.pacificu.edu/up/opt/welcome.html into a web browser. Either of these two methods will present the user with the home page for the bacterial conjunctivitis reference source (figure 1). From this home page, the user can then choose which section that they wish to explore by clicking the computer cursor over one of the six highlighted words surrounding the eyeball at the bottom of the page.
Knowledge Center

It's much more than pink eyes... Click below to begin your trip...

Main Page

Bacteria

Diagnostic Tests

Differential Diagnosis

Pharmacology

References
This will move them to the appropriate section. The organizational structure of the web site is based around six main sections: Main Page, Pharmacology, Diagnostic Techniques, Differential Diagnosis, Bacteria and References. These are summarized in Appendix 1.

The Main Page (figure 2) consists of ten sections. The first section, Etiology, discusses the general etiology for acute, hyperacute, and chronic bacterial conjunctivitis. The second and third section, General epidemiology and General signs and symptoms, respectively provide a generalized overview of the condition bacterial conjunctivitis. The fourth section, Prevention, discusses procedures the patient and the doctor can do to minimize the chance of infection. Natural defense mechanisms of the eye and body are discussed in the fifth section. Section six, Sources for infection, relates to the common vectors and methods that bacteria are introduced to the eye. Section seven through ten deal with the various forms in which bacterial conjunctivitis can occur. Acute bacterial conjunctivitis, Hyperacute bacterial conjunctivitis, Chronic bacterial conjunctivitis, and Neonatal bacterial conjunctivitis are each individually discussed. Information contained on each form includes specific details as to the cause, subjective findings, objective findings, treatment, and follow-up protocols.

Figure 2
The Pharmacology Page (figure 3) consists of five sections. The first section, *Treatment*, discusses the different general treatment options. *Indications* and *Contraindications* are discussed next. Pharmacological *Precautions* are discussed fourth and *Administration* of drops, ointment and solution fifth. Lastly, the *Effectiveness* of specific drugs against specific bacteria are discussed.

Figure 3

**Pharmacology**

The Diagnostic Techniques Page (figure 4) consists of four sections. The section entitled *When to culture* offers clinical guidelines to aid in the decision process of if culturing is required. The *Media types* section discusses the different types of media and the pathogens that they selectively culture. *How to take samples* section discusses the proper procedure for taking eyelid, conjunctival, and corneal samples. *Identification test* section discusses how to perform and interpret some of the specific tests used to differentiate bacteria with similar characteristics.
The Differential Diagnosis Page (figure 5) discusses characteristics of thirty-three separate pathologies that can cause similar symptoms and signs found in bacterial conjunctivitis. It also discusses how to differentiate between these pathologies and bacterial conjunctivitis. These pathologies are adenovirus, allergic, blepharoconjunctivitis, chlamydia, contact lens related reaction, drug induced, dry eye syndrome, epidemic keratoconjunctivitis, episcleritis, foreign-body reaction, fungal conjunctivitis, giant papillary conjunctivitis, acute angle closure glaucoma, herpes simplex, herpes zoster, hypersensitivity reaction, keratoconjunctivitis, lid deformities, Molluscum contagiosum, ocular rosacea, pharyngoconjunctival fever, phlyctenular reaction, pinguecula, scleritis, sexually transmitted disease, subconjunctival hemorrhage, Kawasaki disease, leptospirosis, Stevens-Johnson's syndrome, tear film abnormalities, trichiasis, toxic reaction, and vernal keratoconjunctivitis.
The Bacteria Page (figure 6) consists of four sections. The first section discusses Classification by shape and Gram stain. The next two sections discuss the Normal flora and the Pathogens that have been found in the conjunctiva. The Identification techniques and Diagnostic test section are identical to that found on the Diagnostic Techniques Page.
The References Page (figure 7) details the different textbooks, journal articles and class notes that were used for this project.

**Figure 7**

**Bacterial Conjunctivitis: References**


D Yolton D: Notes from "Ocular Therapeutic Pharmaceuticals" course PUCO spring 1996


H Yolton D: Notes from "Anterior Segment Diseases of the Eye" course, PUCO fall 1994


J Catania LC: Primary Care of the Anterior Segment

K Eckland K, Yolton D, Williams SK: Notes from "Posterior Segment Diseases of the Eye" course, PUCO spring 1995


M Perkins R: Bacteriology of normal and infected conjunctiva. *J Clinical Microbiology* 1975, 1:147


Q Davis FA, *Taber's Cyclopedic Medical Dictionary* 17th ed., FA Davis Company

R Pacific University College of Optometry patient instruction forms.


AE Yolton D: Notes from "Laboratory Procedures for Assessment of Ocular Disease" PUCO course, spring 1996
As a specific example, let's follow the procedure of a user wanting to find out treatment options for hyperacute bacterial conjunctivitis. The user would start by accessing the Bacterial Conjunctivitis home page by the method described above. After the home page has appeared on the screen, the user would then click upon Main Page. The next screen to appear would be figure 8.

Figure 8

From the Main Page the user would click upon Hyperacute. This would in turn make the section dealing with hyperacute bacterial conjunctivitis appear on the screen (figure 9). For this example the user would then select Treatment. This will bring them to figure 10. If the user was unsure of the causative organism they would next select Unidentified pathogen. This would then bring the user to figure 11 which lists the different treatment options. Should specific information of one of the drugs listed be needed, for example Gentamicin, this would be accessible by clicking that highlighted drug name. With this done the information for Gentamicin would then appear, figure 12.
Hyperacute Bacterial Conjunctivitis

Subjective Findings of Hyperacute Bacterial Conjunctivitis

Findings are similar to acute bacterial conjunctivitis but worse.

First symptom is a foreign body sensation.

Young sexually active person typically, but can be found in all age groups.

Unilateral initially then bilateral 2 to 3 days later by autoinoculation.

Teary, gooey, and irritated eyes.

Aching pain.

May be photophobic if cornea is involved.

Decrease in VA.

References H, L, N

Objective Findings of Hyperacute Bacterial Conjunctivitis

In the beginning stages of the infection, the symptoms are similar to those with acute conjunctivitis, but quickly progress to have greater involvement.

Conjunctiva

Bulbar
Figure 10

Pharmacological Treatment of Hyperacute Bacterial Conjunctivitis

Caused by *Neisseria* without corneal ulcer

Caused by *Neisseria* with corneal ulcer

Unidentified pathogen

Ocular discharge will cease within 24 to 48 hours with proper therapy. Other symptoms and signs will slowly resolve over 7 to 14 days.

If Gram stain identifies a *Neisseria* species pathogen and there is no corneal ulcer present, then treat disease as follows.

Systemic medications

- **Penicillin** - the mainstay therapy.
- Amoxicillin/clavulanic acid - effective against a number of gram-negative and gram-positive microbes.
- **Ceftriaxone** - given as an IM injection.
- **Erythromycin**

Topical medications

Fortified Gentamicin

Preparation - add 2 ml (40 mg) of parenteral gentamicin into a 5 ml bottle of commercially available gentamicin eye drops. The resultant solution contains 14 mg/ml and is stable for up to 30 days. Administer drops every 30 minutes around the clock.

Administration

- 0-24 hours - one drop each eye every 30 minutes.
- After 24 hour with improvement - one drop each eye every two hours.
- After 48 hours with continued improvement - one drop each eye every three to four hours.
- After 72 hours with continued improvement - one drop each eye until resolution.

**Ciprofloxacin**

Preparation

None. Available in 0.3% commercial concentration.
Figure 11

Use the following topical antibiotics when treating unidentified pathogen

1. Gentamicin
2. Tobramycin
3. Ciprofloxacin
4. Norfloxacin
5. Olofoxacin
6. Poloxacin
7. Polysporin
8. Neosporin
9. Bacitracin
10. Erythromycin
11. Chloramphenicol

Dosage: every 2 hours for two days in involved eye, then 5 times per day thereafter until resolution.

References D, F, E, H, J, T, U

Figure 12

Gentamicin

Trade names: Genoptic (gtt), Gentacidin (gtt), Garamycin (gtt), Gentak (gtt)

Warnings: Use in pregnant and nursing women should only occur when use is clearly needed and the benefits outweigh the risks to the fetus.

Spectrum of activity: Primarily effective against gram-negative bacilli including Pseudomonas aeruginosa. See also effectiveness against gram-positives and enterobacteriaceae.

Mechanism of action: Inhibition of bacterial protein synthesis.

Dose: 0.3% solution and ointment suitable for treatment. Instill drops to infected eye every 4 hours. Serious infections may be treated every 2 hours until improvement is seen. If using ointment, apply q4h for acute cases and bid or qhs for mild cases.

Side effects: Toxic to cornea. Causes delayed epithelialization and punctate keratitis.

Specifics: Resistance is developing including by Pseudomonas. Generally cross-resistance between gentamicin and tobramycin.
Conclusion

This web site is aimed at providing the practicing optometrist and the optometric student with an informational reference source regarding ocular disease by using bacterial conjunctivitis as a template. The six main sections to the Bacterial Conjunctivitis Page are Main Page, Pharmacology Page, Diagnostic Technique Page, Differential Page, Bacterial Page, and Reference Page. They were established to provide the user an intuitive and quick means to locate specific information.

As in all forms of ocular disease, bacterial conjunctivitis does not always present with a full compliment of the "classic" signs, the reference source includes as many of the signs and symptoms that could be reasonably found, however it is ultimately up to the individual practitioner to make the final clinical diagnosis. Information contained in this project relied heavily on current textbooks, class notes, and journal articles and has tried to represent the current state of knowledge on the topic of bacterial conjunctivitis. Further, all treatment options and protocols are presented to represent the standard of care, however as with the diagnosis it is ultimately the practitioner who defines the final treatment protocol.

Some treatment regimes described in this project may be out of the scope of practice for optometrists in states with limited therapeutic coverage. We have tried to be as specific as possible in describing the management of those conditions that can be managed or co-managed by the optometrist. It is up to the individual optometrist to know the extent of therapeutics that they are allowed to use in their state of practice. Keep in mind that the therapeutic modalities detailed in the project are not inclusive to that particular disease but only the most common modality. Therefore, they are guidelines and not absolutes.

It is beyond the scope of this project to list in detail all known information pertaining to the symptoms, signs, pharmacology, diagnostic techniques, differential diagnosis, and bacteria of bacterial conjunctivitis. Please consult additional sources of references if the
web page information is unsatisfactory or if more information on a topic is required.

We realize due to the magnitude of the project that errors, omissions and unintentional additions may exist. Even though we have endeavored to be as accurate, complete and concise as possible, we recommend that this project be used with additional sources of information and references when diagnosing and treating diseases, especially those that you are unfamiliar with. We therefore do not imply or accept professionally liability for the treatment of those conditions included in this web site.

Although it is not possible for all information concerning bacterial conjunctivitis to be included, it is hoped that this web site is helpful to all who use it and we welcome any corrections or constructive input that can be incorporated into future updates.

As all web browser's are not all exactly the same, there is always an inherent chance that this information will not be accessed by a particular user's browser. This will not be a problem for the vast majority of user's but it is still a problem might occur.

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Appendix 1

Structural outline

I. Main Page
   A. Etiology
      1. Acute bacterial conjunctivitis
      2. Hyperacute bacterial conjunctivitis
      3. Chronic bacterial conjunctivitis
   B. Epidemiology
   C. General signs & symptoms of bacterial conjunctivitis
   D. Prevention of bacterial conjunctivitis
      1. Patients
      2. O.D.'s
   E. Sources of Infection
   F. Natural Defense Mechanisms
   G. Specific types of bacterial conjunctivitis
      1. Acute
         a. Causes
         b. Subjective Findings
         c. Objective Findings
         d. Treatment
         e. Follow-up
2. Hyperacute
   a. Causes
   b. Subjective Findings
   c. Objective Findings
   d. Treatment
      1). caused by Neisseria with corneal ulcer
      2). caused by Neisseria without corneal ulcer
      3). unidentified pathogen
   e. Follow-up

3. Chronic
   a. Causes
   b. Subjective Findings
   c. Objective Findings
   d. Diagnostic Tests
   e. Treatment
   f. Follow-up

4. Neonatal
   a. Causes
   b. Subjective Findings
   c. Objective Findings
   d. Prophylaxis
   e. Treatment
   f. Follow-up

II. Pharmacology Page
A. Treatment protocols
   1. General

B. Pharmaceutical indications
   1. General
   2. Specific for each individual drug
C. Pharmaceutical contraindications
   1. General
   2. Specific for each individual drug

D. Pharmaceutical precautions
   1. General
   2. Specific for each individual drug

E. Pharmaceutical administration
   1. General

F. Drug effectiveness
   1. General
   2. Specific for each individual drug

III. Diagnostic Techniques Page
   A. When to culture
   
   B. Media types
   
   C. How to take samples
   
   D. Identification tests

IV. Differential Diagnosis Page
   A. Key feature of conditions that have clinical features that may resemble bacterial conjunctivitis.
V. Bacteria Page
A. Classification

B. Normal Flora

C. Pathogens
1. Gram + cocci
2. Gram - rods
3. Gram - cocci
4. Gram + bacilli
5. Chlamydiae

D. Identification Techniques & Diagnostic Tests

VI. References Page
Appendix 2

Complete hard copy of web page.
Pacific University College of Optometry

Areas of Interest

Pacific University's College of Optometry curriculum allows every student enrolled in the professional program to develop their skills in the following areas:

- Comprehensive Vision Examination
- Contact Lenses
- Independent Study
- Low Vision
- Ocular & Systemic Disease

Go to Ocular Disease Informational Reference Page

- Pediatrics
- Practice Management
- Sports Vision
- Vision Therapy & Vision Enhancement

Return to Academics

Mail your questions or comments to the webmaster.

last updated: 5/5/97
author: grothla@pacificu.edu
Ocular Disease Informational Reference Page

- Bacterial Conjunctivitis

Return to Areas of Optometric Interest

Mail your questions or comments to the webmaster.
It's much more than pink eyes... Click below to begin your trip...

Main Page

Bacteria
Diagnostic Tests
Differential Diagnosis
Pharmacology

References
realize that with a project of this magnitude that errors and omissions may exist. The information contained in this site is for informational and educational purposes only, and should in no way be used as a sole source for the treatment of any condition. We sincerely hope the information is helpful and we welcome suggestions and corrections. - Monty Snell and George Hertneky

Mail your questions or comments to the webmaster.
Etiology

Tear film is compromised or deficient due to old age, bacterial toxins, immunocompromised or deficient. Both local and systemic disorders can undermine the conjunctiva of its defenses and create an opportunity for its infection.

**Acute:** usually the result of the combination of a compromised defense mechanisms and the availability of an opportunistic bacteria.

**Hyperacute:** usually spread to the eye by direct contact with secretions or infected urine, or indirectly via the hands.

**Chronic:** usually requires an adnexal source of bacteria and typically will resolve when this source is eliminated. Acute forms of conjunctivitis that last over 2 - 4 weeks are classified as chronic.

*Ref. N*

Epidemiology

A common infectious bacterial condition of the outer eye which can affect all ages, races, and genders in all geographic regions.

General signs and symptoms

Acute onset of either unilateral or bilateral burning and stickiness associated with a purulent discharge and hyperemic papillary conjunctival response with lid crusting and debris formation. Vision is initially clear unless keratitis supervenes, and this takes the form of punctate lesions involving the entire cornea. The severity of the infection depends to a certain extent on the pathogen responsible, the age of the individual, state of any immune incompetence, whether or not any lid abnormalities are present, patient hygiene and nourishment, and community conditions.
Prevention

Patients:

1. Good lid and general hygiene
2. Avoid contact with the conjunctiva during the acute process. Limit reinfection.
3. Never use medications for more than 6 to 8 weeks.

O.D.'s:

1. Never patch a conjunctivitis.
2. Watch the cornea during the therapy sequence.
3. Patients tend not to come to follow-up examinations; make sure that you keep track of them.

Sources of infection

Potential reservoirs for pathogenic organisms include the lids, conjunctiva, canaliculi, lacrimal sac, paranasal sinuses, upper respiratory tract, ears, skin and pelvic region. Other sources include contact lenses and their solutions, topical drops and mascara brushes. Given the proper conditions, almost any bacteria can invade the conjunctiva.

Natural defense mechanisms

Epithelium and epithelial glycoalyx, lysozyme, lactoferrin, antibodies, orosomucoid, betalysin, ceruloplasmin, immunoglobulins IgA and IgG, superoxide dismutase, complement system, PMN's, tear flow, blinking, mucus trapping and normal flora.

Acute (mucopurulent) Bacterial Conjunctivitis

Subjective Findings/ Objective Findings/ Treatment/ Follow Up/ Causes

Subjective Findings of Acute Bacterial Conjunctivitis

- Main symptom is patient concern with increasing redness.
- Found in all age groups.
- Unilateral initially then bilateral 2 to 3 days later by autoinoculation.
- Teary and irritated eyes
- History of 2 to 3 days with increasing symptoms and signs.
- Foreign body sensation.
- Red eyes.
- Eyes stuck together in the morning.
- Little to no pain.
- Vision not affected.
- May have a history of upper respiratory infection (URI) or otitis media.
- Frequently associated history of bacterial blepharitis.
- Young, adult contact lenses wearer.

References B, C, D, H, I, J, N
Objective Findings of Acute Bacterial Conjunctivitis

Conjunctiva

Bulbar

- Hyperemic and meaty red. Greater in fornix.
- Small to large papillae on tarsal conjunctiva.
- Circumcorneal area relatively clear.
- Injected blood vessels are movable.
- Small and large blood vessels involved.
- Small conjunctival petechial hemorrhages and marginal corneal infiltrates occur early in common with H influenzae infections.

Palpebral

- Papillae of small to large size usually present.
- Often blanched and congested by secondary edema.

Preauricular lymph node:

- Lymphadenopathy is small or absent. Most bacteria and their by-products are primarily discharged from the ocular surface through the nasolacrimal drainage system, not through lymphatic drainage.

Cornea:

- Can be clear or have diffuse superficial punctate staining (SPK). May be present during first 2 to 3 days of infection and then gone by fourth.
- Marginal infiltrates in inferior cornea.
- S. aureus may produce peripheral corneal infiltrates, phtyctenulosis, and limbal nodules.

Discharge:

- Is scarce and mucopurulent in nature.
- Will cause hard crusts on eyelashes and lid margins.
- Will make opening the eyes in the morning increasingly difficult.
- Will be yellowish to greenish in nature.

Additional findings commonly seen in Acute Pediatric Bacterial Conjunctivitis

- Usually bilateral.
- Purulent exudate.

Concurrent otitis - the physician should also check for otitis in all pediatric patients with conjunctivitis even if symptoms are not present.

Concurrent pharyngitis - the physician should also check for pharyngitis in all pediatric patients with conjunctivitis even if symptoms are not present.

References B. C. D. H. I. J. A B

Treatment of Acute Bacterial Conjunctivitis

- Without intervention- will generally go away by itself in 7 - 10 days but can progress to chronic.
With appropriate intervention- significant improvement in 12 - 36 hours.

Non-pharmacological

1. Lid hygiene- to remove debris.
2. Warm compress- T.I.D. or Q.I.D. especially in the morning to get eyelids open.
3. Irrigation- Can use standard soft contact lens rinsing solutions to irrigate as they contain anti-bacterial agents. This helps to wash out most of the bacteria and their toxins.

References D.J.K

Pharmacological

Click here for specific pharmaceuticals to treat an identified pathogen or use the following topical antibiotics when treating unidentified pathogen.

Topical Antibiotic therapy-

1. Gentamicin
2. Tobramycin
3. Ciprofloxacin
4. Norfloxacin
5. Ofloxacine
6. Polytroxin
7. Polysporin
8. Neosporin
9. Bacitracin
10. Erythromycin
11. Chloramphenicol
12. Sulfacetamide/ Sulfaoxazole

Dosage- usually 4 times a day for 7-10 days

Steroids or mixed antibiotic/steroids

1. Avoid in mild to moderate, caution even in severe.
2. Dosage- usually 4 times a day for 3-5 days (7-10 days max.) then taper.
3. Monitor intra-ocular pressures (IOP's).

References D.F.H.L.I\N

Follow-up for Treatment of Acute Bacterial Conjunctivitis

First follow-up

1. If worse in 24 hours then return to clinic (RTC) OR if not better in 48 hours then RTC OR if not gone in 96 hours then RTC.
2. Patient should RTC in 3 - 5 days regardless of whether symptoms are gone or not.

Second follow-up

1. RTC in 1 week after first follow-up.
2. Dismiss or reassess.

If eye gets worse with treatment then ....
1. Rethink DDX OR
2. Change medications OR
3. Add oral medications OR
4. Extend treatment OR
5. Refer

References B.C.D.H.I.J.J.

**Causes of Acute Bacterial Conjunctivitis**

**Bacteria**

*Gram + cocci*
- S. aureus
- S. epidermidis
- S. pneumonia
- S. pyogenes
- S. viridans

*Gram - bacilli*
- M. lacunata
- H. influenza
- P. aeruginosa

*Coliform species*

*Gram - cocci*
- N. gonorrhoeae

**Chlamydiae**
- C. trachomatis

*The major bacterial agents affecting pediatrics although all are pathogenic.

** Treatment should be aggressive if these sight threatening pathogens are suspected.

References B.D.H.I.J.L.M.N.A.

**Other top causes of Acute Bacterial Conjunctivitis:**

Adenovirus, allergic reaction, blepharoconjunctivitis, chlamydial, contact lens related reaction, dermatologically related conditions, drug induced, dry eye syndrome, epidemic keratoconjunctivitis, episcleritis, follicular types, foreign-body reaction, fungal conjunctivitis, giant papillary conjunctivitis, glaucoma, acute angle closure, herpes simplex, herpes zoster, hypersensitivity reaction, keratoconjunctivitis, lid deformity which leads to corneal exposure, melobomian abscess, molluscum contagiosum, ocular rosacea, pharyngoconjunctival fever, phlyctenular reaction, pinguecula, scleritis, subconjunctival hemorrhage, systemic related (secondary to), tear film abnormalities, trichiasis, toxic reaction, sexually transmitted, and vernal keratoconjunctivitis
Hyperacute Bacterial Conjunctivitis

Subjective Findings of Hyperacute Bacterial Conjunctivitis

Findings are similar to acute bacterial conjunctivitis but worse.

First symptom is a foreign body sensation.

Young sexually active person typically, but can be found in all age groups.

Unilateral initially then bilateral 2 to 3 days later by autoinoculation.

Teary, gooey, and irritated eyes.

Aching pain.

May be photophobic if cornea is involved.

Decrease in VA.

References H, J, N

Objective Findings of Hyperacute Bacterial Conjunctivitis

In the beginning stages of the infection, the symptoms are similar to those with acute conjunctivitis, but quickly progress to have greater involvement.

Conjunctiva

Bulbar
Bacterial Conjunctivitis Main Page

- Hemorrhagic conjunctival changes.
- Hyperemic, and meaty red. Greater in fornix.
- Small to large papillae on tarsal conjunctiva.
- Injected blood vessels are movable.
- Small and large blood vessels involved.

**Palpebral**

- Hemorrhagic conjunctival changes.
- Development of true or pseudomembranes.
- Papillae.

**Preauricular lymph node**

- Prominent and tender

**Cornea**

- Toxic corneal staining
- Possible ulceration

**Discharge**

- Copious purulent discharge
- Yellow-white to yellow-green in color

**Other Objective Hyperacute Findings**

- Usually bilateral
- Upper and lower lid edema, erythema, and hyperemia
- Preseptal cellulitis may be concurrently present
- Tender adnexa
- Iridocyclitis in later stages

*References B, C, D, H, J, N, T*

**Treatment of Hyperacute Bacterial Conjunctivitis**

Lab work-up is mandatory

1. **Culture**
   - Chocolate agar
   - Thayer-Martin selective media
   - Fermentation studies

2. Antibacterial drug sensitivities

3. Gram and Giemsa stains

4. Cytology

If Gram - diplococci are identified, fermentation studies should be performed to distinguish between meningococcus and gonococcus.
It has been suggested that all cases of pediatric hyperacute conjunctivitis should be cultured and a Gram stain performed. If the Gram stain discloses gram-negative diplococci, initial therapy should include both systemic and topical antibiotic therapy.

Notification of public health officials is mandatory.

Frequent lavage of the lid and conjunctival sac is helpful in removing the purulent exudate.

References 11, IN

Pharmacological Treatment of Hyperacute Bacterial Conjunctivitis

Caused by Neisseria without corneal ulcer

Caused by Neisseria with corneal ulcer

Unidentified pathogen

Ocular discharge will cease within 24 to 48 hours with proper therapy. Other symptoms and signs will slowly resolve over 7 to 14 days.

If Gram stain identifies a Neisseria species pathogen and there is no corneal ulcer present, then treat disease as follows.

Systemic medications

- **Penicillin** - the mainstay therapy.
- Amoxicillin/clavulanic acid - effective against a number of gram-negative and gram-positive microbes.
- Ceftriaxone - given as an IM injection.
- Erythromycin

Topical medications

Fortified Gentamicin

Preparation - add 2 ml (40 mg) of parenteral gentamicin into a 5 ml bottle of commercially available gentamicin eye drops. The resultant solution contains 14 mg/ml and is stable for up to 30 days. Administer drops every 30 minutes around the clock.

Administration

- 0 - 24 hours -- one drop each eye every 30 minutes.
- After 24 hour with improvement -- one drop each eye every two hours.
- After 48 hours with continued improvement -- one drop each eye every three to four hours.
- After 72 hours with continued improvement -- one drop each eye until resolution.

Ciprofloxacin

Preparation

None. Available in 0.3% commercial concentration.

Administration
• 0 - 6 hours -- 2 drops each eye every 15 minutes.
• 6 hours - remainder of day -- 2 drops each eye every 30 minutes.
• Day 1 - day 2 -- 2 drops each eye every hour.
• Day 2 to day 14 -- 2 drops each eye every 4 hours.
• Day 14 on -- At discretion of the treating clinician.

Cycloplegics - 1 drop each eye, three times per day.

Atropine 1%
Scopolamine 0.25%
Cyclopentolate 1%

If Gram stain identifies a Neisseria species pathogen and corneal ulcer is present then hospitalize patient for systemic ceftriaxone therapy.

Systemic medications

• Penicillin - the mainstay therapy.
• Amoxicillin/clavulanic acid - effective against a number of gram-negative and gram-positive microbes.
• Ceftriaxone - given as an IM injection.
• Erythromycin

Topical medications

• Bacitracin
• Gentamicin
• Ciprofloxacin

Dosage - every 2 hours for two days in involved eye, then five times per day thereafter until resolution.

Use the following topical antibiotics when treating unidentified pathogen

1. Gentamicin
2. Tobramycin
3. Ciprofloxacin
4. Norfloxacin
5. Ofloxacin
6. Polymixin
7. Polysporin
8. Neosporin
9. Bacitracin
10. Erythromycin
11. Chloramphenicol

Dosage - every 2 hours for two days in involved eye, then five times per day thereafter until resolution.

References D, E, F, H, J, T, U
Follow-up for Treatment of Hyperacute Bacterial Conjunctivitis

First follow-up

1. If worse in 24 hours then return to clinic (RTC) OR if not better in 48 hours then RTC OR if not gone in 96 hours then RTC.

2. Patient should RTC in 3 - 5 days regardless of whether symptoms are gone or not.

Second follow-up

1. RTC in 1 week after first follow-up.

2. Dismiss or reassess.

If eye gets worse with treatment then . . .

1. Rethink DDX OR
2. Change medications OR
3. Add oral medications OR
4. Extend treatment OR
5. Refer

References D, H

Causes of Hyperacute Bacterial Conjunctivitis

Bacteria

Gram + cocci

Staphylococcus aureus

Streptococcus pneumoniae

Gram - bacilli

Pseudomonas aeruginosa

Enterobacteria

Escherichia coli

Serratia marcescens

Klebsiella pneumoniae

Haemophilus influenzae

Haemophilus aegyptius

Gram - cocci

Neisseria gonorrhoeae - most common cause.

Neisseria meningitidis
Chronic Bacterial Conjunctivitis

Subjective Findings / Objective Findings

Diagnostic Tests / Treatment / Follow Up / Causes

Chronic conjunctivitis has many different etiologies of which bacteria is one. As many of the normal flora of the ocular adnexa can be the bacterial cause of the disease, culturing is useful only after a detailed history has eliminated other causes (allergic, viral, chlamydial...). Chronic conjunctivitis will be eliminated after its source is removed.

Subjective Findings of Chronic Bacterial Conjunctivitis:

- Persistent burning sensation
- Conjunctival injection
- Ocular discharge

References H.I.N

Objective Findings of Chronic Bacterial Conjunctivitis

Eyelids

- Hyperemic and edematous eyelids.
- Madarosis.
- A crusted yellowish exudate may encase the base of the lash.
- Recurrent internal and external hordeola.
- Chalazion.

Conjunctiva

Palpebral

- Mild to moderate hyperemia.
- Micropapillary hyperplasia

- Follicular hyperplasia may be observed in chronic M. lacunata infections.
Bacterial Conjunctivitis

Main Page

- Thickening.

Bulbar
- Mild to moderate hyperemia.
- Thickening.

Cornea
- Fine, discrete punctate epithelial keratitis involving inferior 1/3.
- Marginal corneal ulceration involving inferior 1/3.
- Phlyctenules are uncommon.
- Micropannus.
- Subepithelial infiltrates.

Discharge
- Lid matting in the morning
- Mild to moderate stringy mucous strands in fornices.

References B, H, I, N, Z

Diagnostic tests for Chronic Bacterial Conjunctivitis

Following the standardized testing routine below can identify the etiology of chronic conjunctivitis in 69-81% of the cases.

A standardized questionnaire is completed for each patient to evaluate the following: demographic factors, medical history including history of systemic diseases, medications, exposure history, occupational history, allergic history, characteristics of the patient's ocular complaints, eyelid abnormalities, previous diagnostic studies, previous diagnosis and previous treatment. A complete external examination of each eye including palpation of the preauricular and submandibular lymph nodes, evaluation of external and adnexal tissues, slit-lamp biomicroscopy of the anterior segment of the eye, presence of foreign bodies or irritants, Gram and Giemsa staining of conjunctival smears, application of fluorescein and rose bengal to the ocular surface, measurement of tear breakup time, and Schirmer's test with anesthesia. Further diagnostic tests are performed as necessary.

If bacteria, Chlamydia, or Herpes simplex I and II are suspected to be the cause, perform diagnostic identification test.

Treatment of Chronic Bacterial Conjunctivitis

Preliminary diagnosis and treatment are based on the assessment at the patient's initial examination, which includes history, physical findings, and interpretation of routine cytological smears. Amend therapy if the results of microbiologic identification assays indicate an inappropriate initial therapy.

If etiology of disease is determined to be bacterial then treat as follows:

Education
The patient needs to know that it is a chronic problem that may not be able to be completely cured. The symptoms can be controlled but will probably never completely go away.

Lid hygiene
Involves hot compresses and eyelid scrubs. This is probably the best long term treatment for managing the disease.

Eyelid scrubs - Scrub the eyelids, margins and lashes using a
washcloth or a cotton-tipped applicator and a 50:50 solution of baby shampoo and warm water two times per day.

Hot compresses - Soak a washcloth in water that is as hot as the patient is able to withstand. Place washcloth over the eyes for 15 minutes. If the washcloth should cool down then resoak. This will bring blood to the eyelids and also loosen up the glands for mechanical expression. Do this one to two times per day.

Artificial tears as needed.

References: H, O, Z

Pharmacological Treatment of Chronic Bacterial Conjunctivitis

Add if symptoms are severe enough.

See pharmaceutical page for specific pharmaceuticals to treat an identified pathogen or use the following topical antibiotics when treating unidentified pathogen.

Topical Antibiotic therapy - ointment is preferential to drops.

1. Gentamicin
2. Tobramycin
3. Polymyxin
4. Polysporin
5. Neosporin
6. Bacitracin
7. Erythromycin
8. Sulfacetamide/Sulfisoxazole

Dosage - usually only at night for 7-10 days

Steroids or mixed antibiotic/steroids - avoid. Use only to treat secondary changes to the cornea.

References: D, F, H, I, J, N

Follow-up for Treatment of Chronic Bacterial Conjunctivitis

2-4 days following initial visit: communicate results of diagnostic tests, assess response to treatment and alter therapy if necessary.

One week after cessation of antibiotic treatment or two to three weeks after the initiation of long-term therapeutic intervention, re-assess patient. If there is improvement, back off initial therapy and prescribe maintenance therapy. Re-educate patient on his or her chronic condition.

References: H, O

Causes of Chronic Bacterial Conjunctivitis

Bacteria

Gram + cocci:
Bacterial Conjunctivitis

S. aureus
S. epidermidis
S. pneumoniae
S. pyogenes
S. viridans

Gram - rods:
H. influenzae
P. aeruginosa

Coliform:
Proteus mirabilis
Klebsiella pneumoniae
Serratia marcescens
Escherichia coli

Gram - cocci:
N. gonorrhoeae
M. lacunata

Chlamydiae:
C. trachomatis

*The major bacterial agents affecting pediatrics, although all are pathogenic.

References H, I, J, M

Other top causes of Chronic Bacterial Conjunctivitis

Virus, irritant, allergen, contact lens and their solutions, acne rosacea, floppy eyelid syndrome, insect larvae, topical medications, cosmetics, soaps, and perfumes.

Click for Differential Diagnosis information.

References O, A, B, AD

Return to Chronic Bacterial Conjunctivitis
Return to Top of this Page
Return to Bacterial Conjunctivitis Welcome Page

Neonatal Bacterial Conjunctivitis (Ophthalmia Neonatorum)

Subjective Findings/ Objective Findings/ Prophylaxis/ Treatment/ Follow Up/ Causes
Bacterial Conjunctivitis Main Page

Defined as a purulent discharge from the eyes occurring during the first 28 days of life. Occurs in 1.6% to 12% of neonates.

Due to newborns being immunologically immature, any bacteria that causes conjunctivitis can progress to produce sepsis and a lethal outcome.

References N, X, Y

Subjective Findings of Neonatal Bacterial Conjunctivitis

History of previous newborn with neonatal conjunctivitis.

Mother who has not received prenatal care.

Usually bilateral

Red eyes.

Teary, gooey, and irritated eyes.

May be photophobic if cornea is involved.

Most severe symptoms occur with gonococcal or chlamydial conjunctivitis.

References B, C, D, H, I, J, N, X, Y

Objective Findings of Neonatal Bacterial Conjunctivitis

Conjunctiva:

Bulbar:

Mild to severe hyperemia

Chemosis.

Small to large papillae on tarsal conjunctiva.

Injected blood vessels are movable.

Small and large blood vessels involved.

Palpebral:

Mild to severe hyperemia

Development of true or pseudomembranes.

Preauricular lymph node:

Prominent and tender preauricular lymph node.

Cornea:

Toxic corneal staining.

Possible ulceration.

Discharge:
Scant mucoid to copious purulent discharge.

Other:

- Systemic bacterial infection signs present.
- Usually bilateral.
- Upper and lower lid edema, erythema, and hyperemia.
- Preseptal cellulitis may be concurrently present.
- Tender adnexa.
- Iridocyclitis in later stages.

References B, C, D, H, J, N, T, X, Y

Prophylaxis

Prophylactic drops should be given to the newborn no later than one hour after birth.

Gonococcal:

1. 1% silver nitrate - causes a chemical conjunctivitis that appears on the first day and disappears spontaneously within 3 to 4 days.
2. Erythromycin or tetracycline ung.

Chlamydial:

1. Erythromycin or tetracycline ung - should be prophylactic for chlamydia although no studies have shown effectiveness against neonatal chlamydial conjunctivitis.

References D, X, Y

Treatment of Neonatal Bacterial Conjunctivitis

Lab studies are mandatory.

- Gram stain of discharge.
- Examination of a Giemsa-stained conjunctival scrapings.
- Cultures.

Systemic involvement is not uncommon and is serious when present.

Topical

- Bacitracin ung
- Erythromycin ung
- Tetracycline
- Gentamicin gtt
Systemic
ceftiraxone

General differential guidelines

<table>
<thead>
<tr>
<th>Age</th>
<th>Leading Cause</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5 days</td>
<td>Gonococcus</td>
<td>Systemic ceftriaxone: 50mg/kg/day administered IV or IM for 7days; lavage infant’s eyes hourly; treat parents. Rule out N. meningitidis with lab studies.</td>
</tr>
<tr>
<td>5 days to 5 wks</td>
<td>Chlamydia</td>
<td>Oral Erythromycin: 50mg/kg/day given as divided doses 2 or 4 times/day for 14 days; topical therapy of ? value; treat parents</td>
</tr>
<tr>
<td>5 wks to 5 yrs</td>
<td>Streptococcus</td>
<td>Bacitracin ung or Erythromycin ung alternated with gentamicin sol every 2 hrs.</td>
</tr>
<tr>
<td>5 yrs and older</td>
<td>Staphylococcus</td>
<td>Bacitracin ung or Erythromycin ung alternated with gentamicin sol every 2 hrs.</td>
</tr>
</tbody>
</table>

References D, X, Y

Follow-up for Treatment of Neonatal Bacterial Conjunctivitis

First follow-up

1. If worse in 24 hours then return to clinic (RTC) OR if not better in 48 hours then RTC OR if not gone in 96 hours then RTC.

2. Patient should RTC in 3 - 5 days regardless of whether symptoms are gone or not.

Second follow-up

1. RTC in 1 week after first follow-up.

2. Dismiss or reasseess.

If eye gets worse with treatment then . . .

1. Rethink DDX OR
2. Change medications OR
3. Add or change oral medications OR
4. Extend treatment OR
5. Refer.

References D, H

Causes of Neonatal Bacterial Conjunctivitis

Bacteria

Practically every known bacterial species has been seen to be a cause of bacterial neonatal conjunctivitis. Below is a list of some of the more common bacterial pathogens.
**Gram + cocci**
- S. aureus
- S. epidermidis
- S. pneumonia
- S. pyogenes

**Gram - rods**
- H. influenza
- P. aeruginosa
- Enterobacteria

**Gram - cocci**
- N. gonorrhoeae*
- N. meningitidis
- B. catarrhalis

**Chlamydiaceae:**
- C. trachomatis*

*Are the major bacterial agents although all are pathogenic.

**References D, X, Y**

**Other top causes of Neonatal Bacterial Conjunctivitis**
Chemical, viral, trauma, allergic, foreign body, lid deformity, systemic causes, and trichiasis.

**References Y, AB, AD**
Pharmacology

Treatment

Initial treatment should be an antibiotic with broad antibacterial coverage until the specific etiological organism is identified.

Causes of failure to respond to antibacterial treatment

Resistant bacteria, lid infection, inflammation, tumors, lid deformity, tear film abnormalities, ocular rosacea, atopy, dacryocystitis, canaliculitis, foreign body, virus infection, inclusion conjunctivitis, self inflicted, compromised host and opportunistic infection. Ref B

Systemic antibiotic regime to use in the event of failure of topical treatment

<table>
<thead>
<tr>
<th>Bacteria Type</th>
<th>Drug of choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram +</td>
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<tr>
<td>Staph</td>
<td>Cloxacillin + Flucidin</td>
</tr>
<tr>
<td>Strep</td>
<td>Benzylpenicillin</td>
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<td></td>
<td>If Methicillin resistant then use Rifampin or Vancomycin</td>
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<tr>
<td>Gram -</td>
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<tr>
<td>If Beta Lactamase negative</td>
<td>Gentamicin</td>
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<tr>
<td>If Beta Lactamase positive</td>
<td>Ceftazidime</td>
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<tr>
<td></td>
<td>If Beta Lactamase positive</td>
</tr>
</tbody>
</table>
Indications

For the treatment of bacterial conjunctivitis.

Contraindications

- Hypersensitivity to any component of the formulation.
- Epithelial herpes simplex keratitis, vaccinia, varicella, mycobacterial infections or fungal diseases of the ocular structure.

Precautions

- Deep-seated ocular infections or those that are likely to become systemic.
- Long term use may result in bacterial or fungal overgrowth of non-susceptible organisms.

Administration

When instilling drops

1. Check expiration date and then shake bottle.
2. Tilt head back and place medication in inferior conjunctival cul-de-sac.
3. Close eyes and apply pressure on the lacrimal sac for 1 minute following instillation to facilitate drug absorption into eye.
4. Avoid contaminating bottle by not touching tip to any surface and replacing cap after instillation of medication.

When instilling ointment

1. Check expiration date.
2. Squeeze out 0.5 cm of ointment onto clean fingertip and discard.
3. Squeeze out 0.5 to 1.0 cm of ointment on fingertip.
4. Place ointment in inferior cul-de-sac and blink normally.

Terminology

- drop(s) = gt(t)
- ointment = ung
- solution = sol
### Drug Effectivities against Gram Positive Bacteria

*E = Effective*

*RES = Some resistant strains*

*PROPH = Used prophylactically*

<table>
<thead>
<tr>
<th>Drug</th>
<th>Staph. aureus</th>
<th>Strep. sp.</th>
<th>P. aeruginosa</th>
<th>E. coli</th>
<th>K. pneumonia</th>
<th>S. pyogenes</th>
<th>P. vulgaris</th>
<th>S. saprophyticus</th>
<th>S. viridans</th>
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<tr>
<td>Bacitracin</td>
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### Drug Effectivities against Gram Negative Bacteria

*E = Effective*

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<tr>
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<th>H. influenzae</th>
<th>N. meningitis</th>
<th>N. gonorrhoea</th>
<th>E. coli</th>
<th>P. aeruginosa</th>
<th>K. pneumonia</th>
<th>S. pyogenes</th>
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Drug Effectivities against Enterobacteriaceae

\[ E = \text{Effective} \]
\[ \text{RES} = \text{Some resistant strains} \]
\[ \text{PROPH} = \text{Used prophylactically} \]

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**Bacitracin**

Typically found in concentrations of 500 units/g in ophthalmological ointments. Used singularly or in combination with other antibiotics.

**Trade names:** Baciquent (ung), Bacitracin (ung), and AK-Tracin (ung)

**Spectrum of activity:** Primarily gram-positive organisms. Click for gram negative and enterobacteriaceae activity.

**Mechanism of action:** Inhibits cell wall synthesis. A bactericidal drug.

**Dose:**

**Acute:** q4h initially then reduce treatment to q6-8h.

**Mild:** Apply bid.

**Side effects:** Rarely causes adverse effects but contact dermatitis has been reported.

**Specifics:** Stable only in ointment form.

**Gramicidin**

**Trade names:** Gramicidin. Also found in combination solutions taking the place of bacitracin like Neosporin.

**Spectrum of activity:** Gram Positive, Gram Negative, Enterobacteriaceae

**Administration:** See instructions above for procedure to instill solution.

**Mechanism of action:** Disrupts cytoplasmic membrane.
**Side effects:** Rarely causes any.

### Polymyxin B

Used topically in combination with other antibiotics and steroids as it is not commercially available as a stand alone drug.

**Trade names:** In combination- Polysporin (ung), Neosporin (ung), Cortisporin (ung), Maxitrol (gtt), and Terramycin (gtt).

**Spectrum of activity:** Primarily gram-negative bacilli. Click here for Gram Positive and Enterobacteriaceae spectrums of activity.

**Mechanism of action:** Disrupts cytoplasmic membrane. A bactericidal drug.

**Side effects:**

1. **Systemic:** Neurotoxicity- dizziness, ataxia, muscular weakness, and nephrotoxicity. Rarely used systemically.
2. **Topical:** Rarely causes side effects. Sometimes causes irritation and/or allergic reactions.

**Combination:**

- **Ointments-**
  1. Polysporin: Polymyxin B-Bacitracin
  2. Neosporin: Polymyxin B-Bacitracin-Neomycin
  3. Cortisporin: Polymyxin B-Neomycin-Bacitracin-Hydrocortisone
- **Drops-**
  1. Maxitrol: Polymyxin B-Neomycin-Dexamethasone
  2. Terramycin w/ Polymyxin B: Polymyxin B-Oxytetracycline

### Erythromycin

**Trade names:** Erythromycin (ung), AK-Mycin(gtt.), and Ilotycin(gtt).

**Spectrum of activity:** Primarily effective against gram-positive organisms. Gram-negative coverage is limited to N. gonorrhoeae, N. meningitidis, and H. influenzae. Drug is primarily bacteriostatic. There is a possibility that drug could be bactericidal in high concentrations. Not effective against Enterobacteriaceae.

**Mechanism of action:** Inhibition of bacterial protein synthesis. Bacteriostatic drug.

**Dose:**

- **Bacterial conjunctivitis:** Apply q2h then reduce treatment for acute cases; for mild cases, apply bid, to qhs.
- **Neonatal gonococcal prophylaxis:** Apply a thin line of 0.5% Erythromycin ointment 0.5 to 1.0 cm in length to infant’s inferior conjunctival sac. Administer a new tube to all newborns. 1% Silver nitrate solution or 1% tetracycline can also be used for prophylaxis. If mother of child has clinically significant gonorrhea, give IV or IM injections of penicillin G to infant.

**Side effects:** Allergic reactions.

### Chloramphenicol

**Trade names:** Chloramphenicol (ung, sol), AK-Chlor (ung, sol), Chloromycetin (ung), and Chloroptic S.O.P. (ung).

**Spectrum of activity:** A broad-spectrum drug. Is effective in treating a wide variety of gram-positive and gram-negative bacteria. See also spectrum of activity against enterobacteriaceae.

**Mechanism of action:** Inhibition of bacterial protein synthesis. A bacteriostatic drug.

**Indications:** Use only in severe or life-threatening infections where less toxic drugs have proven to be ineffective or

Dose:

- **Ointment:** Available in 1.0% concentration. Place 0.5 cm in inferior cul-de-sac(s) every 3 hours, day and night for the first 48 hours. In severe infections, shorten interval between applications. After 48 hours increase the interval between applications and continue to use until 48 hours after signs of infection are gone.
- **Solution:** Available in 0.5% concentration. Instill 1 or 2 drops every 4 to 6 hours for first 72 hours depending upon the severity of the infection. After 48 hours increase the interval between applications and continue to use until 48 hours after signs of infection are gone.

**Side effects:** (both systemic and topical)

- Aplastic anemia
  1. Not dose dependent.
  2. Irreversible.
  3. Can occur following completion of therapy.
  4. Can be fatal.
- Bone marrow depression
  1. Dose related
  2. Reversible
- Neurologic complications including optic neuropathy.
- Gastrointestinal problems.

**Trimethoprim**

Available in combination with Polymyxin B under the trade name Polytrim.

Spectrum of activity: Effective against aerobic **gram-positive** bacteria. See also effectiveness against **gram-negatives** and **enterobacteriaceae**.

Mechanism of action: Inhibition of protein synthesis. As Trimethoprim inhibits a different step in the pathway of protein synthesis than sulfonamides, both drugs can be used together synergistically.

Dose: 1 to 2 drops bid to qid for 7 to 10 days.

Side effects: Since the drug inhibits its production, folinic acid should be given concurrently to prevent anemia and WBC depression. Allergic reactions can occur.

Combinations: Polytrim: Trimethoprim-Polymyxin B (effective as a broad spectrum combination as Polymyxin B is effective against Pseudomonas while Trimethoprim is not)

**Fluoroquinolones**

*Expensive!!*

**Norfloxacin**

*Ref D, E, F, G*

Trade names: Chibroxin (gtt)

⚠️ **Warnings:** Use in pregnant and nursing women should only occur when use in clearly needed and the benefits outweigh the risks to the fetus. Can cause an occasional fatal hypersensitivity reaction in patients that have received systemic Norfloxacin medication. Only a few patients had a history of hypersensitivity reactions.

Spectrum of activity: Broad spectrum (both **gram-positive** and **gram negative**, including Pseudomonas)

Mechanism of action: Inhibits bacterial DNA synthesis
Bacterial Conjunctivitis - Pharmacology

Use: Norfloxacin is approved for use in children one year of age and older.

Dose: Depending upon the severity of the condition, 1 to 2 gtt to infected eye(s) q 2 to 4 h for 2 d then QID for up to 5 days. Do not take dairy products, antacids or iron preparations within one hour of taking medication.

Side effects: Discomfort on instillation, foreign body sensation, itching, bitter taste following instillation.

Adverse Reactions: Conjunctival hyperemia, chemosis, photophobia, bitter taste in mouth.

Patient Information: Discontinue use and notify prescribing doctor at the first sign of a skin rash or other allergic reaction.

Ciprofloxacin

Trade names: Ciloxan (gtt)

Warnings: Use in pregnant and nursing women should only occur when use in clearly needed and the benefits outweigh the risks to the fetus. Benefits to mother must be determined in order to decide if nursing should be discontinued or mother taken off Ciprofloxacin. Can cause an occasional fatal hypersensitivity reaction in patients that have received systemic Ciprofloxacin medication. Only a few patients had a history of hypersensitivity reactions.

Spectrum of activity: Broad spectrum (both gram-positive and gram-negative, including Pseudomonas).

Mechanism of action: Inhibits bacterial DNA synthesis

Use: Approved for use for patients over 12 years of age.

Dose: Depending upon the severity of the condition, 1 to 2 gtt to infected eye(s) q 2 to 4 h for 2 d then QID for up to 5 days. Do not take dairy products, antacids or iron preparations within one hour of taking medication. Flush eyes with water in cases of overdose.

Side effects: Discomfort on instillation, foreign body sensation, itching, bitter taste following instillation, drowsiness.

Adverse reactions: White crystalline precipitates, lid margin crusting, crystals/scales, conjunctival hyperemia, dermatopathy, allergic reactions, nausea, decreased vision.

Patient Information: Discontinue use and notify prescribing doctor at the first sign of a skin rash or other allergic reaction.

Ofloxacin

Trade names: Ocuvox (gtt)

Warnings: Use in pregnant and nursing women should only occur when use in clearly needed and the benefits outweigh the risks to the fetus. Can cause an occasional fatal hypersensitivity reaction in patients that have received systemic Ofloxacin medication. Only a few patients had a history of hypersensitivity reactions.

Spectrum of activity: Broad spectrum (both gram-positive and gram-negative, including Pseudomonas).

Mechanism of action: Inhibits bacterial DNA synthesis

Dose: Depending upon the severity of the condition, 1 to 2 gtt to infected eye(s) q 2 to 4 h for 2 d then QID for up to 5 days. Do not take dairy products, antacids or iron preparation within one hour of taking medication.

Side effects: Discomfort on instillation, foreign body sensation, itching, bitter taste following instillation.

Adverse reactions: Tearing, photophobia, dryness

Patient Information: Discontinue use and notify prescribing doctor at the first sign of a skin rash or other allergic reaction.
Aminoglycosides

Neomycin

Trade names: Usually seen in combination with other drugs. The names of topical drugs containing neomycin are Neosporin (ung), Cortisporin (gtt), and Maxitrol (gtt).

Spectrum of activity: Gram-positive, gram-negative, enterobacteriaceae.

Mechanism of action: Inhibition of bacterial protein synthesis. Resistance is common.

Dose: 1 to 2 drops bid to qid for 7 to 10 days.

Side effects: Topical application can cause a contact allergic reaction in the form of a superficial keratitis, conjunctivitis, dermatitis

Topical Combinations:

1. Neosporin: Neomycin-Polymyxin B-Bacitracin
2. Cortisporin: Neomycin-Polymyxin B-Hydrocortisone
3. Maxitrol: Neomycin-Polymyxin B-Dexamethasone

Specifics: Pseudomonas is not sensitive to neomycin. Products containing neomycin also include Polymyxin B.

Gentamicin

Trade names: Genoptic (gtt), Gentacidin (gtt), Garamycin (gtt), Gentak (gtt)

Warnings: Use in pregnant and nursing women should only occur when use is clearly needed and the benefits outweigh the risks to the fetus.

Spectrum of activity: Primarily effective against gram-negative bacilli including Pseudomonas aeruginosa. See also effectivitics against gram-positives and enterobacteriaceae.

Mechanism of action: Inhibition of bacterial protein synthesis.

Dose: 0.3% solution and ointment suitable for treatment. Instill drops to infected eye every 4 hours. Serious infections may be treated every 2 hours until improvement is seen. If using ointment, apply q4h for acute cases and bid or qhs for mild cases.

Side effects: Toxic to cornea. Causes delayed epithelialization and punctate keratitis.

Specifics: Resistance is developing including by Pseudomonas. Generally cross-resistance between gentamicin and tobramycin.

Tobramycin

Trade names: Tobrex (gtt & ung), AK-Tob(gtt)

Warnings: Use in pregnant and nursing women should only occur when use is clearly needed and the benefits outweigh the risks to the fetus. Benefits to mother must be determined in order to decide if nursing should be discontinued or mother taken off of Tobramycin.

Spectrum of activity: Primarily effective against gram-negative bacilli including P. aeruginosa. See also effectivitics against gram-positives and enterobacteriaceae.

Mechanism of action: Inhibition of bacterial protein synthesis.
Dose: 0.3% solution and ointment suitable for treatment. Instill drops to infected eye every 4 hours. Serious infections may be treated every 2 hours until improvement is seen. If using ointment, apply q4h for acute cases and bid or qhs for mild cases. Overdosage may cause punctate keratitis, erythema, increased lacrimation, edema and lid itching.

Side effects: Toxic to cornea and conjunctiva- causes delayed epithelialization, corneal ulceration, punctate keratitis and conjunctival hyperemia and chemosis.

Specifics: Generally cross-resistance between gentamicin and tobramycin.

**Sulfa-based Drugs**

**Sodium Sulfacetamide**

Trade names:

- **Ointments:**
  - 10%: AK-Sulf, Bleph-10, Cetamide, and Sodium Sulamyd.
- **Solutions:**
  - 10%: AK-Sulf, Bleph-10, Ocussulf-10, Sodium Sulamyd, and Sulf-10
  - 15%: Isopto Cetamide
  - 30%: Sodium Sulamyd

**Warnings:** Use in pregnant and nursing women should only occur when use in clearly needed and the benefits outweigh the risks to the fetus. Benefits to mother must be determined in order to decide if nursing should be discontinued or mother taken off of Sodium Sulfacetamide. Do not use in infants under 2 months of age.

**Spectrum of activity:** Broad spectrum of activity with widespread resistance. See gram-positive, gram-negative, and enterobacteriaceae effectivities.

**Mechanism of action:** Inhibition of bacterial protein synthesis of folic acid. A bacteriostatic drug. As Sodium Sulfacetamide inhibits a different step in the pathway of protein synthesis than Trimethoprim, both drugs can be used together synergistically.

**Use:** Use in less severe forms of bacterial conjunctivitis.

**Dose:** Depending on the severity of the infection, instill 1 to 2 drops of solution every 1 to 3 hours or ointment 1 to 4 times daily and at bedtime to infected eye.

**Side effects:** Be aware that there is a low incidence of hyper-sensitivity reactions (contact dermatitis) in the general population to sulfite containing medications. May cause corneal epithelial healing to be retarded, conjunctival edema, reactive hyperemia, local photosensitization, increased burning and stinging with increased concentration, and myopia.

**Specifics:** Since humans get folic acid from their diet, medication does affect the body's level of this protein. Do not use with silver preparations. Sulfa based drugs are inhibited by local anesthetics and pus.

**Sulfisoxazole**

Trade names: Gantrisin 4% (gtt)

**Warnings:** Use in pregnant and nursing women should only occur when use in clearly needed and the benefits outweigh the risks to the fetus. Benefits to mother must be determined in order to decide if nursing should be discontinued or mother taken off of Sulfisoxazole. Do not use in infants under 2 months of age.

**Spectrum of activity:** Broad spectrum of activity with widespread resistance. See gram-positive, gram-negative, and enterobacteriaceae effectivities.

**Mechanism of action:** Inhibition of bacterial protein synthesis of folic acid. As Sulfisoxazole inhibits a different step in the pathway of protein synthesis than Trimethoprim, both drugs can be used together synergistically.
Dose: Depending on the severity of the infection, instill solution every 1 to 3 hours or ointment 1 to 4 times daily and at bedtime to infected eye.

Side effects: Be aware that there is a low incidence of hyper-sensitivity reactions (contact dermatitis) in the general population to sulfite containing medications. May cause corneal epithelial healing to be retarded, conjunctival edema, reactive hyperemia, local photosensitization, increased burning and stinging with increased concentration, and myopia

Specifics: Since humans get folic acid from their diet, medication does affect the body's level of this protein. Do not use with silver preparations. Sulfur based drugs are inhibited by local anesthetics and pus.

**Polytrim**

Components: Polymyxin B-Trimethoprim

Click to see information on Polymyxin B or Trimethoprim.

**Polysporin**

Form: Ointment

Components: Bacitracin-Polymyxin B

Dose: Apply q3-h for 7 to 10 days.

Click to see information on Bacitracin or Polymyxin B.

**Neosporin**

Forms: Ointment and Solution.

Components:

- Ointment: Bacitracin-Neomycin-Polymyxin B
- Solution: Gramicidin-Neomycin-Polymyxin B

Dose:

- Ointment: Apply q3-6h for 7 to 10 days.
- Solution: 1 to 2 drops bid to qid for 7 to 10 days.

Click to see information on Bacitracin, Gramicidin, Neomycin, or Polymyxin B.

**Penicillins**

- Inhibit bacterial cell wall synthesis.
- A family of drugs; not a specific drug.
- Rarely used topically as they induce allergic reactions.

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Classification

Shape

- Spherical- coccus, cocci
- Rod-shaped- bacillus, bacilli
- Spiral-shaped- spirillum, spirilla

Gram stain - Reaction to gram stain divides bacteria into two groups

- Purple- positive
- Pink- negative

Bacteria of Normal conjunctiva

- S. epidermidis
- S. aureus
- Aerobic diptheroids*
- H. influenzae*
- Gastroenteric bacteria*
- Peptostreptococcus
- Propionibacterium acnes
- Lactobacillus species
- Haemophilus species
- Moraxella species

*Thought to be transient in nature
**Descriptions of Pathologic Bacteria**

**Gram + cocci: Staphylococcus species and Streptococcus species**

*Staphylococcus species: S. aureus, S. Epidermidis*

1. Most common cause of conjunctivitis
2. Gram-positive cocci arranged in irregular clusters
3. Ocular infections: blepharitis, conjunctivitis, corneal ulcers, cellulitis
4. Systemic infections: skin abscesses, impetigo, wound infections, pneumonia, enterotoxin food poisoning, toxic-shock syndrome

*S. aureus*

1. Probably the most common cause of conjunctivitis in the western world.
2. Affects all age groups.
3. May resolve spontaneously or progress to a chronic infection.

*S. epidermidis*

1. Contaminates cosmetics which in turn commonly cause conjunctivitis.

*Streptococcus species: S. pneumoniae, S. pyogenes, S. viridans*

1. Gram positive cocci, arranged in chains or pairs
2. Ocular infections: conjunctivitis, corneal ulcers

*S. pneumoniae*

1. Found in upper respiratory tract.
2. Found mostly in preschool and grammar school children and in parents of these children.

*S. pyogenes*

1. Rarely causes a severe conjunctivitis with inflamed membrane formation.

*S. viridans*

1. Normal flora of the upper respiratory tract.

**Gram - rod**

*Haemophilus species, Moraxella species, and Coliform species*

*Haemophilus species: H. influenza, H. aegyptius*

1. Systemic infections: meningitis, otitis media, respiratory infections
2. Somewhat fastidious, aerobic bacteria with pleomorphic characteristics (look like slender rods).
3. Cause small conjunctival petechial hemorrhages and marginal corneal infiltrates to occur early.
4. Found in upper respiratory tract.
5. Found more in children than adults.
6. Strains causing conjunctivitis not so virulent.

**Moraxella species: M. lacunata**

1. Large, aerobic diplobacilli.
2. Some species constitute normal flora on the mucous membranes.
3. A common cause of angular conjunctivitis (although S. aureus is the more common cause).
4. Can also cause a chronic diplobacillary conjunctivitis with follicular hypertrophy that does not evoke a purulent response.

**Coliform species: Acinetobacter calcoaceticus, Proteus species, Klebsiella pneumoniae, Serratia marcescens**

1. Enteric bacteria.
3. A less common cause of disease than Staph, Strep, or H. influenza.

**Gram - cocci: Neisseria species**

**Neisseria species: N. gonorrhoeae, N. meningitidis, N. catarrhalis, N. sicca and Branhamella catarrhalis**

1. Gram-negative diplococci usually inside PMNs
2. Ocular infections: hyperacute, purulent conjunctivitis- can invade healthy and uncompromised tissue. Can result in corneal perforation.
3. Systemic infections: gonorrhea

**N. gonorrhoeae**

1. Very pathogenic.
2. Causes neonatal conjunctivitis. Usually acquired from an infected mother during birthing process.
3. Adults probably self-inoculate themselves from the genital region.

**N. meningitidis**

1. Very pathogenic.
2. Clinical course identical to that of N. gonorrhoeae but typically has a milder course with less corneal involvement
3. Causes infrequent but serious cases of conjunctivitis.
4. Causes meningococcemia if it gets into bloodstream.

**N. catarrhalis and N. sicca**

1. Typically non-pathogenic, but occasionally cause chronic conjunctivitis.
2. Are frequently isolated from normal oropharynx.

**Branhamella catarrhalis**

1. Found in the upper respiratory tract.
2. May be mistaken for meningococci.
3. Frequently produces beta-lactamase.

**Acinetobacter calcoaceticus**

1. Causes acute and chronic conjunctivitis.
2. A culture is needed to distinguish from Neisseriae.
Gram + Bacilli

Bacillus of Doderlein

Gram + spore forming, aerobic, motile or nonmotile rod shaped bacteria that is sometimes found in chains. Usually non-pathogenic.

Listeria monocytogenes

Lives in soil and becomes pathogenic for humans under favorable conditions such as pregnancy, immunosuppression, or extreme age. Most commonly causes meningitis in humans.

Chlamydiae

Chlamydia trachomatis

Intracellular parasites

Most common sexually transmitted pathogen.

Ocular infections may progress to trachoma-like scarring.

**Adenovirus**
History of upper respiratory infection, mild visual fluctuations, watery discharge, and lymph node enlargement. Can compromise natural defense mechanisms of eye and expose conjunctiva to pathological bacteria.

**Allergic**
Itches! Personal or family history of allergies, mucus discharge is stringy, frequent seasonal relationship, and onset in hours or days.

**Blepharoconjunctivitis**
Lids edematous, hyperemic, and tender. Inferior punctate erosions along lid margins.

**Chlamydia**
An obligate intracellular bacterium, produces a combination of bacterial and viral symptoms and signs. Sexually active adults with a new partner in previous 2-3 months. Can compromise natural defense mechanisms of eye and expose conjunctiva to pathological bacteria. Click here for Chlamydial Diagnostic test.

**Contact lens related reaction**
Redness, burning, and itching soon after lens insertion. Giant Papillary Conjunctivitis

**Drug induced**
Reactions often occur to preservatives in eye drops causing marked hyperemia and a fine papillary reaction. Other reactions occur to prolonged use of topical antibiotics or antivirals, causing a conjunctival papillary reaction, keratinization, or punctal stenosis.

**Dry eye syndrome**
Abnormal tear film, foreign body sensation, stringy mucus, transient blurring of vision, low Schirmer's test, and staining defects. Punctate erosions of the conjunctiva and/or cornea in the mid zone of the interpalpebral fissure.

**Epidemic keratoconjunctivitis**
Acute follicular conjunctivitis, burning, irritation, photophobia, preauricular lymphadenopathy and corneal involvement. Got it from someone else.

**Episcleritis**
Deep injection (enlarged blood vessels will not move with Q-tip), mild pain, and no discharge.
**Foreign-body reaction**
- History of foreign material in eye, foreign body observed on conjunctiva and/or cornea. Tracking defects observed on the conjunctiva and/or cornea.

**Fungal conjunctivitis**
- More common in warm, humid climates. History of agricultural ocular injury, producing intense hyperemia and corneal edema and neerosis.

**Giant papillary conjunctivitis**

**Glaucoma, acute angle closure**
- Red eye, photophobic, nausea, vomiting, elevated IOP, and mid-dilated pupil.

**Herpes simplex**
- Skin lesions adjacent to eye, acute follicular conjunctivitis, preauricular lymphadenopathy, punctate epithelial erosion, and dendritic epithelial keratitis. Can compromise natural defense mechanisms of eye and expose conjunctiva to pathological bacteria. Click here for Herpes simplex Diagnostic Test.

**Herpes zoster**
- Vesicles on lid, pain, follicular conjunctivitis, papillary conjunctivitis, punctate epithelial keratitis, and decreased anterior corneal sensation. Can compromise natural defense mechanisms of eye and expose conjunctiva to pathological bacteria.

**Hypersensitivity reaction**
- Itching, unilateral (contact types) or bilateral (exogenous), fluctuating vision, pink to red bulbar conjunctiva, and stringy discharge.

**Keratoconjunctivitis**
- Will have bacterial conjunctivitis symptoms and sign along with the corneal presentation of lack of epithelium, stromal thinning, infiltration under and around ulcer, and edema.

**Lid deformity which leads to corneal exposure**
- Punctate erosions usually over the lower one to two thirds of the cornea.

**Molluscum contagiosum**
- Chronic follicular conjunctivitis not associated with lymphadenopathy. Usually seen in adolescents and young adults with molluscum lesion on lid.

**Ocular rosacea**
- Chronic meibomianitis and recurrent chalazia. Keratitis in 5% of cases

**Pharyngoconjunctival fever**
- Generally children. History of pharyngitis, low grade fever and follicular conjunctivitis. Recent swimming pool and/or hot tub exposure is common.

**Phlyctenular reaction**
- Pinkish-white bulbar nodule, surrounding hyperemia, and a soft, necrotic center will form and slough.

**Pinguecula**
- Long standing history of UV, outdoor, wind, and/or dry climate. Patient will usually notice it for the first time when it becomes inflamed. Will report as "acute onset". A slightly elevated oval or triangular mass with base toward limbus and next to, but not on, the cornea.

**Scleritis**
- Inflammation of scleral, episcleral, and conjunctival blood vessels, mild to extreme pain, and patient history of rheumatoid arthritis.

**Sexually Transmitted Disease (STD)**
- Take a detailed personal history to determine if patient has an STD, has changed sexual partners recently, and perform STD screening test.
Subconjunctival hemorrhage
An "eye bruise". Patient may or may not have a history of trauma, valsala-like maneuvers, or systemic causes. Usually unilateral presentation of flat sheets of uniform red blood with no vessel patterns observed.

Systemic related (Secondary to)
Kawasaki disease - an acute, febrile childhood disease resembling scarlet fever. Patient presents with fever, lethargy, bright red oral mucosa, and bilateral conjunctival congestion.

Leptospirosis - an infection with the spirochete Leptospira.

Stevens-Johnson's syndrome: Generally young healthy males. Papillary conjunctivitis leading to pseudomembrane formation.

Tear film abnormalities
Increase in mucus strands and debris, low Tear Break Up Time, concave or absent marginal tear meniscus.

Trichiasis
Confirm DDX with slit lamp exam.

Toxic reaction
Conjunctival hemorrhages and chemosis. Alkali burns may cause complete blanching of conjunctiva due to destruction of blood vessels.

Vernal Keratoconjunctivitis
Intense itching, recurrent, familial history of allergy, seasonal, burning, photophobia, and stringy mucous discharge.

References B, C, D, F, H, I, J, K, L.

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When to culture?

Microbial cultures are indicated when clinical findings are insufficient to arrive at a diagnosis, when the tissue reaction is severe, or when the infection has not responded to treatment in a suitable time. Indications for culturing include:

1. Hyperacute conjunctivitis
2. Neonatal conjunctivitis (ophthalmia neonatorum)
3. Post-operative conjunctivitis and/or infections, e.g. endophthalmitis.
4. Chronic conjunctivitis
5. Central corneal ulcers
6. Membranous or pseudomembranous conjunctivitis
7. Preseptal or orbital cellulitis
8. Post-traumatic infections

Media Types

**Blood Agar** - Blood agar is the most commonly used medium as it will support the growth of most bacteria. Neisseria and Haemophilus do not grow well on blood agar, however.

**Chocolate Agar** - Used for Neisseria and Haemophilus identification.

**Thayer-Martin Agar** - Used for gonococcal isolation.

**Mannitol Salt Agar** - Used to differentiate between S. epidermidis and S. aureus. S. aureus can ferment the sugar, mannitol, turning the pink agar yellow, whereas S. epidermidis cannot.

**Sabouraud's Agar** - Used for fungal isolation.

**MacConkey Agar** - Contains bile salts and crystal violet which inhibit the growth of gram-positive bacteria. This medium also contains lactose, and thus gram-negative bacteria that can grow on lactose can be differentiated
How to take samples

To compare normal to pathogenic flora, both eyes should be cultured. Whenever possible, specimens should be directly inoculated onto the solid media and promptly delivered to the lab. When this is not feasible, transport media such as the Culturette can be used to keep the bacteria viable until the sample is plated by the lab. The Culturette contains Stuart's medium for transporting specimens.

Obey all universal precautions to prevent infecting yourself or other patients.

Cultures should be taken before the instillation of anesthetics (exception: cornea culture) or antibiotics, as these reduce the number of bacteria in the eye. If antibiotic therapy has already begun, it is necessary to discontinue the antibiotic at least 1 day before culturing.

Eyelid Culture Procedure

1. Clean away any crusts or debris from the lid margins
2. Moisten a cotton swab with unpreserved saline.
3. Pull the lid away from the eye and wipe along the margin of the eyelid. Roll the swab along the lid margin three or four times so that it absorbs some material.
4. Immediately inoculate the media plates.
5. Using the swab from the right eye, place the swab on the agar surface in the lower left quadrant of the plate and slowly streak a capital "R". Material from the left eyelid is streaked as a capital "L" in the lower right quadrant of the plate. Roll the applicator along the surface of the plate. Do not let the applicator dig into the plate or break the surface. Use a separate swab for each sample.
6. Label the sample with the patient's name, doctor's name, time and date of sample.

Conjunctival Culture Procedure

1. The inferior palpebral conjunctiva is the usual site for obtaining conjunctival specimens. Evert the lower lid, pulling it down and away from the eye.
2. Gently roll a moistened applicator along the entire inferior palpebral conjunctiva. Allow the applicator to absorb as much material as possible. Do not rub the conjunctiva and avoid touching the applicator to the lashes, lid margins, or your fingers.
3. Immediately streak a vertical zig-zag pattern in the top left quadrant of the medium plate for the right conjunctiva, and top right quadrant for the left conjunctiva.

Corneal Culture Procedure

1. Instill a topical ophthalmic anesthetic in each eye.
2. Using an alcohol lamp, propane torch, or Bunsen burner, flame a Kimura platinum spatula, heating it for several seconds and allowing it to air cool.
3. Focus on the ulcer using a slit lamp and place the spatula temporarily and tangentially to the corneal lesion. Provide a suitable fixation object for the patient.
4. Using the edge of the spatula, gently scrape the advancing edge and then the ulcer bed, removing only the surface cells. The advancing edge and ulcer bed are separate samples, being plated separately. Always move the spatula in a downward motion away from the eye.
5. Take multiple samples of both areas of the ulcer, flaming the spatula after each sampling. Place the first sample on slides for Gram and Giemsa staining. Next, inoculate blood, chocolate, and Sabouraud's agar plates by lightly streaking the spatula over the surface. Make a minimum of two rows of "C's" with each "C" representing a separate sample. Label the plates. Because of the relatively small number of recoverable bacteria, transport media are not used for corneal ulcer cultures.
Identification Tests

Catalase Test

Used to differentiate Staphylococci from Streptococci. The Staphylococci produce catalase which converts hydrogen peroxide to water and oxygen. The oxygen will be seen as bubbles when the staph are exposed to hydrogen peroxide.

Coagulate Test

Used to differentiate S. aureus from S. epidermidis. S. aureus is coagulase positive; that is, it produces an enzyme that has the ability to form a clot in normal uncoagulated plasma. S. epidermidis is coagulase negative.

Bacterial antibiotics sensitivity studies

Discs containing antibiotics are placed on the blood agar plates once the growth of the microorganisms has been identified. The zones of growth inhibition around each disc are measured, indicating each antibiotic’s effectiveness.

Diagnostic identification tests for Chlamydia and Herpes simplex virus I and II.

Instill a topical anesthetic and swab inferior and superior palpebral conjunctiva of each eye with swabs prewetted with Schaudler’s broth. To test for Chlamydia, roll a swab onto slides for a direct immunofluorescent monoclonal antibody staining test and then place in Chlamydial transport media. To test for Herpes simplex virus types I and II, roll another swab onto slides for a direct immunofluorescent monoclonal antibody staining test and then place in viral transport media.

Slides for direct immunofluorescent monoclonal antibody staining are air-dried and then fixed with water-free acetone. Slides are then refrigerated at 4°C and processed within 48 hours. A total of 30ml of fluorescein-conjugated monoclonal antibody to Chlamydia or herpes simplex virus types I and II are then pipetted onto the appropriate specimen, which is kept within a humidified chamber at room temperature for 15 minutes, rinsed with water, and air-dried. Slides are read at X400 magnification under oil immersion by fluorescent microscopy. A specimen was considered positive for Chlamydia if three or more typical elementary bodies were identified and positive for herpes simplex virus if one or more typical inclusions were noted.

Chlamydial transport vials are then immediately frozen to -70°C. Specimens are thawed within 48 hours and inoculated onto monkey kidney-McCoy cell monolayers in microtiter plates as previously described. One set of duplicate wells are stained at two days (first passage), and another set passed at two days ten stained at four days (second passage) with fluorescein-conjugated monoclonal antibody to Chlamydia. Specimens are examined at X400 magnification and scored positive if one or more typical inclusion bodies are found.

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