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Acute bacterial conjunctivitis in Assiout,* Upper Egypt

A one-year study

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Conjunctivitis is the commonest eye disease in Egypt, where it presents a major problem of public health. The chief menace of acute infective conjunctivitis lies in the corneal complications which may cause blindness. Since the late 1930s, the gonococcus and Koch-Weeks bacillus have been regarded as the most common causes of this condition in Egypt (Wilson, 1935; Lyons and Amies, 1949), but other organisms, such as pneumococci, streptococci, staphylococci, and *Moraxella*, may also be involved.

Most investigations of the problem in Egypt have been carried out near Cairo and Giza, but there are differences in climatic and social conditions between Upper and Lower Egypt, and this study has been made at the eye clinic of Assiout University in Upper Egypt.

This paper presents the results of a one-year bacteriological and epidemiological study.

Material

In the year 1967, a total of 28,872 patients was seen. The average number per month at each season and the average number of cases of conjunctivitis per month at each season are shown in Table I and Fig. 1. Conjunctivitis occurred most often in the Spring and Autumn; Summer came next and Winter last. A series of 320 patients from Assiout City and the surrounding villages was selected for study.

Table I *Average number per month of cases of acute conjunctivitis related to average number per month of all patients at each season*

Season		*Winter*	*Spring*	*Summer*	*Autumn*
Patients per month		1590	2300	3200	3100
Patients with conjunctivitis per month	No.	500	1500	1087	1574
	Per cent.	31·5	65	34	51

Methods

Each patient was given a thorough clinical examination and a sample of the conjunctival discharge was taken from each eye using a sterile platinum loop. The samples were immediately cultured on blood agar plates, and incubated at 37°C. for 48 hours to allow the slowly-growing bacteria to develop. Direct culture was more efficient than Gram-stained smears in detecting ocular bacteria of all types.

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* Assiout city (375 km. from Cairo) is the capital of Upper Egypt, where one of Egypt's new medical schools is established.

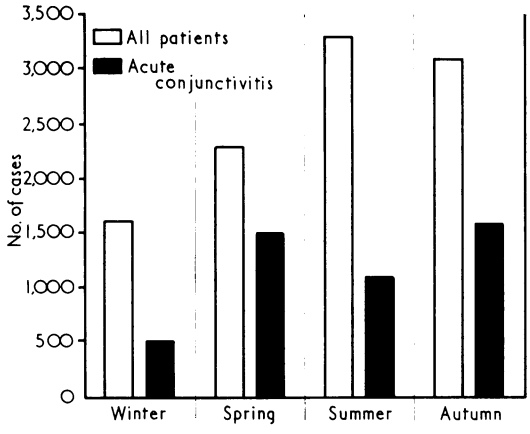

FIG. 1 *Average monthly number of cases of acute conjunctivitis related to average number of all patients*

Several strains of each organism isolated were tested for sensitivity to various antibiotics and chemotherapeutic agents.

Results

CULTURES (Table II)

In 189 of the 320 cases, ocular pathogens were isolated, in 126 cases only normal ocular flora were found, and in five cases the culture was negative.

Table II *Cultures of pathogenic bacteria and normal flora*

Result of culture		*Pathogens alone*	*Normal flora*	*Mixed*	*Negative*	*Total*
Cases	No.	8	126	181	5	320
	Per cent.	2·5	39·5	56·5	1·5	100

Seven of the known ocular pathogens were isolated, alone or in combination (Table III).

Table III *Isolation of bacterial ocular pathogens, in order of frequency*

Pathogen		*Koch-Weeks bacillus*	*Haemolytic streptococcus*	*Pnemococcus*	*Gonococcus*	Staph. pyogenes	*Moraxella*	E. coli	*Total*
Alone		73	54	21	12	6	5	1	172
Combined		12	10	3	4	5	5	1	40
Total	No.	85	64	24	16	11	10	2	212
	Per cent.	40	30	11·3	7·5	5·1	5	0·5	100

The normal ocular flora comprised *C. xerosis* and *Staph. albus*, alone or in combination (Table IV, overleaf). A mixed culture was obtained in 181 cases (Table V, overleaf).

A comparison of Tables IV and V shows that infection with pathogenic organisms affects the growth of the non-pathogenic flora. *C. xerosis* increased in frequency from 12·7 to 32·5 per cent. in the presence of pathogenic bacteria, and *Staph. albus* decreased from 39·7 to 26·5 per cent.

Table IV *Non-pathogenic ocular flora without bacterial pathogens*

Normal flora		C. xerosis *only*	Staph. albus *only*	C. xerosis *plus* Staph. albus	*Total*
Cases	No.	16	50	60	126
	Per cent.	12·7	39·7	47·6	100

Table V *Association of pathogenic and non-pathogenic flora*

Normal	*flora plus pathogens*	C. xerosis	Staph. albus	C. xerosis *plus* Staph. albus	*Total*
Cases	No.	59	48	74	181
	Per cent.	32·5	26·5	41	100

RELATIVE INCIDENCE OF BACTERIA AT DIFFERENT SEASONS (Table VI and Fig. 2)

The Koch-Weeks bacillus is seen to have two peaks, one in Autumn and one in Spring, the former being higher; it is the commonest organism at all seasons, except in Winter when it is replaced by *Strept. haemolyticus*, and it also has a higher incidence in Winter than in Summer.

Table VI *Bacterial pattern of acute conjunctivitis, by season*

Season		*Winter*	*Spring*	*Summer*	*Autumn*	*Total*
Number of cases		40	50	79	151	320
Koch-Weeks bacillus	No.	8	12	13	52	85
	Per cent.	20	24	16·4	34·4	26·5
Haemolytic streptococcus	No.	14	6	7	37	64
	Per cent.	35	12	8·8	24·6	20
Pneumococcus	No.	6	4	7	7	24
	Per cent.	15	8	8·8	4·6	7·5
Gonococcus	No.	2	4	5	5	16
	Per cent.	5	8	6·3	3·3	5
Staph. pyogenes	No.	0	1	5	5	11
	Per cent.	0	2	6·3	3·3	3·4
Moraxella	No.	3	5	1	1	10
	Per cent.	7·5	10	1·2	0·6	3
Staph. albus	No.	22	31	62	112	227
	Per cent.	55	62	78·4	74	70·9
C. xerosis	No.	19	31	55	102	207
	Per cent.	47·5	62	69·6	67·5	64·6
E. coli	No.	0	0	2	0	2
	Per cent.	0	0	2·3	0	0·6

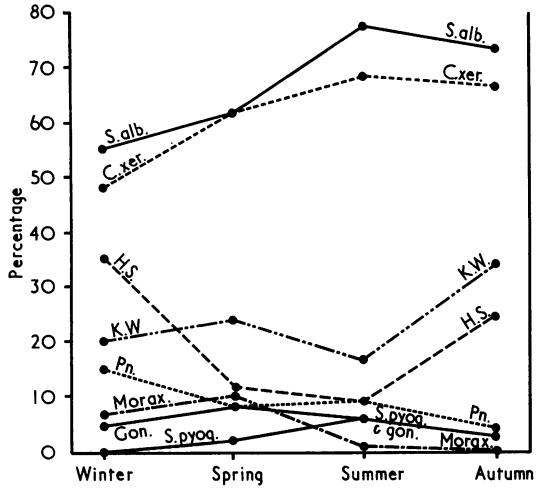

FIG. 2 *Bacterial pattern of acute conjunctivitis at different seasons*

S.alb. = *Staph. albus*
H.S. = Haemolytic streptococcus
K.-W. = Koch-Weeks bacillus
Pn. = Pneumococcus
Morax. = Moraxella
Gon. = Gonococcus
S.pyog. = *Staph. pyogenes*
C.xer. = *Corynebacterium xerosis*

RELATIONSHIP OF ORGANISMS TO AGE AND SEX (Table VII)

We selected the moderate and severe cases of conjunctivitis for our study, but as regards age and sex the selection was random.

Conjunctivitis is seen to be mainly a disease of children, with a maximum incidence at 6 years and under, and it is slightly more common in boys. No cases due to the pneumococcus or gonococcus were reported after the age of 7 years. Twelve of the sixteen cases due to the gonococcus occurred in boys, and nine of the ten cases due to *Moraxella* in girls.

Table VII *Distribution of organisms, by age and sex*

Organisms	*Age (yrs)*				*Sex*	
	0–1	1–6	6–12	More than 12	Male	Female
Koch-Weeks bacillus	16	34	12	3	44	41
Haemolytic streptococcus	19	32	8	5	36	28
Pneumococcus	18	6	0	0	13	11
Gonococcus	10	6	0	0	12	4
Staph. pyogenes	5	4	1	1	5	6
Moraxella	2	3	3	2	1	9
E. coli	0	2	0	0	2	0
Staph. albus	81	97	26	24	122	106
C. xerosis	82	90	18	17	112	95
Total cases	119	137	35	29	175	145

EFFECT OF DURATION OF DISEASE ON THE ISOLATION OF BACTERIA (Table VIII)

Acute conjunctivitis is a disease of short duration. The majority of cases in this series came to hospital within 8 days of onset. When they were analysed to find the effect of the

duration of the disease, it was found that the likelihood of isolating bacterial pathogens diminished slightly with the passage of time.

Table VIII *Rate of obtaining a positive culture, by periods of disease*

Day		1–2	3–4	5–6	7–8	9–10	More than 10
Culture	Pathogens with or without normal flora	54	74	15	26	5	15
	Normal flora only	28	48	13	7	4	16
	Total	82	122	28	43	9	31
Percentage pathogens		65·8	60·6	53·5	60·4	55·5	50

EFFECT OF TREATMENT ON THE ISOLATION OF PATHOGENIC BACTERIA

Many patients had had some sort of treatment either local or systemic before coming to the hospital. Table IX shows that any treatment affected the likelihood of isolating pathogenic bacteria, the organism most affected being the haemolytic streptococcus; but the percentage of positive cultures from cases under treatment is still high, which shows that the treatment was inadequate.

Table IX *Effect of Treatment on Isolation of Pathogens*

Treatment	*Given*		*Not given*	
Organism	*No.*	*Per cent.*	*No.*	*Per cent.*
Koch-Weeks bacillus	29	34·1	56	66·9
Haemolytic streptococcus	18	28	46	72
Pneumococcus	9	37·5	15	62·5
Gonococcus	6	37·5	10	62·5
Staph. pyogenes	4	36·3	7	63·9
Moraxella	4	40	6	60
E. coli	1	50	1	50
Total	71	33·5	141	66·5

ANTIBIOTIC SENSITIVITY (Table X)

The sensitivity of these organisms to a selected group of antibiotics and to sulphadiazine was classified into four categories by the diameter of the zone of inhibition on the plate: *viz.* highly sensitive (H S), moderately sensitive (M S), slightly sensitive (S S), and resistant (R).

Sensitivity was least to penicillin and sulphadiazine, probably because these two drugs tend to be prescribed indiscriminately in hospitals and general practice, often in inadequate doses. Aureomycin (chlortetracyeline) and chloromycetin (chloramphenicol) were found to be the most effective drugs, especially when used topically. Haemolytic streptococci, gonococci, and pneumococci were sensitive to most of the drugs tested.

Table X *Antibiotic sensitivity*

Organism		*Koch-Weeks bacillus*	*Haemolytic streptococcus*	*Gonococcus*	*Pneumococcus*	Staph. pyogenes	*Moraxella*	Staph. albus
Therapeutic agent	Sulphadiazine	R	SS	SS	R	R	R	SS
	Penicillin	R	SS	SS	SS	R	R	R
	Streptomycin	R	HS	HS	HS	MS	R	MS
	Chloramphenicol	HS	HS	HS	HS	HS	HS	HS
	Tetracycline	SS	HS	HS	HS	SS	SS	MS
	Chlortetracycline	HS	HS	HS	HS	SS	MS	MS
	Oxytetracycline	MS	HS	HS	HS	SS	SS	HS

Discussion

Conjunctivitis is known to occur in seasonal epidemics, generally in the Spring and Autumn. This seasonal variation is related to the fly population which is the vector for transmission of the disease, a fact which was observed nearly a century ago by Howe (1888) and has since been amply confirmed by Lyons and Abdine (1952) and Ponghis (1957).

In 131 cases of this series (about 40 per cent.), a negative culture was obtained or one or more of the normal ocular flora was grown. This absence of known pathogenic bacteria raises several questions. The inhibitory effect of lysozyme and the misdiagnosis of early cases of trachoma as acute bacterial conjunctivitis should be borne in mind. Adenoviruses, which fail to grow on ordinary bacteriological media, have been shown to cause conjunctivitis (Bell, Snyder, and Murray, 1960; Kasel, Evans, Spickard and Knight, 1963), as well as pleuropneumonia-like organisms (PPLO) (Warthin, 1948; Krücken and Fabry, 1955; Holland and Worlton, 1957; Weinberger, Ropes, Kulka, and Bauer, 1962). The possibility that organisms failed to grow because some of the patients had already received treatment should also not be overlooked.

The question must also be raised whether the so-called nonpathogenic flora, such as *C. xerosis* and *Staph. albus*, are in fact potential pathogens. Some maintain that the only criterion of pathogenicity should be that an organism is found to be parasitic on living cells (Lindner, 1921; Pillat, 1921). This view would rule out organisms like *Staph. albus* from any active part in conjunctival pathology, yet this organism was found in 110 genuine cases of acute conjunctivitis either alone or associated with *C. xerosis*. The role of this organism as a potential pathogen in acute conjunctivitis therefore needs to be further studied, and such work is now in progress.

C. xerosis was isolated in 209 of our 320 cases, and in sixteen cases was the only organism found. It is known to be an almost constant inhabitant of the conjunctival sac, but the earliest attempts to incriminate it as a pathogen were fruitless both clinically (Weeks, 1887) and experimentally (Fraenkel and Franke, 1887). This organism could hardly exist alone in the conjunctiva, and it probably depends for its existence on other organisms in symbiosis.

The data presented in Tables IV and V show that, in cases of conjunctival inflammation, the local flora change considerably (Duke-Elder, 1965), since isolations of *C. xerosis* more than doubled and those of *Staph. albus* decreased.

The isolation of *Staph. albus* in 232 cases (72·5 per cent.) confirms the findings of other workers that this organism is more prevalent in the conjunctivae in hot climates (62 per cent. in Queensland, Gibson, 1951; 95 per cent. in Egypt, Kamel, 1949), and less prevalent in cold climates (*e.g.* Great Britain: 34 per cent. in healthy conjunctivae (Smith, 1954), 11·3 per cent. in cases of conjunctivitis (Jones, Andrews, Henderson, and Schofield, 1957)).

The Koch-Weeks bacillus was the commonest pathogenic organism isolated in this series at all seasons except the Winter. The autumn peak is higher and is followed by a post-autumnal peak which means that it is isolated more often in Winter than in Summer. This is a feature of Assiout epidemics in contrast to other parts of Egypt, and may be due to the fact that autumnal weather extends for a longer period at Assiout. In cool countries such as Great Britain, the Koch-Weeks bacillus is rarely encountered in conjunctivitis (Duke-Elder, 1965) and its peak is known to occur in late Winter (Jones and others, 1957). In North Africa and the Middle East there are peaks in May and September (Wilson, 1935; Huet, 1956; Ahmad, 1958).

The haemolytic streptococcus was the next most frequent organism, although streptococci are rarely found in the conjunctival sac, being present in only 1 to 4 per cent. of normal eyes (Duke-Elder, 1965). This and the pneumococcus were more commonly encountered in the Winter season, which may be related to the Winter prevalence of upper respiratory tract infection.

The gonococcus is known to be a common cause of acute conjunctivitis in Egypt (Wilson, 1935; Lyons and Amies, 1949), but was fourth in frequency in our series. Whether this is due to a low incidence of venereal diseases in Upper Egypt is open to further investigation.

The pneumococcus was isolated in only 24 cases (7·5 per cent.); it is found in healthy conjunctivae in varying proportions: 3·2 per cent. (Smith, 1954) and 10 to 12 per cent. (Lundsgaard, 1927). It is difficult to determine how far it should be regarded as a pathogen but it was found alone in 21 of the 24 cases in which it was isolated.

Moraxella was found in ten cases (about 3 per cent.), and in half of these it existed with other pathogens. This organism, which is known to produce subacute angular blepharoconjunctivitis rather than acute diffuse inflammation, was found by Smith (1954) in a small proportion of healthy conjunctivae, but has also been reported in 1 per cent. of cases of acute conjunctivitis (Jones and others, 1957). There are at least four different strains of *Moraxella* (Murray and Truant, 1954) to which the conjunctiva may react differently.

E. coli was isolated in only two cases; in one of them it was found in pure culture. It has been isolated from the conjunctival sac in 2 per cent. of normal individuals (Smith, 1954), but Sadoughi (1948) thought that it was usually a contaminant. It was obtained in pure culture in acute conjunctivitis by Sanyal (1929) and Friedenwald (1929). Infection in guinea-pigs has been shown to produce purulent keratoconjunctivitis (Rédey and Csizmazia, 1960).

Summary

(1) 320 cases of acute conjunctivitis seen at the Assiout University Eye Clinic were investigated bacteriologically and epidemiologically.

(2) In 189 cases (59 per cent.), one or more of the known bacterial ocular pathogens was isolated, either alone or associated with normal flora.

(3) In 131 cases (41 per cent.), normal flora or a negative culture were obtained.

(4) The commonest pathogen was the Koch-Weeks bacillus, followed by haemolytic streptococcus, pneumococcus, and gonococcus. Two cases were possibly due to *E. coli*.

(5) A marked increase in the frequency of isolation of *C. xerosis* was found in cases infected with pathogens.

(6) Koch-Weeks bacillus was the most common cause of conjunctivitis at all seasons (except the Winter where it was replaced by the haemolytic streptococcus) and occurred in epidemic peaks in the Spring and Autumn.

(7) Conjunctivitis was found most often in the first 6 years of life. The gonococcus was more commonly isolated from males and *Moraxella* from females.

(8) The isolation of pathogenic bacteria from the conjunctiva was affected by the duration of the disease and by previous treatment of any sort.

(9) The pathogens isolated in this series were found to be totally or highly resistant to penicillin and sulphonamides and markedly sensitive to chlortetracycline and chloramphenicol.

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