

Adenovirus serotypes isolated from ocular infections in London

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SUMMARY During the period 1973-8 700 adenoviruses were isolated from the eyes of patients presenting at Moorfields Eye Hospital. Of these, 678 were serotyped by a neutralisation test. Twenty-one different serotypes were identified. Serotype 3, 7, and 10 accounted for 68% of the isolates, 4, 8, 15 (15/29), and 19 for 25%, and the other 14 serotypes for 7%. Community outbreaks of ocular infections by adenovirus 3, 4, 7, 10, and 15 (15/29) were observed. Outbreaks with adenovirus 3, 7, and 10 appeared to continue for 2 years or more, whereas outbreaks with 4 and 15 (15/29) were restricted to one year or less. Hospital outbreaks by adenovirus 8 and 19 were also recorded. During the same period 18 of these 21 adenovirus serotypes were isolated from the nonocular sites (mainly respiratory tract) in 7804 cases. There was a close association in the distribution of adenovirus 1, 2, 3, 5, and 6 in the ocular and nonocular sites. No such association was observed for adenovirus serotypes 4, 8, 10, 15 (15/29), and 19.

In a previous study¹ we reported clinical and epidemiological features of ocular infections caused by various adenovirus serotypes.

In this paper we report the distribution of adenovirus serotypes isolated from the eyes of patients presenting to Moorfields Eye Hospital, London, over the years 1973-8. This study has provided an opportunity to compare the distribution of adenovirus serotypes in ocular and nonocular (mainly respiratory) sites.

Materials and methods

Between 1973 and 1978 700 adenovirus isolations were made in our laboratory from the eyes of patients presenting at Moorfields Eye Hospital, London. Conjunctival swabs were collected and cultured in HEP2 cells; methods of collection, transport, and storage of specimens, and virus isolation have been described previously.² Virus serotyping was done by a standard neutralisation procedure with type-specific antisera.

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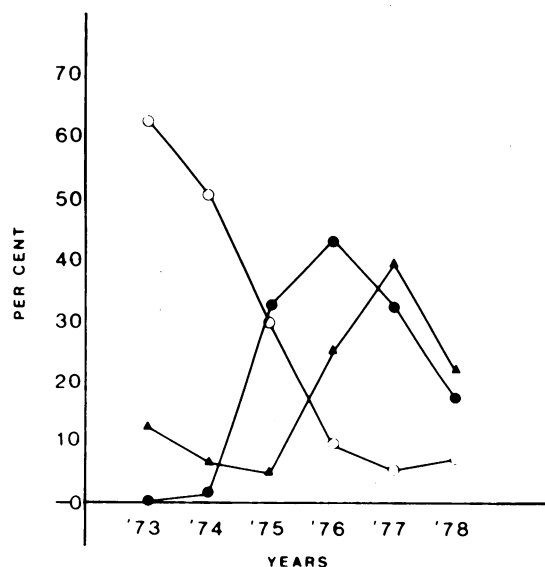


Fig. 1 Annual incidence of adenovirus serotypes 3, 7, and 10 (▲ adenovirus 3, ○ adenovirus 7, ● adenovirus 10).

Table 1 Annual distribution of ocular adenovirus serotypes: 1973-8

Serotype	Year						Total	% of total
	1973	1974	1975	1976	1977	1978		
1	2	0	1	4	1	1	9	1.3
2	1	0	3	4	2	4	14	2.1
3	9	5	6	38	53	27	138	20.3
4	2	3	17	17	12	29	80	11.8
5	0	3	1	1	0	0	5	0.74
6	0	0	2	3	0	0	5	0.74
7	45	38	36	15	7	9	150	22.1
8	5	3	1	0	0	22	31	4.5
9	0	0	1	0	0	0	1	0.15
10	0	1	40	66	44	21	172	25.3
13	0	0	0	0	0	1	1	0.15
14	1	0	0	0	0	0	1	0.15
15 (15/29)	1	0	6	1	10	0	18	2.6
16	0	0	0	0	1	4	5	0.74
17	0	0	1	0	0	0	1	0.15
19	6	21	5	3	0	0	35	5.1
21	0	1	1	0	0	1	3	0.44
22	0	0	0	0	3	1	4	0.59
24	0	0	0	0	1	0	1	0.15
29	0	0	0	0	1	0	1	0.15
30	0	0	1	0	0	2	3	0.44
Total	72	75	122	152	135	122	678	100

Results

OCULAR ISOLATES

Frequency. Of the 700 isolates 678 were typed, 12 were untypeable, and 10 were not available for typing. Twenty-one different serotypes were identified. Serotypes 3, 7, and 10 were predominant, accounting for 68% of the isolates; serotypes 4, 8, 15 (15/29), and 19 accounted for 25%; while the remaining 14 serotypes occurred infrequently and accounted for only 7% of the isolates (Table 1). Eighteen isolates were identified as serotype 15, but 3 of these cross-reacted with antiserum against serotype 29. They are therefore presented as serotype 15 (15/29).

Annual incidence. The annual incidence of the 21 serotypes is shown in Table 1. There was considerable fluctuation between the 3 predominant serotypes (3, 7, and 10) over the 5-year period (Fig. 1). During the first 2 years adenovirus 7 accounted for over half of all the isolates. However, it showed a marked decline from a peak position in 1973 (62%) to only 7% of isolations by 1977. Adenovirus 3 and 10 showed an almost identical pattern of rise and fall separated by an interval of a year.

Adenovirus 4 distribution increased substantially during the last year of the survey. The remaining serotypes occurred relatively infrequently, and as a result little can be attributed to their pattern of variation.

Seasonal variation. Only 2 serotypes, namely, 7 and 10, showed distinct seasonal variations, the former

being more frequently isolated in the spring and the latter in the winter (Fig. 2).

Age and sex distribution. The majority of ocular adenovirus isolates (66%) were from the age groups 20-40; only 15% were from patients below 20 years, and 19% from patients over the age of 40 (Fig. 3). Individual serotypes conformed to the general pattern of age distribution. Infection was commoner in males than in females (ratio 1.4 to 1).

Outbreaks. Community related outbreaks occurred due to serotypes 3, 4, 7, 10, and 15 (15/29). Outbreaks due to serotype 3, 7, and 10 were very persistent, continuing for 2 or more years. Nosocomial transmission accounted for the majority of infections due to adenovirus 8 (1978) and adenovirus 19 (1973-4).

NONOCULAR ISOLATES

During the period 1973-8, 18 of the 21 ocular adenovirus serotypes were also isolated from nonocular sites in 7804 cases in England and Wales (Public Health Laboratory Service, unpublished data). Serotypes 13, 29, and 30 were not isolated from the nonocular sites. Serotypes 1, 2, and 7 were the most frequently reported in nonocular sites, accounting for 68% of isolations, while serotypes 3, 4, and 5 accounted for 29%. The remaining 12 serotypes were infrequently reported. Marked annual fluctuations in isolation rates of the various serotypes occurred, some of which were associated with rises in ocular infection whereas others appeared unrelated (Fig. 2). Changes in the incidence of serotypes 1, 3, 5, and 6

from nonocular and ocular infections were closely related, whereas clusters of ocular infections due to adenovirus 4, 8, 10, 15 (15/29), and 19 were not associated with corresponding rises in nonocular infections due to these serotypes. Adenovirus 7 infections in general showed concomitant infections, but a number of clusters of nonocular and ocular infections occurred independently of each other.

Discussion

In this series 92% of ocular adenovirus infections (sporadic cases and outbreaks) were due to serotypes 3, 4, 7, 8, 10, 15 (15/29) and 19. The remaining serotypes were associated only with occasional sporadic cases.

The outbreaks due to adenovirus 3 and 7 developed and declined slowly extending over several years (Fig. 2). The adenovirus 7 outbreak reported here appears to have been part of a very extensive outbreak during the early 1970s which occurred not only throughout

this country³ but also affected Scandinavia⁴ and North America.⁵ It is of interest that this extensive outbreak was followed almost immediately by an adenovirus 3 outbreak, suggesting the possibility of cyclic interaction between these 2 serotypes. Such cyclic activity has been reported in respiratory infections with adenovirus 1 and 2.⁶

An outbreak due to adenovirus 4 developed rapidly at the beginning of 1978 and persisted for the year. It coincided with a community outbreak in the Bristol area.⁷

Although adenovirus 10 was detected only once in 1974, an outbreak due to this serotype developed in 1975 and has continued since then, peaking each year in winter. Outbreaks on this scale due to adenovirus 10 have not been reported previously, though an outbreak associated with serotype 10/19 was reported from Bristol during 1977-8.⁸ Sporadic cases due to adenovirus 10 are rarely reported.^{9,10}

During 1973 an outbreak due to adenovirus 19 occurred; this involved both the local community and

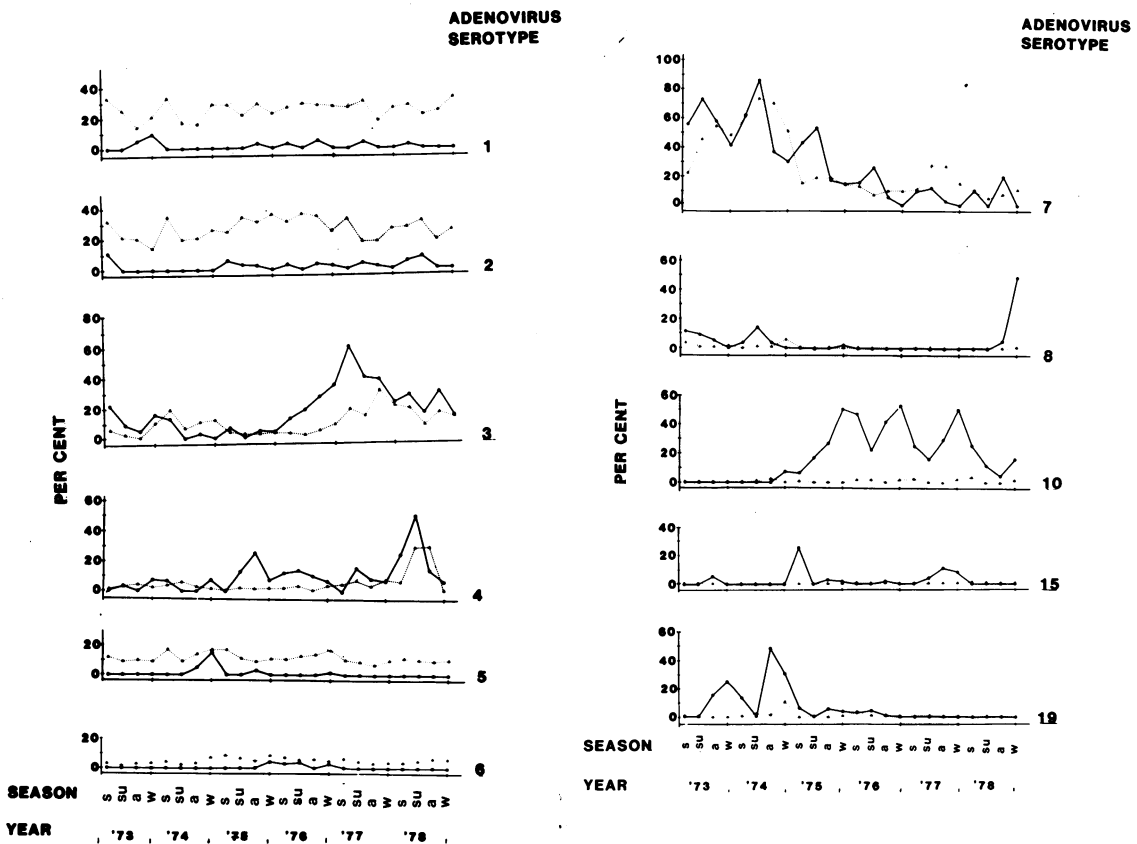


Fig. 2 Seasonal incidence of ocular and nonocular adenovirus serotypes during 1973-8. Solid line: ocular isolates. Broken line: nonocular isolates. S=spring, Su=summer, A=autumn, W=winter. Serotype 15 includes 3 isolates of serotype 15/29.

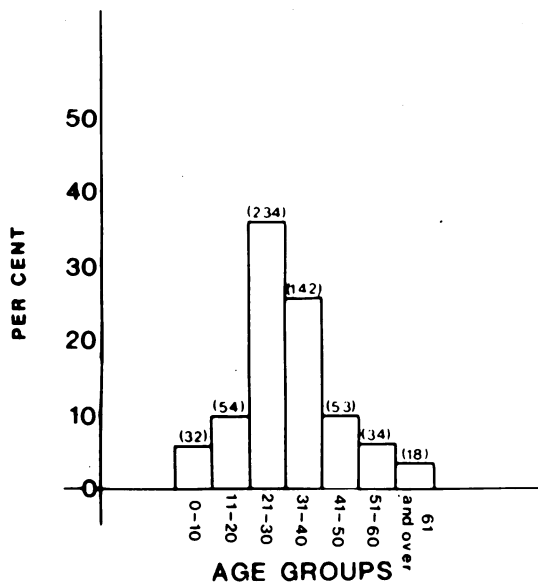


Fig. 3 Age distribution in patients with ocular adenovirus infections. Figures in parentheses indicate sample size.

the hospital. The outbreak extended into 1974, with some isolations being made during 1975 and 1976. Ocular infections during the same period were reported from the USA,¹¹ Holland and Belgium,¹² Canada,¹³ and Scotland.¹⁴ During the last 2 years of this survey, however, this serotype has not been detected.

Two small clusters of infections caused by adenovirus 15 (15/29) were detected, one in 1975 and the other in 1977. Ocular infection due to this serotype is rarely encountered.¹⁵

Only 2 adenovirus serotypes exhibited clear seasonal variations. Adenovirus 7 showed an early summer peak (April to June) each year, except 1978 when the peak was delayed to July-September. The peak incidence for adenovirus 10 on the other hand was consistently during the winter months (October to December).

It was of interest that certain adenovirus serotypes commonly associated with nonocular sites were rarely found in ocular infections. Adenovirus 1, 2, and 5, accounting for 55% of the nonocular infections, were seldom isolated from the eye. Conversely, adenovirus 4, 8, 10, 15 (15/29), and 19, frequently isolated from

the eye, were seldom reported from other sites. These findings suggest that for certain serotypes nonocular sites, particularly the respiratory tract, are not a major reservoir of virus for ocular infection.

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