A primary school outbreak of pharyngoconjunctival fever caused by adenovirus type 3

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Abstract

High rates of absenteeism in a North Queensland primary school, due to eye irritation, fever, headache, and stomach pain, were reported to the Tropical Public Health Unit in October 2000. Subsequent investigation demonstrated that the symptoms were due to adenovirus infection. Symptoms were consistent with a diagnosis of pharyngoconjunctival fever. At the height of the outbreak, about 40 per cent of students were absent. There was a strong association between the development of symptoms, and having been swimming on a recent school camp. Adenovirus could not be isolated from swimming pool water from the resort where the camp had been held. However, when inspected the swimming pool was not adequately chlorinated or maintained. It is probable that adenovirus infection was transmitted via swimming pool water at the school camp, and the outbreak might have been avoided by higher standards of swimming pool maintenance. *Commun Dis Intell* 2001;25:9-12.

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Introduction

Adenovirus infections of humans are ubiquitous, and with other less common manifestations, cause coryza and pharyngitis in infants, upper respiratory infections, pharyngoconjunctival fever, diarrhoea and haemorrhagic cystitis in children, acute respiratory disease and pneumonia in young adults, and epidemic keratoconjunctivitis in adults. There are 47 known serotypes of human adenoviruses. No clear role in causing human disease is known for over half of these; for those that do cause disease the serotype of the virus and age of the host are important in determining clinical presentation.[1] Acute respiratory disease in military recruits, mostly caused by adenovirus type 4 and less often adenovirus type 7, can cause considerable morbidity.[2] In children adenovirus type 7 may cause community outbreaks, with respiratory symptoms and fever, sometimes causing severe disease and possibly death.[3]

Pharyngoconjunctival fever is a syndrome of pharyngitis, conjunctivitis, fever,[2] rhinitis and cervical adenitis.[1] It usually affects children and young adults, and is most commonly caused by serotype 3 or 7, although others including serotypes 1, 4 and 14 have also been implicated.[2] The syndrome may occur sporadically and can cause outbreaks in families and other closed populations, but it is best recognised as causing outbreaks centred around 'summer camps', especially those with swimming pools and small lakes.[2] In a large outbreak of 80 cases acquired during a swimming contest in Greece in 1995, adenovirus was detected in swimming pool water using PCR thus demonstrating the role of swimming pool water as a source of infection.[4]

We describe an outbreak of pharyngoconjunctival fever due to adenovirus type 3 that occurred in north Queensland after a school camp during October 2000.

Materials and methods

The Tropical Public Health Unit was contacted by the principal of a north Queensland primary school on 19 October 2000, because of concern regarding absenteeism caused by an outbreak of eye irritation, fever, headache and stomach pain. Subsequently, 3 visits were made to the school, on 20 October, 1 November, and 8 November 2000. These were to review students clinically and collect viral culture specimens and acute sera, to collect convalescent sera, and to complete a questionnaire on symptomatology and for a case-control study, respectively. Samples were collected from the swimming pool suspected of being the source of the infection on 9 November 2000.

One of us (DH) reviewed the students clinically. A history was taken and examination performed. Throat and eye swabs were collected. Virus isolation was performed as follows: samples were inoculated into MRC-5, LLC-MK2, BGMK, RD and MDCK cells in Dulbecco's MEM. All cultures were passaged every 7 days for 3 weeks. After each passage cells were screened for respiratory viruses by fluorescent antibody tests using the Bartels Respiratory Kit. The isolates were typed by DNA Restriction Analysis.[5] Serological testing was performed using complement fixation. Swimming pool water was tested for adenovirus by using hollow-fibre ultrafiltration and nested RT-PCR.[6,7]

Students completed a questionnaire on symptoms, attendance at the camp and activities while there. The data were then entered into an Access database, subsequent analysis performed using the Statistical Package for the Social Sciences (SPSS), and graphs produced using Excel. Data on absenteeism were also collected from the school rolls. Data were only studied for those days when complete rolls were available: information on preschool absenteeism

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was not analysed because these students do not attend school every day.

Results

Description of the school and the school camp

The school is located on the Atherton Tablelands, approximately 50km north-west of Cairns. At the time of the outbreak 53 students were enrolled at the school (Table 1).

Children at the school were aged between 4 and 12, with a median of 9, years. Twenty-eight (53%) were female.

Between 11 and 13 October 2000, children from the school attended a camp at a coastal resort in Far North Queensland. The camp was at an educational facility with a large saltwater swimming pool. Only children from grades 3 to 7 were able to attend the school camp, and of the 36 children in these grades, 30 attended the camp.

Clinical case descriptions and laboratory investigations

Seven children, all of whom had attended the school camp, were reviewed on 20 October 2000, and symptom information was supplemented from a questionnaire completed on 8 November 2000 (Table 2). Physical findings are not shown, but when these were measured the children had fever and tachycardia. One 12-year-old female (F, 12y; Table 2) had obvious conjunctivitis of the left eye and one 12-year-old male (M2, 12y; Table 2) cervical lymphadenopathy. None had physical signs of lower respiratory tract infection. Cardiovascular examination was normal in all, and none had hepato- or splenomegaly. None had a rash. The joints of one 9-year-old child (F, 9y; Table 2) who complained of arthralgia were examined, but no objective signs of arthritis were found. Three of 4 children who had paired sera collected showed a diagnostic CF titre rise to adenovirus. Adenovirus 3 was isolated by MRC-5 culture from all of 2 eye swabs and 4 throat swabs collected.

Table 1. Students by grade, adenovirus 3 outbreak, north Queensland, 2000

Grade	Number of students
Preschool	5
Year 1	7
Year 2	5
Year 3	3
Year 4	10
Year 5	9
Year 6	6
Year 7	8
Total	53

The outbreak

The greatest rate of absenteeism among the 48 students in grades 1 to 7 occurred on 20 October 2000, when nearly 40 per cent were absent. The highest rates of absenteeism for students who had been on the school camp were on 19 and 20 October 2000. For those who had not been on the school camp peak absenteeism, just under 40 per cent, occurred on 31 October 2000 and 3 November 2000 (Figure 1). The mean (range) number of days absent for the period shown in Figure 1 was 2.9 (0-9), 3.1 (0-11), and 3.0 (0-11) days, for those who did and those who did not attend the camp, and grades 1 to 7, respectively.

Table 2. Symptoms and laboratory findings, adenovirus 3 outbreak, north Queensland, 2000

Gender and age (years)	Onset date (Oct)	Symptoms	CF titres		Viral culture results (collected 20 October)
			20 October	1 November	
F, 8y	16	Sore throat, fever, diarrhoea, headache, nausea, anorexia, jaw ache	-	-	Not done
M, 9y	18	Sore throat, fever, diarrhoea, headache, vomiting, anorexia	< 8	< 8	Throat and left eye swabs. Adenovirus 3 detected
M1, 12y	18	Sore throat, fever, diarrhoea, headache, vomiting	< 8	> 512	Throat swab. Adenovirus 3 detected
F, 9y	17	Sore throat, fever, rhinorrhoea, otalgia, headache, nausea, vomiting, anorexia, back pain, muscle and joint pain	-	-	Not done
M2, 12y	17	Itchy, red eyes, sore throat, fever, rhinorrhoea, diarrhoea, headache, vomiting, anorexia	< 8	128	Throat swab. Adenovirus 3 detected
M, 11y	18	Itchy, red eyes, sore throat, fever, rhinorrhoea, diarrhoea, otalgia, headache, nausea, vomiting, anorexia, myalgia, slight cough	< 8	> 512	Throat swab. Adenovirus 3 detected
F, 12y	17	Itchy, red eyes, fever, headache, nausea	-	-	Left eye swab. Adenovirus 3 detected

Figure 1. School absenteeism, adenovirus type 3 outbreak, north Queensland, 2000

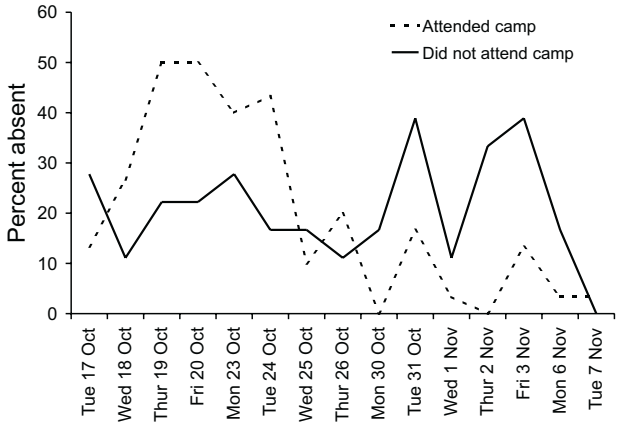
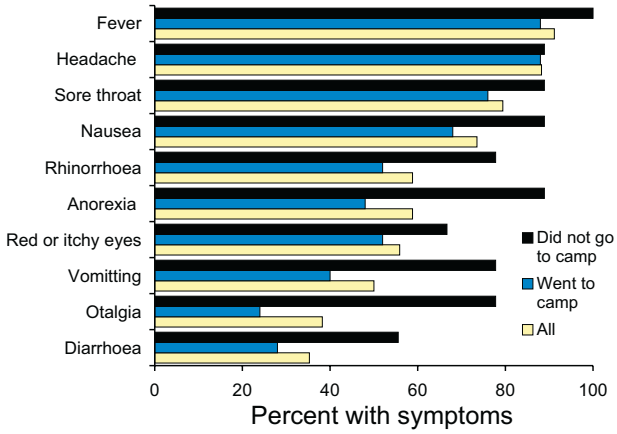


Figure 2. Symptoms, adenovirus type 3 outbreak, north Queensland, 2000



Thirty-four students were unwell in the period 17 to 23 October 2000, suggesting an incubation period of 6 to 9 days following the school camp;[2] of these, 25 (74%) had been on the school camp. Assuming primary cases were acquired at the camp, the other 9 cases were presumably secondary cases, and may have been acquired within households from older siblings who had attended the camp. Fever, headache and sore throat were the commonest symptoms among these 34 students (Figure 2).

There were only 5 students who stated they became unwell after the incubation period as defined above; 4 had a fever, 4 a headache, 3 a sore throat, 4 nausea, 3 rhinorrhoea, 1 anorexia, 3 red or itchy eyes, 1 vomiting, 3 otalgia and 1 diarrhoea.

The likelihood of having been unwell within the incubation period (i.e. 6 to 9 days[2]) was significantly increased for students who had been swimming at the school camp (odds ratio = 9.0, 95% confidence interval: 2.4-33.9). The likelihood of having one or more of red, itchy or watery eyes, fever, or a sore throat was also significantly increased (odds ratio = 5.5, 95% confidence interval: 1.6-18.4).

A one-hundred-litre sample of swimming pool water collected on 9 November 2000 was tested by PCR for adenovirus DNA; none was detected. The residual chlorine concentration when the pool was sampled at approximately 11.00 am, was 1.0 ppm. Faecal coliforms were cultured from swabs taken from among algae on the steps of the swimming pool.

Discussion

The study demonstrates that pharyngoconjunctival fever caused by adenovirus 3 was the cause of a primary school outbreak that resulted in high rates of absenteeism in October 2000. While not conclusive, there is a strong link between the resort education centre swimming pool that the school had recently used, and pharyngoconjunctival fever. The later peak of absenteeism for students who had not attended the camp suggests that secondary cases were acquired after the return of students from the camp, either within households or the school community. The degree of morbidity caused was considerable, and the rate of absenteeism resulted in appreciable disruption to the school routine.

While adenovirus was not isolated from the swimming pool water, there was evidence that the pool was not appropriately maintained. For a commercial swimming pool in this geographical location an inadequate chlorine residual of 1.0 ppm was being used, and this was only being checked once per day in the cool of the morning. It is likely that on a hot day, with a large number of swimmers, all the available chlorine in the pool would be exhausted within 2 hours of testing. Because of the extreme and prolonged heat that can be experienced in Far North Queensland, and also the dilution caused by high rainfall, 2.0 ppm chlorine residual would be appropriate. These levels should be checked at least 5 times per day to ensure the desired levels are being maintained.

Faecal coliforms were detected in patches of algae on the swimming pool steps, suggesting the pool was not being adequately cleaned. While no legislation currently exists to enforce water quality and operational standards of Queensland swimming pools, recommended standards are available.[8] Transmission of adenovirus via swimming pool water, probably as a result of inadequate chlorination, has been demonstrated in another outbreak[4] and the evidence presented here points to the swimming pool as the source of infection. It is likely that the outbreak could have been avoided through better standards of swimming pool maintenance.

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