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The Evaluation of Anti-Adenoviral Therapeutic Agents for Use in Acute Conjunctivitis

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1. Introduction

External ocular infections caused by adenoviruses are among the most common eye infections seen worldwide. They lead to highly infectious community epidemics, seasonal outbreaks, lost productivity, significant patient discomfort and in some cases permanent visual compromise from long-term immune-mediated sequelae[1]. Though several therapeutic agents have been evaluated for acute viral conjunctivitis in both animal models and human trials, none to date have been approved for therapeutic use in humans[2,3,4]. Both bacterial and viral pathogens cause acute infectious diseases of the ocular surface with similar clinical presentation. Key differences exist in the mechanism, host response and epidemiology of each etiologic agent. Consideration of these differences shapes our approach to treatment and our approach to the evaluation of therapeutic agents in clinical trials.

2. Clinical features of bacterial and adenoviral conjunctivitis

All acute conjunctivities share some common clinical features that aid in the design of appropriate clinical evaluations. Most cases involve conjunctival hyperemia with varying chemosis, some component of ocular discharge and a constellation of symptoms that can include foreign body sensation, pain and itching. A recent evidence-based review[5] examined several databases, including the Cochrane Controlled Trials Register, along with standard ophthalmology texts and concluded that signs and symptoms of acute bacterial and acute viral conjunctivitis are essentially identical. Measurement of the resolution of these symptoms is an essential part of the clinical evaluation of agents for use in acute conjunctivitis of any etiology. Analogy can be made with bacterial conjunctivitis for the clinical signs and symptoms of viral infection, and this analogy can guide in the selection of clinical endpoints. For this reason, the use of similar clinical criteria for one of the primary efficacy endpoints in both viral and bacterial clinical trials is suggested.

3. Differences in bacterial and adenoviral relationship to the healthy ocular surface

Bacterial conjunctivitis is commonly caused by normal ocular surface flora[6]. When the balance between host defense and microbial colonization on the ocular surface is somehow disrupted, the commensal relationship can proceed to frank infection[7]. Key factors that

affect this pathogenic conversion appear to be related both to host defense compromise and specific bacterial species present[8].

In contradistinction to bacteria, adenovirus species are not typically found among the normal ocular flora[9,10,11]. A definitive study employing tissue culture in ocular swab samples obtained from the conjuntival fornicies was unable to demonstrate the presence of adenovirus from even a single sample of over 200 collected in asyptomatic patients presenting for routine eye exam[12]. The absence of adenoviral colonization was similarly demonstrated in conjunctival specimens studied by tissue culture obtained from a series of patients with symptoms of non-infectious keratoconjunctivitis sicca[13]. The presence of adenovirus on the ocular surface would seem to indicate active or recent convalescent infection. This is a critical difference between bacterial and adenoviral conjunctivitis and must be considered when selecting efficacy endpoints for the evaluation of therapeutic agents. Anti-bacterials can clearly demonstrate their clinical utility by simply showing the resolution of clinical signs and symptoms in a shorter time period than would be expected with non-intervention. There is no need to show elimination of bacterial colonization as bacterial sterility is not a feature of the healthy ocular surface. Bacterial conjunctivitis is a much rarer cause of community outbreaks and is less likely to be associated with person-to-person transmission. Described below is the very different behavior of viral conjunctivitis and the relationship between transmissibility and viral shedding.

4. Viral transmission and shedding

The differences in the transmissibility of bacterial and viral conjunctivitities merit careful consideration. Ocular adenoviral infection represents a significant public health problem in the US and worldwide[14, 15] Although exact numbers are difficult to determine, estimates from a US survey of outpatient health encounters[4,9], comparison with epidemiological surveys completed in outside the US[15] and studies of incidence in military recruits[16] suggest that the number of cases of viral conjunctivitis may be as high as 15-20 million per year in the United States. Adenovirus conjunctivitis is a reportable infection in Germany[17] and is classified as a Category IV infectious disease by Japan's National Epidemiological Surveillance of Infectious Diseases (NESID) with mandated collection, analysis and publication of reports on occurrences[18].

Adenoviral transmission between infected and uninfected hosts is particularly efficient in areas of high population density, overcrowding or poor hygiene[19]. Studies on the rate of[20] horizontal transmission to asymptomatic family members and close contacts suggest transmissibility of up to 50%[21,22,23]. Adenovirus is spread through droplets from the respiratory tract, stool, saliva and tears. Through a process known as viral shedding, infectious particles are transferred from the extracellular environment of lytic infected cells through a variety of fomites[24]. Adenoviral particles, presumably shed from infected patients, have been isolated from multi-dose ophthalmic medications and diagnostic solutions[25,26] Recovery of infectious adenovirus has been reported from samples obtained from inanimate hard surfaces and objects for up to 49 days[27,28]. Actively infected persons readily transmit adenoviruses. Viral shedding persists for 12-14 days after onset of clinical signs and symptoms. Transmission can be prevented by personal hygiene measures including frequent handwashing; cleaning of towels, pillowcases and handkerchiefs; and disposal of contaminated facial tissues. Patients with adenoviral conjunctivitis may shed virus to these objects which can in turn infect other hosts Individuals who work with the public, in

schools, or in healthcare facilities in particular should consider a temporary leave of absence from work to prevent infection of others, especially those who are already ill[29]. This is common in hospital and clinic settings and can lead to systemic disease with or without conjunctivitis, particularly in immunocompromised patients[30]. The most effective measures for limiting the severity of adenoviral conjunctivitis outbreaks rely on reducing the contamination of objects, workspaces and surfaces by aggressive steps to remove shed virus particles[31,32]. It follows that reducing shedding at the source - the infected ocular surface- would be a highly effective strategy for epidemic prevention and control.

The clear relationship between shedding virus and infectivity necessarily affects our therapeutic options and our therapeutic requirements in acute viral conjunctivitis. The additional burden is placed on the evaluation of anti-adenoviral agents given their devastating potential to cause outbreaks. Proposed therapeutic agents should aim for a reduction in viral shedding in addition to the resolution of clinical symptoms. An evaluation of efficacy that incorporates both reduced viral infectivity and improvement in symptoms is required to fully demonstrate the utility of any proposed anti-adenoviral therapeutic agent.

Similar patterns of epidemic spread, droplet transmission and shedding are not typical features of bacterial conjunctivitis, though outbreaks have been reported in humans[33] and vector-dependent spread confirmed in animal models[34,35,36]. Bacterial conjunctivitis is a much less likely cause of outbreaks and is not a significant public health challenge (we acknowledge the enormous importance of bacterial conjunctivitis caused by *C. Trachoma* and defer its discussion as it is more commonly a chronic, endemic, recurrent infection with a distinct clinical course)[37]. Though vertical transmission remains an important aspect of neonatal bacterial conjunctivitis, these cases are rare in the industrialized world and do not share the features of epidemic infection. Furthermore neonatal conjunctivitis passed intra-partum from mother to newborn is easily eliminated through ocular administration of povidone-iodine at the time of birth[38].

5. Ocular immune response in bacterial and adenoviral infections

Components of both the innate and adaptive acquired immune systems play important roles in ocular defense.[39] While the predominantly extracellular bacterial pathogens are more effectively controlled by the innate ocular defense mechanisms, viral infections often lead to a more prolonged course. Viral exposures frequently involve a more robust acquired immune cascade with significant inflammatory damage[4041,42]. It is precisely this exuberant immune reaction that leads to the signs and symptoms of viral conjunctivitis and immune-mediated sequelae. It is often clinically beneficial to temper the ocular immune response in both viral and bacterial infections, with topical steroids frequently the agents of choice. Steroids have well characterized effects on both innate and adaptive immunity. The features of the immune responses to viral and bacterial pathogens need to be considered along with the relative effects of steroid on each system: Steroids have a more dramatic inhibitory effect on the adaptive system, and this is precisely the system that is most important at eliminating viral infections. In expected that steroids would have less of an effect on the eye's ability to counter bacterial pathogens than they would on the elimination of viral organisms. It has been demonstrated that co-administration of potent topical steroids along with antibiotics does not lead to higher bacterial counts (measured as CFU's)[43] in the normal bacterial conjunctival flora.

It has been repeatedly shown in ocular adenoviral infection that use of topical steroids can prolong the duration of viral shedding and therefore lengthen the period of transmissibility in these cases[44]. It is for this reason that topical steroid monotherapy in ocular adenovirus infections is ill-advised. It is well known that a short course of topical corticosteroids (and in some severe cases oral steroids) can limit patient discomfort and prevent some immune-related inflammatory complications of acute viral conjunctivitis. While this strategy may have some efficacy in the short-term amelioration of symptoms, even a short course of relatively low-potency corticosteroids without the addition of a suitable anti-viral agent can increase the duration of viral shedding and prolong the infectivity of affected patients[45]. The addition of topical steroids cripples the eye's immune response to viral pathogens. The effect on the ability to effectively clear viral infections is so pronounced that the addition of topical steroids can even reverse the effect of the most potent anti-virals[46]. This in turn can potentiate the occurrence of community outbreaks and epidemic transmission in schools, places of business and medical facilities[47]. As described above, this additionally requires that effects on infectivity be considered along with symptom resolution in the clinical evaluation of anti-adenoviral therapies[48].

6. Detection of adenoviral infectivity

There are several techniques available for the detection of adenovirus from ocular specimens. Despite recent advances in nucleic acid-based detection and the availability of a rapid point-of-care immunochromatographic tests for the presence of specific viral components, cell culture remains the only reliable method for the demonstration of viable, infectious virus.

Cell culture with confirmatory immunofluorescence (CC-IFA) is a highly sensitive and specific test and is considered the "gold standard" for the recovery of infectious virus from ocular samples. CC-IFA requires the presence of infectious virus and demonstrates unequivocally the ability of the recovered virus to cause a cytopathic effect (CPE) in a living cell. When combined with immunoflourescent staining, it provides a means to determine the presence, infectivity and identity of a viral specimen.

A sample from a conjunctival swab is inoculated in susceptible cell line and followed over time to measure the cytopathic effects (CPE). The "Shell Vial Culture" method is a specific cell culture technique that enables more rapid identification of CPE[49]. This test utilizes shell vials, centrifugation and visualization of adenovirus proteins inside host cells through binding of fluorescent dye. Shell vials are glass culture tubes that contain a coverslip coated with an A549 cell monolayer. The culture tube is inoculated with the clinical specimen and the tube is centrifuged at low speed and incubated. It is hypothesized that the centrifugation enhances the adenoviral entry into the susceptible cells. The visualization technique is indirect, where a secondary antibody labeled with fluorochrome is used to recognize a primary antibody directed towards a conserved adenoviral epitope. This test significantly shortens the time requirement and enhances the sensitivity and specificity. Positive results can be obtained from the visualization of even a single brightly stained cell, confirming that the adenoviral particles were capable of entering a cell, uncoating, replicating and producing infectious prodigy virions. In this way CC-IFA in general and the Shell Vial method specifically provide an unequivocal way to determine the infectivity of an ocular specimen. It is for this reason that we propose assessment of infectivity by CC-IFA as a second primary endpoint for clinical trials designed to evaluate the efficacy of anti-adenoviral therapeutic agents.

Single Active Ingredient Antibiotic Drugs
Besifloxacin (Besivance)
Ciprofloxacin (Ciloxan)
Neomycin (NeoSporin)
Erythromycin (Ilotycin)
Gatifloxacin (Zymar)
Tobramycin (AK_Tob, Tobrex)
Gentamycin (Gentak, Gentasol)
Moxifloxacin (Vigamox)
Polymyxin B and trimethoprim (Polytrim)
Bacitracin (Ak-Tracin, Bacitcin)
Ofloxacin (Ocuflox)
Sulfacetamide (Cetamide, Ocusulf_10)
Combination Antibiotic-Steroid Drugs
Tobramycin and dexamethasone (Tbradex)
betamethasone and neomycin
dexamethasone and neomycin/ polymixin B (Maxitrol)
Loteprednol / tobramycin (Zylet)
Prednisolone/polymyxin B/neomycin (PolyPred)
Prednisolone/gentamycin (PredG)
Prednisolone / sulfacetamide (Blephamide)

Though all of the above are commonly used to treat viral and bacterial conjunctivitis, none are approved by the FDA for use in acute viral conjunctivitis.

Table 1. Drugs commonly used to treat acute conjunctivitis

7. Proposed clinial study design for demonstrating utility of therapeutic agents in acute adenoviral conjunctivitis

The ideal treatment for adenoviral conjunctivitis would alleviate patient symptoms, resolve clinical signs, decrease inflammatory damage, shorten the clinical course of infection, reduce the duration of viral shedding and decrease the period of infectivity. The evaluation of all therapeutic agents for use in adenoviral conjunctivitis should include analysis of clinical and infectious parameters and consider effects on the individual patient and the community as a whole. The use of separate primary efficacy endpoints is proposed that can demonstrate the following:

1. Resolution of signs and symptoms associated with viral conjunctivitis.
2. Decrease in infectious viral shedding measured by CC-IFA at the test-of-cure visit.

Resolution of signs and symptoms of the disease is the most clinically meaningful assessment and derives from the similar clinical features shared by acute bacterial and acute viral conjunctivitis. Particularly from the patient's individual perspective, the resolution of signs and symptoms is the most important clinical outcome. Much can be learned and

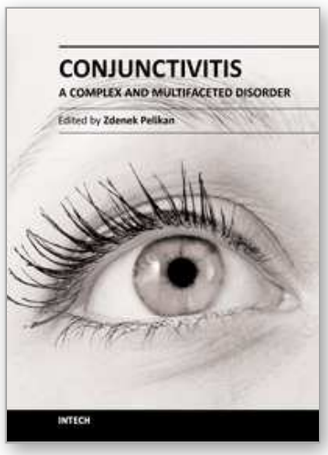
borrowed from the myriad experience gained over decades of clinical trials in bacterial conjunctivitis. The use of standardized conjunctivial grading, scaled scoring for ocular discharge and conjunctival injection all have application in both bacterial and viral disease.
The required analysis of viral shedding, which derives from the differences in transmission between bacterial and viral conjunctivitis, is important to ensure that symptomatic relief in individuals doesn't lead to prolonged infectivity. The ideal therapeutic will radpidly decrease viral loads and shorten the overall length of time that active, replicating virus can be isolated from the ocular surface. This will ensure that the simple masking of symptoms cannot be substituted for a true viral cure. Though indivdual subjects may improve on symptom-alleviating therapy only, the requirement to reduce infectivity should ensure that no agents gain approval that could potentially lengthen epidemics or threaten the public health.
The requirement for all proposed agents to satisfy both of these endpoints is the most effective way to ensure that proposed ant-adenoviral therapies address both the infectious and inflammatory consequences of the disease.

8. References

[1] Ford E, Nelson KE, Warren D. Epidemiology of epidemic keratoconjunctivitis. *Epidemiol Rev,* 1987; 9:244–61.
[2] Hillenkamp J, Reinhard T, Ross R, *et. al*., The effects of cidofovir 1% with and without cyclosporin A 1% as a topical treatment of acute adenoviral keratoconjunctivitis : A controlled clinical pilot study. *Ophthalmology,* 2002; (5):845-850.
[3] Teuchner B, Nagl M, Schidlbauer A, *et. al*., Tolerability and efficacy of N-Chlorotaurine in epidemic keratoconjunctivitis—a double-blind, randomized, phase-2 clinical trial. *J Ocul Therapeut,* 2005; 21:157-164.
[4] Romanowski EG, Gordon YJ. Efficacy of topical cidofovir on multiple adenoviral serotypes in the New Zealand rabbit ocular model. *Invest Ophthalmol Vis Sci,* 2000; 41:460–3.
[5] Rietveld RP, van Weert HC, ter Riet G, Bindels PJ. Diagnostic impact of signs and symptoms in acute infectious conjunctivitis: systematic literature search. *BMJ.* Oct 4 2003;327(7418):789.
[6] Tabbara KF, Hyndiuk RA. *Infections of the Eye*. Little, Brown;1996.
[7] Smolin and Thoft's The Cornea: Scientific Foundations and Clinical Practice, 4th ed. Philadelphia: Lippincott Williams and Wilkins; 2005.
[8] Watanabe K, Watanabe KM, Hayasaka S. Methicilin-resistant Staphylococci and ofloxacin-resistant bacteria from clinically healthy conjunctivas. *Ophthalmic Res* 2001; 33: 136–139.
[9] Kaneko H, Maruko I, Iida T, et al. The possibility of human adenovirus detection from the conjunctiva in asymptomatic cases during nosocomial infection. *Cornea.* Jun 2008;27(5):527-530.
[10] Alvaregna L, Scarpi M, Mannis MJ. "Viral Conjunctivitis" In: Krachmer JH, Mannis MJ, Holland EJ.(eds.) Cornea (Vol.1): Fundamentals, Diagnosis, Management. 2nd Edition, Elsevier, Philadelphia, 2005, 629-639.
[11] Vastine D, Schwartz H, Yamashiroya H, Smith R, Guth S. Cytologic diagnosis of adenoviral epidemic keratoconjunctivitis by direct immunofluorescence. *Invest. Ophthalmol. Vis. Sci.* March 1, 1977 1977;16(3):195-200.

[12] Cambon E, Pollard M. Viral Studies of the Normal Eye *Arch Ophthalmol*, Oct 1959; 62: 562 - 565.
[13] Studies of the viral flora in keratoconjunctivitis sicca. *Br J Ophthalmol*. 1975 January; 59(1): 45–46.
[14] Ishii K, Nakazono N, Fujinaga K, et al. Comparative studies on aetiology and epidemiology of viral conjunctivitis in three countries of East Asia--Japan, Taiwan and South Korea. *Int J Epidemiol.* Mar 1987;16(1):98-103.
[15] D'Angelo LJ, Hierholzer JC, Holman RC, Smith JD. Epidemic keratoconjunctivitis caused by adenovirus type 8: epidemiologic and laboratory aspects of a large outbreak. *Am J Epidemiol.* Jan 1981;113(1):44-49.
[16] Heggie, AD. Incidence and etiology of conjunctivitis in Navy recruits. *Mil Med* 1990;155:1-3.
[17] Schrauder A, Altmann D, Laude G, Claus H, Wegner K, Köhler R, Habicht-Thomas H, Krause G. Epidemic conjunctivitis in Germany, 2004. *Euro Surveill*. 2006;11
[18] Aoki K, Tagawa Y. A twenty-one year surveillance of adenoviral conjunctivitis in Sapporo, Japan. *Int Ophthalmol Clin.* Winter 2002;42(1):49-54.
[19] Maranhao AG, Soares CC, Albuquerque MC, Santos N. Molecular epidemiology of adenovirus conjunctivitis in Rio de Janeiro, Brazil, between 2004 and 2007. *Revista do Instituto de Medicina Tropical de Sao Paulo.* Jul-Aug 2009;51(4):227-229.
[20] Cheung D, Bremner J, Chan JT. Epidemic kerato-conjunctivitis--do outbreaks have to be epidemic? *Eye.* Apr 2003;17(3):356-363.
[21] Schrauder A, Altmann D, Laude G, et al. Epidemic conjunctivitis in Germany, 2004. *Euro Surveill.* Jul 2006;11(7):185-187.
[22] Schepetiuk SK, Norton R, Kok T, Irving LG. Outbreak of adenovirus type 4 conjunctivitis in South Australia. *J Med Virol.* Dec 1993;41(4):316-318.
[23] Dawson CR, Hanna L, Wood TR, Despain R. Adenovirus type 8 keratoconjunctivitis in the United States. 3. Epidemiologic, clinical, and microbiologic features. *Am J Ophthalmol.* Mar 1970;69(3):473-480.
[24] Warren D, Nelson KE, Farrar JA, et al. A large outbreak of epidemic keratoconjunctivitis: problems in controlling nosocomial spread. *J Infect Dis.* Dec 1989;160(6):938-943.
[25] R. Kowalski, E. Romanowski, B. Waikhom, Y. Gordon The survival of adenovirus in multidose bottles of topical fluorescein. *Am J Ophthalmol*, 126:835-836
[26] Uchio E, Ishikio H, Aoki K, Ohno S. *Am J Ophthalmol* 2002, 134; 618-619.
[27] Nauheim RC, Romanowski EG, Araullo-Cruz T, et al. Prolonged recoverability of desiccated adenovirus type 19 from various surfaces. *Ophthalmology.* Nov 1990;97(11):1450-1453.
[28] Gordon YJ, Gordon RY, Romanowski E, Araullo-Cruz TP. Prolonged recovery of desiccated adenoviral serotypes 5, 8, and 19 from plastic and metal surfaces in vitro. *Ophthalmology.* Dec 1993;100(12):1835-1839; discussion 1839-1840.
[29] *External Disease and Cornea.* Basic and Clinical Science Course, 2004-2005. Section 8. San Francisco, Calif: American Academy of Ophthalmology; 2005:130–134.
[30] Hierholzer JC. Adenoviruses in the immunocompromised host. *Clin Microbiol Rev.* Jul 1992;5(3):262-274.

[31] Dart JKG, El-Amir AN, Maddison T et. al. Identification and control of nosocomial adenovirus keratoconjunctivitis in an ophthalmic department. *Br J Ophthalmo*200; 93: 918-920.
[32] Gottsch, J.D., Froggatt, J.W. III, Smith, D.M., et al. Prevention and control of epidemic keratoconjunctivitis in a teaching eye institute. *Ophthalmic Epidemiol*. 6:29–39, 1999.
[33] Dawson CR. Epidemic Koch-Weeks conjunctivitis and trachoma in the Coachella Valley of California. *Am J Ophthalmol* 1960;49:801-8
[34] Payne WJ Jr, Cole JR Jr, Snoddy EL, Seibold HR. The eye gnat Hippelates pusio as a vector of bacterial conjunctivitis using rabbits as an animal model. *J Med Entomol* 1977;13:599-603.
[35] The California eye gnat. *Science* 1929;69:14
[36] Dow RP, Hines VD. Conjunctivitis in Southwest Georgia. *Public Health Rep* 1957;72:441-8.
[37] World Health Organization (2003) Report of the 2nd global scientific meeting on trachoma. WHO/PBD/GET 03.1.
[38] Isenberg SJ, Apt L, Wood MA. A controlled trial of povidone-iodine as prophylaxis against ophthalmia neonatorum. *New England J Med,* 1995; 332:562-566.
[39] Mannis MJ, Smolin G. "Natural defense mechanisms of the ocular surface." In: Pepose JS, Holland GN, Wilhelmeus KR (eds.) Ocular Infection and Immunity. Mosby; St. Louis, MO, 1996, 185-190.
[40] Knop, E. and N. Knop, Anatomy and immunology of the ocular surface. *Chem Immunol Allergy*, 2007. 92: p. 36-49
[41] Smolin and Thoft's The Cornea: Scientific Foundations and Clinical Practice, 4th ed. Philadelphia: Lippincott Williams and Wilkins; 2005.
[42] Akpek, E.K. and J.D. Gottsch, Immune defense at the ocular surface. *Eye*, 2003. 17(8): p. 949-56
[43] Ermis SS, Aktepe OC, Inan UU, Ozturk F et. al. Effect of topical dexamethasone and ciprofloxacin on bacterial flora of healthy conjunctiva. *Eye*, 2004; 18: 249-252.
[44] Gordon YJ, Araullo-Cruz T, Romanowski EG. The effects of topical nonsteroidal anti-inflammatory drugs on adenoviral replication. *Arch Ophthalmol*. 1998; 116: 900-905.
[45] Romanowski EG. Yates KA. Gordon YJ. Short-term treatment with a potent topical corticosteroid of an acute ocular adenoviral infection in the New Zealand white rabbit. *Cornea* 2001; 20(6):657-60.
[46] Romanowski EG, Araullo-Cruz T, Gordon YJ. Topical corticosteroids reverse the antiviral effect of topical cidofovir in the Ad5-inoculated New Zealand rabbit ocular model. *Invest Ophthalmol Vis Sci.* Jan 1997;38(1):253-257.
[47] Romanowski EG, Roba LA, Wiley L, Araullo-Cruz T, Gordon YJ. The effects of corticosteroids on adenoviral replication. *Arch Ophthalmol,* 1996; 114:581-585
[48] Romanowski EG. Yates KA. Gordon YJ. Short-term treatment with a potent topical corticosteroid of an acute ocular adenoviral infection in the New Zealand white rabbit. *Cornea* 2001; 20(6):657-60.
[49] Kowalski RP, Karenchak LM, Romanowski EG, Gordon YJ. Evaluation of the shell vial technique for detection of ocular adenovirus *Ophthalmology*,106: 1324-1327.



Conjunctivitis - A Complex and Multifaceted Disorder
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This book presents a number of interesting and useful aspects and facets concerning the clinical features, properties and therapeutical management of this condition. Dr. H. Mejía-López et al. present an interesting survey of the world-wide epidemiologic aspects of infectious conjunctivitis. Dr. U. Ubani evaluates conjunctival symptoms/signs participating in the clinical features of this disorder. Dr. A. Robles-Contreras et al. discuss immunologic aspects underlying possibly the conjunctivitis. Dr. Z. Pelikan presents the cytologic and concentration changes of some mediators and cytokines in the tears accompanying the secondary conjunctival response induced by the nasal challenge with allergen. Dr. S. Sahoo et al. summarize the treatment and pharmacologic control of particular clinical forms of conjunctivitis in general practice. Dr. S. Leonardi et al. explain the basic pharmacologic effects of leukotriene antagonists and their use for the treatment of allergic conjunctivitis. Dr. J.A. Capriotti et al. evaluate the therapeutical effects of various anti-adenoviral agents on the acute conjunctivitis caused by adenovirus. Dr. V. Vanzzini-Zago et al. assess the prophylactic use and efficacy of "povidone-iodium solution", prior the ocular surgery. Dr. F. Abazi et al. present the clinical features, diagnostic and therapeutical aspects of "neonatal conjunctivitis". Dr. I.A. Chaudhry et al. review the special sub-form of conjunctivitis, being a part of the "Trachoma". Dr. B. Kwiatkowska and Dr. M. Maślińska describe the clinical, pathophysiologic and immunologic features of conjunctivitis. Dr. S. Naem reviews the conjunctivitis form caused by Thelazia nematodes, occurring principally in animals.

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