Contact Lens and Anterior Eye 42 (2019) 679–684

Contents lists available at ScienceDirect

Contact Lens and Anterior Eye

journal homepage: www.elsevier.com/locate/clae

Viral conjunctivitis: a retrospective study in an Australian hospital

Emmanuel Marinos[a,*], Maria Cabrera-Aguas[b], Stephanie Louise Watson[b]

[a] The University of Sydney, Sydney, New South Wales, Australia
[b] The University of Sydney, Save Sight Institute, Discipline of Ophthalmology, Sydney Medical School, Sydney, New South Wales, Australia

ARTICLE INFO

Keywords:
Conjunctivitis
Viral conjunctivitis
Adenovirus
Contact lens
Herpes simplex virus

ABSTRACT

Importance: To update the literature on the current trends of viral conjunctivitis infections in Sydney, Australia.
Background: To find correlations between viral and patient characteristics on disease outcomes and to assess the rates of antibiotic and steroid use in patients with viral conjunctivitis prior to and after assessment by ophthalmology trainees.
Design: Retrospective single-centre case series.
Participants: 368 eyes of 224 patients diagnosed with viral conjunctivitis at the Sydney Eye Hospital from 1 st January - 31 st March 2017.
Methods: Patients were identified from hospital records or polymerase chain reaction results.
Results: 368 eyes of 224 patients, median age 35.3 (range 7–82) and 59.8% males, were included. 152 (67.9%) patients presented already on antibiotic treatment. Most patients (83.5%) had no previous ocular history aside from 35 (15.6%) who were regular contact lens wearers. PCR was performed in 170 (75.9%) patients, with 92 (54.1%) positive for adenovirus, and 7 (4.1%) for HSV. The average duration of symptoms prior to presentation was 6.3 days. 177 (78.0%) patients presented within 1 week of symptom onset and these patients were more likely to be adenovirus positive on PCR (OR = 2.37). Patients with symptoms of longer duration were more likely to have photophobia (OR = 2.96) and have had steroid treatment (OR = 3.80).
Conclusions and relevance: Patients with viral conjunctivitis typically presented within a week of symptom onset, with bilateral disease and on topical antibiotics. Pseudomembranes and a palpable preauricular lymph node were not common. As treatments emerge for viral conjunctivitis patients may need to be encouraged to present earlier.

1. Introduction

Conjunctivitis is one of the most common ophthalmic presentations to the emergency department (ED) both in Australia and across the globe. It affects patients across all age groups and of any socioeconomic class [1]. Viral conjunctivitis is the most common cause of infectious conjunctivitis, accounting for 60–75% of cases [2,3]. It also has a considerable economic and societal impact due to a range of factors. These include the direct costs of general practitioner and emergency department visits, the costs of diagnostic tests and prescription treatments, and indirect costs associated with loss of work or time away from school or university [3].

There have been very few epidemiological studies on patterns of viral conjunctivitis in Australia in the past 30 years [4–6]. To date, no sex predilection for viral conjunctivitis has been found [7], however some subtypes of adenoviral conjunctivitis are more common in younger age groups [8]. Weather also appears to affect the incidence of adenoviral conjunctivitis, with outbreaks in Australia, China, and the United States tending to occur more frequently in the summer months [9]. While contact lens wear is known to be the single largest risk factor for microbial keratitis [10], there is no current evidence to suggest that contact lens wear is an independent risk factor for developing viral conjunctivitis. Diagnosis of viral conjunctivitis is based on clinical and laboratory findings. However, clinical diagnosis of adenoviral conjunctivitis has been shown to be unreliable particularly in primary care settings, with an inaccuracy rate of 50% when compared with laboratory-confirmed diagnoses [11]. Additionally, it has been difficult to clinically differentiate between follicular conjunctivitis caused by adenovirus, herpes simplex virus (HSV), varicella zoster virus (VZV), *Chlamydia trachomatis*, ocular surface medicamentosa, and ocular rosacea [12]. Correct and early identification of aetiology allows appropriate treatment and the avoidance of longer-term complications.

One of the most significant costs of viral conjunctivitis arises from prescription antibiotics [3]. In the Netherlands, around US $10.9

* Corresponding author.
E-mail address: Emmanuel.marinos@gmail.com (E. Marinos).

https://doi.org/10.1016/j.clae.2019.07.001
Received 3 March 2019; Received in revised form 3 July 2019; Accepted 3 July 2019

million dollars was spent in a single year on topical antibiotic eye drops, while the British National Health System spends around US $8.7 million per year [13]. In the United Kingdom, rates of antibiotic treatment for patients with infectious conjunctivitis by general practitioners are estimated to be between 80% and 95% [14,15]. In the United States, improved diagnostic rates of viral conjunctivitis is estimated to reduce the number of inappropriate antibiotic prescriptions by over 1 million and provide savings of US $430 million per year [3]. Similar rates of antibiotic prescribing is seen across other developed countries [3,12]. Currently specific treatments for viral conjunctivitis are being evaluated in clinical trials and once available will likely impact antibiotic use [16].

Our aim was to analyse recent trends in epidemiology, clinical signs and symptoms, PCR results, and treatment strategies for viral conjunctivitis patients. Through this analysis, we tried to identify any predisposing factors and any correlations between clinical signs, viral aetiology, and treatment strategies. In particular, we have presented data on antibiotic and corticosteroid use in these patients.

2. Methods

A retrospective case series was conducted of all patients presenting to the Sydney Eye Hospital Emergency Department with viral conjunctivitis from January 1, 2017 – March 31, 2017. The Sydney Eye Hospital is a quaternary referral ophthalmology hospital located in the central business district of Sydney, NSW Australia. A search of the electronic medical records was performed to identify all emergency department presentations within the three-month period. Encounters were selected in which the diagnosis entered was 'conjunctivitis' or 'viral conjunctivitis'. The electronic medical records of each of these encounters was analysed to ensure that the primary diagnosis was viral conjunctivitis. Entries with other primary diagnoses (e.g. bacterial conjunctivitis, allergic conjunctivitis, keratitis) were excluded. If there were multiple equivocal primary diagnoses that included viral conjunctivitis, these were also included. Encounters which demonstrated bacterial infection on PCR testing (either at their initial assessment or at any follow-up visits at the Sydney Eye Hospital) were also excluded. All PCR tests entered in this same period from the emergency department which had a positive result for adenovirus were obtained and their respective encounters included in the study. The decision to perform PCR analysis was made at the discretion of the treating medical officer. In cases in which there was a clinical suspicion, bacterial swabs in addition to PCR for *Chlamydia trachomatis* and *Neisseria gonorrhoea* were also taken. All patients were seen by unaccredited or accredited ophthalmology trainees working in the Sydney Eye Hospital Emergency Department. The minimum required level of training was at least two post-graduate years of medical training for all medical officers working in the emergency department. Medical officers who were not on the training program were required to an accredited registrar review the patient also before a diagnosis was made and a treatment plan formulated. The study was approved by the South Eastern Sydney Local Health District Human Research Ethics Committee (HREC Reference Number: 18/011).

De-identified data was obtained and entered into a private REDCap (Research Electronic Data Capture) database and stored on The University of Sydney server. Data collected from the medical records included patient demographics, prior treatment, current symptoms, past ocular and medical history, medications and allergies, objective examination signs, visual acuity, intraocular pressure (IOP), PCR results, and prescribed treatment. Visual acuity was converted from Snellen readings to logMAR units. IOP was measured using the Icare® TAO1i tonometer. Severity of signs such as conjunctival hyperaemia/injection and the presence of follicles or papillae were entered as mild, moderate, or severe according to the documentation of clinical signs in the patient records. Where no gradings were described, or findings represented pictorially, no grading was entered. For patients with bilateral but asymmetric disease, the higher level of sign severity from each eye was recorded. Entries from the medical officer, triage nurse, and examination nurse were analysed. Where discrepancies were found, preference was given to information entered by the medical officer. All patients examined by medical officers underwent a complete anterior segment examination including lid eversion and corneal examination with fluorescein staining.

Descriptive statistics summarised the socio-demographic, clinical characteristics, pathology, treatment for this case series. Statistical evaluation of quantitative differences between unaffected and affected eyes in patients was calculated with two sample paired t-tests (one-tailed) for means using GraphPad Prism (GraphPad Software, Inc. San Diego, CA, USA). Significance was set at $p < 0.05$. Binary qualitative subgroup analyses were calculated using odds ratios. All subgroups were compared against each other. Characteristics which were analysed as such were: symptom duration, contact lens wear, photophobia, PCR testing, adenoviral positive PCR result, hyperaemia, presence of follicles, presence of papillae, presence of preauricular lymph nodes, prescription of topical antibiotics from ED, prescription of topical steroids from ED.

3. Results

3.1. Demographics

368 eyes of 224 patients with a mean age 38.1 years and median age 35.3 (range 7–82) and 59.8% males, were included over the 3-month study period. The average age for males was 36.9 years and 39.3 years for females. Table 1 summarises the demographics of the included patients. 101 patients presented in January, 55 in February, and 68 in March.

3.2. Ocular history

37 patients (16.5%) had a prior ocular condition, most commonly a corneal pathology. Contact lens wear was recorded in 35 (15.6%) patients. 23 (10.3%) patients reported recent contact with someone with a red eye. Past ocular history is detailed in Table 2.

The majority of patients (n = 181, 80.8%) had commenced a treatment prior to presentation to the Sydney Eye Hospital. This was most commonly antibiotics (n = 152, 67.9%), of which most were topical eye drops (n = 131, 58.4%). Topical steroids were given to 22 (9.8%) patients (Table 3).

3.3. PCR results

PCR was performed in 170 (75.9%) patients. 137 (78.7%) of patients with symptom duration less than 1 week were tested with PCR compared with 33 (66.0%) patients with symptom duration greater than 1 week. 92 (41.1% of total, 54.1% of those tested) were positive for adenovirus and 7 (3.1% of total, 4.1% of those tested) were positive for herpes simplex virus (HSV). No patients were positive for varicella zoster virus (VZV).

Table 1
Demographics for patients with viral conjunctivitis at the Sydney Eye Hospital from January 1, 2017 – March 31, 2017.

Characteristic	n = 224	(%)
Sex:		
Male	134	59.8
Female	90	40.2
Age (years):		
Average	38.1	
Median	35.3	
Range	7 - 82	

Table 2
Ocular history in patients with viral conjunctivitis. Note: in 8 cases, the contact lens type was not recorded.

Characteristic	n = 224	(%)
Prior ocular condition:		
None	187	83.5
Corneal disease	10	4.5
Retinal disease	9	4.0
Dry eyes / blepharitis	5	2.2
Glaucoma	5	2.2
Uveitis	1	0.4
Other	7	3.1
Previous episode of viral conjunctivitis	25	11.2
Recent contact lens wear	35	15.6
Daily contact lenses	10	4.5
Extended-wear contact lenses	17	7.6
Recent ocular surgery	3	1.3

Table 3
Types of treatment given to patients with viral conjunctivitis prior to presentation.

Prior Treatment	n = 224	(%)
Any prior treatment	181	80.8
Antibiotics	152	67.9
Chloramphenicol eye drops	110	49.1
Chloramphenicol eye ointment	20	8.9
Tobramycin eye drops	19	8.5
Framycetin eye drops	7	3.2
Ciprofloxacin eye drops	5	2.2
Gentamicin eye drops	4	1.8
Oral antibiotics / Other	21	9.4
Lubricant eye drops	37	16.5
Steroid eye drops	22	9.8
Fluorometholone eye drops	12	5.4
Dexamethasone eye drops	4	1.8
Prednisolone acetate eye drops	3	1.3
Other	4	1.8
Antihistamines/Mast cell stabilisers	14	6.3
Antivirals	5	2.2
Other	6	2.7
No prior treatment	43	19.2

3.4. Symptoms and signs

Bilateral signs were present in 144 (64.3%) patients and unilateral signs present in 80 (35.7%) patients. In patients with bilateral disease, a sign was marked present if it appeared in at least one eye. For signs with different severity in each eye, the higher level of severity was taken. The average duration of symptoms prior to presentation was 6.3 days, with 174 (77.7%) patients presenting within 1 week. All but one patient presented within 1 month of symptom onset. Table 4 summarises the prevalence of various symptoms and signs in patients. Of the 7 HSV patients, 5 had unilateral findings, 1 had photophobia, 6 had follicles, and 2 had preauricular lymphadenopathy. None of these patients had a pseudomembrane, but 3 patients had purulent discharge and 2 had watery discharge.

3.5. IOP and VA

There was no significant difference in BCVA between affected and unaffected eyes in patients with unilateral viral conjunctivitis ($p = 0.116$). BCVA was measured in 69 (30.8%) patients with unilateral disease, with 11 patients excluded due to pre-existing corneal or retinal pathology affecting vision. There was no significant difference in IOP between the affected and unaffected eyes in patients with unilateral conjunctivitis ($p = 0.242$). IOP was compared in 72 (32.1%) patients with unilateral disease in which IOP was measured in both eyes. One patient was excluded due to significant pressure difference secondary to advanced glaucoma.

Table 4
Symptoms and signs of patients with viral conjunctivitis.

Symptom or Sign	n = 224	(%)[a]
Eye pain/discomfort	209	93.3
Photophobia	37	16.5
Hyperaemia	209	93.3
Mild	47	47.0
Moderate	42	42.0
Severe	11	11.0
Conjunctival follicles	180	80.4
Mild	31	36.5
Moderate	33	38.8
Severe	21	24.7
Conjunctival papillae	37	16.5
Mild	4	16.7
Moderate	14	58.3
Severe	6	25.0
Discharge	150	67.0
Watery	75	33.5
Purulent	70	31.3
Pseudomembrane	27	12.1
Preauricular lymph node/s	25	11.2

[a] Percentages for gradings (mild/moderate/severe) are of the subset of patients in which a grading was recorded.

3.6. Prescribed treatment

The majority of patients (n = 187, 83.5%) discharged from the emergency department were prescribed lubricating eye drops. A significant number (n = 61, 27.2%) were either prescribed new antibiotics or instructed to continue taking antibiotics they had been previously prescribed. Corticosteroid eye drops were prescribed to 58 (25.9%) patients, with 53 (23.7%) being prescribed fluorometholone eye drops. Antivirals were prescribed to 6 (2.7%) patients in case of HSV conjunctivitis, of which 4 were HSV positive on PCR. NSAIDs were not prescribed (Table 5).

3.7. Correlations

Subgroup analyses were performed in order to find significant differences in symptomatology, PCR results, and treatment prescribed. The most significant differences found were between those with duration of symptoms less than or greater than 1 week, and patients with or without a pseudomembrane on examination. Patients with symptoms for less than 1 week were significantly more likely to be adenovirus positive on PCR (OR 2.37, 95% CI: 1.18–4.76; $P = 0.016$), while those with symptoms for greater than 1 week were significantly more likely to

Table 5
Treatment prescribed to patients with viral conjunctivitis by ophthalmology trainees at Sydney Eye Hospital (n = 224). Key: IV = intravenous, IM = intramuscular, NSAID = non-steroidal anti-inflammatory drugs.

Treatment Type	n = 224	(%)
Lubricating eye drops	187	83.5
Antibiotics	61	27.2
Chloramphenicol eye drops	31	13.8
Chloramphenicol eye ointment	14	6.3
Ofloxacin eye drops	12	5.4
Oral/IV/IM antibiotics	10	4.5
Corticosteroids	58	25.9
Fluorometholone eye drops	53	23.7
Dexamethasone eye drops	5	2.2
Antihistamines/Mast cell stabilisers	16	7.1
Antivirals	6	2.7
NSAIDs	0	0
No treatment	2	0.9

have photophobia (OR 3.0, 95% CI: 1.40–6.28; P = 0.0047) and be treated with steroids (OR 3.80, 95% CI: 1.95–7.42; P = 0.0001). These patients were also more likely to have bilateral signs (OR 1.78, 95% CI: 0.88–3.60; P = 0.11), though this was not statistically significant. Among patients who underwent PCR testing, those with recorded findings of follicles were not significantly more likely to be adenovirus positive than those without (OR: 1.40, 95% CI 0.74–2.64, P = 0.299). Pseudomembranes were present in 27 (12.1%) patients, and these patients were significantly more likely to be adenovirus positive (OR 4.03, 95% CI: 1.68–9.68; P = 0.0018) and be treated with steroids (OR 26.6, 95% CI: 8.66–81.8; P < 0.0001). Contact lens wear, photophobia, the presence of follicles, and discharge were not significantly correlated with positive adenovirus PCR result.

4. Discussion

Our study found that viral conjunctivitis affects patients of all ages and most commonly affects those without a prior ocular history. Contact lens wearer was reported in 15.6% of patients (7.6% wore extended wear lenses) but was not associated with a higher rate of PCR positivity for adenovirus when compared with non-contact lens wearers. The majority of patients tested had a positive PCR result for adenovirus (54.1%). HSV conjunctivitis without keratitis contributed to a small percentage of viral conjunctivitis (4.1% of those tested) consistent with other studies. Prior to presentation 67.9% of patients were prescribed antibiotics, with similar rates reported in other Western countries [14,17]. Most patients presented within 1 week of symptom onset, and two thirds of patients presented with bilateral symptoms. In our sample, viral conjunctivitis seemed to have no significant impact on visual acuity or IOP. The most significant correlations with adenoviral positivity on PCR and steroid treatment were duration of symptoms and the presence of a pseudomembrane. About a quarter of patients were given antibiotic treatment in case of bacterial conjunctivitis, and a quarter of patients were given topical steroid treatment for symptom management. The impact of this rate of steroid prescriptions cannot be determined from this study.

Data on the clinical features, diagnosis and treatment of patients affected by viral conjunctivitis in Australia is lacking. In our series, the vast majority of patients had no previous ocular history. The largest group of patients with previous ocular history were those with a prior corneal condition; however, they still only represented 4.5% of the sample and most were not contact lens wearers. Regular contact lens wearers comprised 15.6% of the sample size, with almost half of these patients (7.6%) using extended-wear lenses. Australian data estimates around 5% of people aged 15–64 wear regular contact lenses [18]. It should be noted however that contact lens wearers were not significantly more likely to have a positive adenovirus PCR result in this study. There are also limited data to support a correlation between contact lens wear and viral conjunctivitis. A recent literature review on contact lens wear complications found contact lens wear to be a significant risk factor for several conditions, including dry eye, allergy activation, herpes reactivation, microbial keratitis, and giant papillary conjunctivitis [19]. However, viral conjunctivitis was not found to be a known complication of regular contact lens wear. Indeed, some contact lens wearers with negative PCR results may have been misdiagnosed to have viral conjunctivitis.

The rates of prior treatment in this study were similar to patterns seen in developed countries with regards to “red eye” patients [2,14]. The vast majority (80.8%) of patients in this study presented to hospital on treatments; their presentation may have been because the treatments had not successfully resolved their symptoms. Most of these patients were given antibiotics (67.9% of all patients), with the majority prescribed chloramphenicol eye drops or ointment (58.0% of all patients). 16.5% of patients were prescribed lubricating eye drops. Rates of antibiotic prescribing for acute conjunctivitis in primary care providers in Western countries has been estimated to be between 70% and 95% [2,15]. This appears to reflect similar rates of antibiotic prescribing in primary care practice for other common viral conditions such as upper respiratory tract infections [15]. This study identified that antibiotics were prescribed frequently for conjunctivitis patients in Australia, and this was similar to rates reported across the developed world. A recently released Royal Australian and New Zealand College of Ophthalmology position statement provides guidance for chloramphenicol use in red eyes [20]. Interestingly, 9.8% of patients in this study had already been given topical steroid treatment prior to presentation. It should be noted that while some of these patients had been seen by an ophthalmologist, many were prescribed steroids by their general practitioner. The risks of exacerbating an undiagnosed herpes simplex infection and increasing the risk of bacterial super-infection with inappropriate corticosteroid use are well-established in the literature [8,21,22]. This study suggests that further education is required to minimise the rates of prescribing of corticosteroids by general practitioners for patients with conjunctivitis in order to avoid potentially severe complications.

The most common signs and symptoms were eye pain or discomfort (93.3%) and hyperaemia (93.3%). This study found no significant impact of viral conjunctivitis on either best-corrected visual acuity or on intraocular pressure. Conjunctival follicles were reported in the vast majority (80.3%) of patients, while papillae were noted in 16.5%. This suggests that the majority of viral conjunctivitis patients will have follicles present, but that the presence of papillae does not rule out a viral aetiology. Among patients who underwent PCR testing, those with recorded findings of follicles were slightly more likely to be adenovirus positive than those without, but this was not statistically significant (OR: 1.40, 95% CI 0.74–2.64, P = 0.299). As such, we do not believe this study provides sufficient evidence supporting or refuting a correlation between the presence of follicles and adenoviral PCR positivity. Watery discharge was present in about one third (33.5%) of patients and purulent discharge in one third (31.3%). While purulent discharge or “crusting” is often considered a sign of bacterial conjunctivitis, the study suggests that a significant number of viral conjunctivitis cases also present with purulent discharge. The presence of a pseudomembrane was found in 12.1% of patients, and the presence of an enlarged or tender preauricular lymph node was seen in 11.2% of patients. While these are both helpful diagnostic signs, they do not appear to be present in the majority of viral conjunctivitis cases. About two thirds of the patients in this study (64.3%) presented with bilateral eye symptoms or signs. Bilateral signs are a useful distinguishing feature of viral conjunctivitis from bacterial conjunctivitis [8]. The vast majority of patients in this study (77.7%) presented within 1 week of symptom onset. The fact that 80.8% of patients had visited a general practitioner, optometrist, or ophthalmologist prior to presenting suggests that patients may require further education on the clinical course of viral conjunctivitis and the reasons that would warrant a presentation to a hospital emergency department.

With regards to diagnostic tests for adenovirus, cell culture has long been considered the “gold standard”, as once a virus is isolated, the diagnosis is definitive and further characterisation of the virus is possible [23]. The main drawbacks of cell culture are that it is costly, time-intensive, and subjective. As such, the most common test for viral conjunctivitis in the developed world at present is the detection of viral DNA by polymerase chain reaction (PCR). PCR is 93% sensitive and 97.3% specific for diagnosing adenovirus from conjunctival swabs, and similar values have been demonstrated in diagnosing HSV [23]. PCR was performed in about three quarters (75.9%) of patients. Over half of those tested (54.1%) had a positive result for adenovirus. Interestingly, patients presenting with symptoms for less than 1 week were more than twice as likely to be adenovirus positive on PCR compared to those with symptoms for more than 1 week (OR = 2.37). It should be noted however that a slightly higher percentage of patients (78.7%) with symptom duration less than 1 week were tested compared with those of symptom duration greater than 1 week (66.0%). Additionally, patients with a pseudomembrane seen on examination were four times more

likely to be adenovirus positive on PCR than those without (OR = 4.03). These correlations could be due to increased viral activity in the early stages of viral conjunctivitis and high levels of viral activity reflected by the presence of a pseudomembrane, thereby increasing the chance of isolating adenoviral DNA. Only 7 patients (3.1%) had herpes simplex virus isolated on PCR testing, which is consistent with the literature rate of 3–5% [11]. No patients in this study tested positive for varicella zoster virus, possibly suggesting a low incidence of isolated conjunctivitis with ocular VZV infections without other clinical manifestations.

A newer diagnostic test that is not yet available in Australian public hospitals is the rapid detection testing kit for adenovirus. The AdenoPlus assay (Rapid Pathogen Screening Inc., Sarasota, Florida, USA) is an inexpensive and swift office-based test that is designed to detect 53 serotypes of adenovirus and provide a positive result within 10 minutes [11]. Studies have shown the AdenoPlus to have a very high specificity between 92 and 98% in diagnosing adenoviral conjunctivitis [24–26]. However, three separate studies have elicited sensitivity values of 85% [24], 39.5% [25], and 50% [26]. As such, it appears the test is highly specific but lacks sensitivity when compared with PCR analysis. It was also noted in one study that the use of the AdenoPlus in a prospective patient group resulted in significantly lower rates of antibiotic prescriptions compared with a retrospective group using PCR alone [26]. Overall, the benefit of rapid detection testing kits is in providing a simple, cheap method that may confirm a diagnosis of adenoviral conjunctivitis in the office setting. Such testing will be useful once treatments for viral conjunctivitis now in clinical trial reach the clinic [8].

Most patients (83.5%) were discharged from the emergency department with lubricating eye drops, while 27.2% were either instructed to continue or commence new antibiotics, most commonly chloramphenicol. This suggests either that there may still a degree of uncertainty even amongst ophthalmology trainees in distinguishing bacterial from viral conjunctivitis, or there were other reasons for prescribing antibiotics (such as to prevent a superinfection). Corticosteroids were prescribed to a quarter (25.9%) of patients. Our subgroup analysis showed that patients presenting with symptoms of greater than 1-week duration were almost 4 times more likely to be prescribed corticosteroids on discharge than those with symptoms for less than 1 week (OR = 3.80). Additionally, of the 27 patients with a pseudomembrane, 23 of them (85.2%) received steroid treatment on discharge. The purpose of corticosteroids in viral conjunctivitis is to lessen the patient's symptoms of pain, photophobia, and purulent discharge. Most patients in this study had already seen a general practitioner or optometrist and been treated prior to their presentation. As such, the high rate of steroid prescribing seen in this study may reflect patients seeking treatment due to significant concerns for their ongoing symptoms. The impact of this rate of steroid prescribing is unclear.

One of the most promising new treatments for adenoviral conjunctivitis is the use of povidone-iodine, a non-specific disinfectant that kills extracellular organisms [11]. It is an inexpensive and readily available antiseptic solution that is commonly used as a preparation for ocular surgery and to prepare donor eyes for corneal harvesting. It does not have any effect intracellularly, but as it does not depend on immunological mechanisms, it does not induce drug resistance. A study on the use of single dose 2.5% povidone-iodine in infants with adenoviral conjunctivitis demonstrated a reduction in the severity of symptoms and the length of recovery time without any significant side effects [27]. A combination therapy with both topical dexamethasone and povidone-iodine has also been trialled. While this therapy is only safe for use in patients with confirmed adenoviral conjunctivitis due to the potential exacerbation of HSV infections by the steroid component, it does not appear to significantly improve patients' symptoms or the incidence of subepithelial infiltrates [28]. While the treatment was associated with more frequent reports of stinging sensation, it does appear to reduce the duration of the disease [28].

This study had a number of limitations. First, we only observed patients in a 3-month period from 1 st January - 31 st March 2017. These are the warmer months of the year in the Southern Hemisphere and therefore there may be seasonal differences compared with data taken in winter months, as the evidence suggests adenoviral conjunctivitis may be more prevalent in the warmer seasons [9,29]. Ideally, future studies would be able to analyse data from patients across a full year to be able to assess seasonal variations and trends in viral conjunctivitis presentations. Nonetheless this study included a large number of patients during this time period. Secondly, data was obtained second-hand, from the analysis of other medical practitioners' electronic documentation. There is considerable variability in the style, detail, and information recorded by different practitioners leading to bias. As the study was conducted in a single department over a three-month period, the number of treating doctors was limited, with most of these doctors seeing a significant proportion of patients. Ideally, a larger study incorporating a greater number of treating doctors would reduce the potential effect of this variability. It should also be noted that the treating doctors were either ophthalmology residents or registrars, which may have contributed to variations in the documentation of clinical findings. The third limitation of this study is the lack of follow-up data. Outpatient follow-up records were stored on separate physical files and it was not within the scope of this study to collect and analyse all data from these follow-up visits. There is a possibility that patients who did not have adenovirus positive PCR results may have returned for follow-up and had their diagnosis changed on secondary review. An ideal future study could obtain data from follow-up visits to both ensure that any clinical diagnoses without a positive PCR result was not deemed incorrect, and to assess the impact, both positive and negative, of the prescribed treatments for each patient.

In conclusion, viral conjunctivitis affects patients across all age groups regardless of ocular history. Patients were found to be more likely to have bilateral disease; with pseudomembranes and a palpable preauricular node occurring less commonly. Notably, the majority of our patients had seen another practitioner prior to presentation. Improved education on the natural history of the disease may reduce presentations to the emergency. However, rapid and specific tests for adenoviral conjunctivitis along with a safe and efficacious therapy are needed.

Author statement

Primary and Corresponding Author. Study design, participant recruitment, data collection and analysis, manuscript writing and editing and literature review.

Clinical Researcher. Ethics submission, database setup, data collection and manuscript editing.

Primary Supervisor. Study design, database setup, manuscript writing and editing and literature review.

Financial support

None.

Declaration of Competing Interest

No conflicting relationship exists for any author.

References

[1] American academy of ophthalmology. Conjunctivitis, American Academy of Ophthalmology, San Francisco, CA, 2003.
[2] M. Keen, M. Thompson, Treatment of acute conjunctivitis in the United States and evidence of antibiotic overuse: isolated issue or a systematic problem? Ophthalmology 124 (August (8)) (2017) 1096–1098.
[3] B.L. Udeh, J.E. Schneider, R.L. Ohsfeldt, Cost effectiveness of a point-of-care test for adenoviral conjunctivitis, Am J Med Sci 336 (September (3)) (2008) 254–264.

[4] R.M. Stasiuk, I.F. Robertson, Adeno-viral kerato conjunctivitis, Aust J Ophthalmol 9 (1981) 55–58.
[5] P.C. McMinn, J. Stewart, C.J. Burrell, A community outbreak of epidemic kerato-conjunctivitis in central Australia due to adenovirus type 8, J Infect Dis 164 (December (6)) (1991) 1113–1118.
[6] S.K. Schepetiuk, R. Norton, T. Kok, L.G. Irving, Outbreak of adenovirus type 4 conjunctivitis in South Australia, J Med Virol 41 (December (4)) (1993) 316–318.
[7] C. Adlhoch, I. Schöneberg, G. Fell, D. Brandau, J. Benzler, Increasing case numbers of adenovirus conjunctivitis in Germany, 2010, Eurosurveillance 15 (November (45)) (2010) 19707.
[8] V. Jhanji, T.C. Chan, E.Y. Li, K. Agarwal, R.B. Vajpayee, Adenoviral kerato-conjunctivitis, Surv Ophthalmol 60 (September (5)) (2015) 435–443.
[9] L. Zhang, N. Zhao, J. Sha, C. Wang, X. Jin, S. Amer, et al., Virology and epidemiology analyses of global adenovirus-associated conjunctivitis outbreaks, 1953–2013, Epidemiol Infect 144 (June (8)) (2016) 1661–1672.
[10] J.K. Dart, F. Stapleton, D. Minassian, Contact lenses and other risk factors in microbial keratitis, Lancet 338 (September (8768)) (1991) 650–653.
[11] H.E. Kaufman, Adenovirus advances: new diagnostic and therapeutic options, Curr Opin Ophthalmol 22 (July (4)) (2011) 290–293.
[12] Y. Mitsui, L. Hanna, J. Hanabusa, R. Minoda, S. Ogata, H. Kurihara, et al., Association of adenovirus type 8 with epidemic keratoconjunctivitis: special reference to the infantile form of the disease, AMA Arch Ophthalmol 61 (June (6)) (1959) 891–898.
[13] National Center for Health Statistics, J.P. Ganley, J. Roberts, Eye conditions and related need for medical care among persons 1-74 years of age, United States, (2019), pp. 1971–1972.
[14] R.P. Rietveld, G. Ter Riet, P.J. Bindels, F.G. Schellevis, H.C. van Weert, Do general practitioners adhere to the guideline on infectious conjunctivitis? Results of the Second Dutch National Survey of General Practice, BMC Fam Pract 8 (December (1)) (2007) 54.
[15] H. Everitt, P. Little, How do GPs diagnose and manage acute infective conjunctivitis? A GP survey, Fam Pract 19 (December (6)) (2002) 658–660.
[16] Australian New Zealand Clinical Trials Registry [Internet]: Sydney (NSW), NHMRC Clinical Trials Centre, University of Sydney (Australia), Identifier ACTRN12619000177156. A phase 2, Multi-centeR, randomized, DoUBle-Masked, placebo-controlled StudY to evaluate the clinical safety and efficacy of OKG-0301 in the treatment of acute adenoviral conjunctivitis (RUBY); 2019 jul 12 [cited 2019 July 3rd]; [1 page], Available from: (2005) www.anzctr.org.au/ACTRN12619000177156.aspx.
[17] C. Kilduff, C. Lois, Red eyes and red-flags: improving ophthalmic assessment and referral in primary care, Bmj Open Qual 5 (June (1)) (2016) u211608–w4680.
[18] K. Edwards, L. Keay, T. Naduvilath, F. Stapleton, A population survey of the penetrance of contact lens wear in Australia: rationale, methodology and results, Ophthal Epidemiol 16 (January (5)) (2009) 275–280.
[19] F. Alipour, S. Khaheshi, M. Soleimanzadeh, S. Heidarzadeh, S. Heydarzadeh, Contact lens-related complications: a review, J Ophthalmic Vis Res 12 (April (2)) (2017) 193.
[20] The Royal Australian and New Zealand College of ophthalmologists, Chloramphenicol use in ophthalmic practice, (2018) June Retrieved from https://ranzco.edu/.
[21] S. Bennett, W.F. Carman, R.N. Gunson, The development of a multiplex real-time PCR for the detection of herpes simplex virus 1 and 2, varizella zoster virus, adenovirus and Chlamydia trachomatis from eye swabs, J Virol Methods 189 (April (1)) (2013) 143–147.
[22] E. Uchio, S. Takeuchi, N. Itoh, N. Matsuura, S. Ohno, K. Aoki, Clinical and epidemiological features of acute follicular conjunctivitis with special reference to that caused by herpes simplex virus type 1, Br J Ophthalmol 84 (September (9)) (2000) 968–972.
[23] E.M. Elnifro, R.J. Cooper, P.E. Klapper, A.C. Yeo, A.B. Tullo, Multiplex polymerase chain reaction for diagnosis of viral and chlamydial keratoconjunctivitis, Invest Ophthalmol Vis Sci 41 (June (7)) (2000) 1818–1822.
[24] R. Sambursky, W. Trattler, S. Tauber, C. Starr, M. Friedberg, T. Boland, et al., Sensitivity and specificity of the AdenoPlus test for diagnosing adenoviral conjunctivitis, JAMA Ophthalmol 131 (January (1)) (2013) 17–21.
[25] K.R. Kam, H.S. Ong, C. Bunce, L. Ogunbowale, S. Verma, Sensitivity and specificity of the AdenoPlus point-of-care system in detecting adenovirus in conjunctivitis patients at an ophthalmic emergency department: a diagnostic accuracy study, Br J Ophthalmol (2015) Apr 8:bjophthalmol-2014.
[26] K.K. Holtz, K.R. Townsend, J.W. Furst, J.F. Myers, M.J. Binnicker, S.M. Quigg, et al., An assessment of the AdenoPlus point-of-care test for diagnosing adenoviral conjunctivitis and its effect on antibiotic stewardship, Mayo Clin Proc Innov Qual Outcomes 1 (September (2)) (2017) 170–175.
[27] Z. Özen Tunay, O. Ozdemir, I.S. Petricli, Povidone iodine in the treatment of adenoviral conjunctivitis in infants, Cutan Ocul Toxicol 34 (January (1)) (2015) 12–15.
[28] R.D. Pinto, R.P. Lira, R.Y. Abe, R.S. Zacchia, J.P. Felix, A.V. Pereira, et al., Dexamethasone/povidone eye drops versus artificial tears for treatment of presumed viral conjunctivitis: a randomized clinical trial, Curr Eye Res 40 (September (9)) (2015) 870–877.
[29] D.L. Yirrell, J.M. Darville, A.G. Armstrong, M.J. Irish, A correlation between the weather and the incidence of ocular adenovirus infections, Arch Virol 91 (September (3-4)) (1986) 367–373.