MILK-BORNE DIPHTHERIA A GENERATION AGO

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In their valuable article[1] on the occurrence of *C. diphtheriae* infection in dairy cows, M. M. Greathead, B.V.Sc., and P. J. N. R. Bisschop, B.V.Sc., state that they could only find two reports of such infection of cows in South Africa. It fell to my lot when Medical Officer of Health (MOH) of Cape Town from 1923 to 1944 to deal with four outbreaks of diphtheria that were shown to be associated with lesions of the skin of the teats or udders of cows in dairy herds. Particulars of these milk-borne outbreaks I included in the annual reports of the MOH for the years 1923 - 24, 1924 - 25, 1927 - 28, and 1936 - 37, which are to be found in the Medical Library of the University of Cape Town and elsewhere. They were not, however, published in any professional journal, and so that they may be more easily found they are now reproduced in the present article. The first of the following outbreaks I encountered during my first year in South Africa.

CLAREMONT OUTBREAK 1924

In the year ended 30 June 1924, 75 cases of diphtheria were notified in the Claremont ward (ward 13), as compared with an average of 11 cases each in the other wards of the Cape Town municipality. This excess was found to be explained by undue incidence of the disease among the customers of three dairymen, in whose herds some of the cows were found to be suffering from ulceration of the teats on examination by the Council's Veterinary Officer (VO), the late J. Forrest, M.R.C.V.S.* The Government Pathologist, the late Dr. G. W. Robertson, succeeded in some instances in isolating *C. diphtheriae* in pure culture from the swabs taken from these ulcers, proving their virulence, and completing their identification.

The affected cows were isolated from the herds until the lesions had healed, and following upon this action the outbreak ceased.

The bacteriological work in connection with the other outbreaks recorded in this article was also carried out in the Government Pathological Laboratory, Cape Town.

OBSERVATORY OUTBREAK 1925

In the first half of the calendar year 1925 a sharp increase of diphtheria occurred in Cape Town, especially in January and March, the corrected number of cases notified in the first 6 months being 34, 13, 94, 25, 22, 14. In those months the diphtheria cases in the district of Observatory, which is situated partly in ward 10 and partly in ward 9, were 16, 5, 49, 9, 2, 2; in January and March amounting to about one-half of the total for the whole municipality.

In January, 5 of the 16 Observatory cases were supplied by a small milkseller (A), who was getting his milk from two cowkeepers (I and II).

At the two cowkeepers' premises swabs were taken from the Native milkers, with negative results. The cows were examined by the VO for sores on the teats and udders, but nothing suspicious was found except a sore in one cow of cowkeeper I. This was swabbed and returned as negative, and it was concluded that there was nothing suspicious at either cowkeeper's premises.

Milkseller A and his family and staff were all swabbed (they had no suspicious symptoms) and Klebs-Loeffler bacilli, identified by isolation and virulence test, were obtained from the throat swab of one of the Native employees. This man was sent for isolation to the City Hospital on 14 January, and the action was followed by a subsidence of the outbreak. It was hoped that the cause had been removed.

In February the position remained quiet; two diphtheria cases occurred among the customers of milkseller A.

In March the diphtheria both in Observatory and the municipality as a whole increased suddenly and rapidly, and of the first 12 Observatory families then involved, 6 were found to be supplied with milk by milkseller A, who also supplied a Government institution at Maitland where 3 cases occurred in March and April. Again swabs were taken from the family and staff of milkseller A, and this time another Native employee gave a positive swab from the throat and was removed to hospital on 9 March, as well as milkseller A himself, whose swab was suspicious, though he proved afterwards not to be a carrier. On 10 March milkseller-A's milk round was discontinued for a time, his customers being supplied directly from the premises of cowkeeper I. A third Native employee of milkseller A was found to give a positive throat swab and was sent to the City Hospital on 17 March.

In spite of the action taken, an undue number of diphtheria cases continued to occur in Observatory. Attention

*Dr. Forrest undertook all the veterinary work reported in this article.

was then drawn to a few cases (5 in March and 2 in April) among the customers of a milkseller (C) in Woodstock, who was found to have been receiving milk from cowkeeper I from 1 March. This directed further suspicion to this cowkeeper's milk, which was strengthened by the fact that 2 cases of diphtheria had occurred in January, and 3 cases on 1 March and 2 March, among the customers of another milkseller (B), in ward 6, who had been supplied by cowkeeper I for some months until 28 February. One case also occurred in March among the few private customers whom cowkeeper I supplied direct.

A further examination of the cattle of cowkeeper I was made by the VO on 7 March and swabs were taken from sores on the udders of 2 cows, with negative results. On 6 April the VO re-examined the cows and took swabs from 3 of them, with negative results. One of these 3 cows, however, had on the udder ulcers which, in the light of the observations made during the 1924 outbreak at Claremont, were regarded as suspicious. The milk from this cow was therefore excluded from that of the herd, and the cow was afterwards disposed of. Following this action the outbreak came to an end.

The facts appeared to indicate that the milk from cowkeeper I contained the infection of diphtheria from time to time throughout the outbreak from January to March 1925, but although there was suspicious ulceration of the cows' udders no diphtheria bacilli were found in swabs from the ulcers. It was recognized also that during these months there was an increase of diphtheria incidence in other parts of the Cape Town municipality which, as well as a number of cases in Observatory, had no apparent association with the milk from cowkeeper I or milkseller A. No evidence was found to suggest any infection in the milk supplied by cowkeeper II.

The positive nasopharyngeal swabs from the employees of milkseller A might well have been the result of contact with milk that had been infected before delivery by cowkeeper I.

KENILWORTH OUTBREAK 1926 AND 1928

At dairy K, in Kenilworth, about 20 - 23 cows were kept in milk, and the trade was entirely retail. The customers lived in ward 13 of the Cape Town municipality and in the adjoining municipality of Wynberg, which on 5 September 1927 was merged into the Cape Town municipality as ward 15 (Wynberg ward). Before that date only cases that occurred in ward 13 are included in this account of the outbreak; subsequently cases occurring in ward 15 are included as well as those in ward 13.

After 2½ years during which no customers of dairy K were known to have had diphtheria, 4 customers fell ill with diphtheria in 14 months, one each in March 1925, December 1925, January 1926 and April 1926. Then 19 customers developed the disease in the remaining 8 months of 1926 (3 in May, 3 in June, 1 in July, 1 in August, 3 in September, and 8 in December). Then in the year 1927, 6 customers went down (2 in February, 2 in August, and 2 in November). The largest outbreak took place in 1928, when, after one case in January, 24 customers developed diphtheria in February and the first 3 days of March, by which time dairy K was closed down. Of the 54 cases among the customers of the dairy, enumerated above, all but 2 were whites.

In the 11 months January - November 1926, of the 63 cases of diphtheria in ward 13, 13 were in households supplied with milk by dairy K. The cows in dairy K were inspected from time to time during this period and no indication of diphtheria infection was found. In December 1926, 8 of the 9 cases notified from ward 13 were customers of the dairy, and a further inspection was made by the MOH and the VO on 31 December. The owner and his staff of 5 Natives were swabbed, with negative results, and the 23 cows were examined. Four were found to have ulcers on the teats and they were at once removed from the herd and their milk kept separate. Swabs were taken from the sores on these 4 cows, and in 2 of them (Witkwaas and Kolletje) germs were found morphologically resembling the diphtheria bacillus. Another inspection was made on 4 January 1927, when 5 more cows with ulcers or cuts on the teats were similarly put into isolation (Bessie, Daisy, Kolmuis, Cheeky and Bluebird). The swabs from each of these five contained bacilli resembling diphtheria bacilli. The cultures from 6 of the cows giving positive swabs were further examined by Dr. J. D. Wicht, Acting Government Pathologist, whose report dated 10 January 1927 was as follows:

Beaded bacilli indistinguishable from Klebs-Loeffler *B. diphtheriae* were found on primary cultures of all 6 swabs. Inoculation of these mixed cultures was made on 5 January into 6 pairs of guinea-pigs, one of each pair being protected by subcutaneous injection of 1,000 units of diphtheria antitoxin. The results were as follows:

Kolletje. Both animals dead on 7 January. P.M. appearances were not conclusive of infection with Klebs-Loeffler bacilli.

Bessie. Both animals alive on 10 January.

Daisy. Unprotected animal died on 9 January. P.M. appearances—marked injection of adrenals, etc. Protected animal alive on 10 January.

Kolmuis. Unprotected animal dead on 8 January. P.M. examination showed marked injection of adrenals and abdominal organs. Protected animal alive on 10 January.

Cheeky. Unprotected animal died on 9 January. P.M. showed marked injection of peritoneum and adrenals. Protected animal alive on 10 January.

Bluebird. Unprotected animal died on 7 January. P.M. examination showed marked injection of adrenals and abdominal organs. Protected animal died on 9 January; no injection of adrenals noted at P.M.

A granular diphtheroid was isolated in pure culture from Daisy, Kolmuis and Bessie. These 3 cultures were injected in protected and unprotected guinea-pigs on 7 January. All these animals were alive and well on 10 January.

Remarks. Although these findings do not furnish conclusive evidence, I think we are justified, especially in the light of previous experience, in assuming the presence of Klebs-Loeffler *B. diphtheriae*. It is unfortunate that attempts at isolation in pure culture failed.

The isolation of the cows with sores was continued until they had healed and were passed by the VO.

After 31 December 1926 no more customers of dairy K developed diphtheria for several weeks, and the action taken in isolating the cows with sores therefore appeared to be effective.

When, in the middle of February 1927, two more cases occurred in customers, the dairy was again inspected by

the MOH and VO on 16 February. Two cows (Duchess and Dates) were found to have similar sores and were isolated until the sores had healed. Swabs from the sores gave negative results.

When, after 6 months again with no cases, two more customers developed diphtheria in August 1927, the VO again examined the cows and found two (Cheeky and Flower) with cut teats. In the cultures from the sores Dr. Wicht found a few bacilli indistinguishable from diphtheria bacilli, though he was unable to isolate them in pure culture, and the two cows were isolated.

Again this action was followed by a cessation of cases among the customers for 11 weeks, when, in November 1927, two more developed. The VO then examined the cows again and took swabs from the teats of two of them (Bontrook and Violet), but did not consider it necessary to isolate them from the herd. The swabs were returned as negative.

Altogether in 1927 only 6 of the 31 cases of diphtheria notified in wards 13 and 15 were reported as being supplied with milk from dairy K.

When the heavy outbreak of February 1928 began, the MOH and VO inspected the dairy on 14 February, and the cows were found to be freer from sores on the udder than on any former inspection. One cow (Cheeky) had a scabbed-over sore on a teat, and the swab from this was negative. All the workers on the dairy, except one Native who refused (his nose and throat appeared to be healthy), were swabbed, and one Native, whose nasal swab was positive, was removed to hospital the next day. This man, who showed no suspicious signs, had only been employed on the dairy since 1 February 1928. The mixed culture from his swab was fatal within 24 hours both to the protected and the unprotected guinea-pig; the bacilli could not be isolated in pure culture.

As further cases of diphtheria continued to occur among the customers, and as the absence of lesions in the cows made it impossible to take the action that on previous occasions had been followed by a cessation of cases, the MOH submitted a report on 15 February on consideration of which the City Council decided to cancel the dairyman's licence and thus to compel him to cease carrying on his trade of cowkeeper at dairy K. His milk round was accordingly discontinued at the end of February 1928, and the farm has not been used since for dairy cows.

The dairyman was thus left with a herd of 20 cows, and these the Council decided to take off his hands at a price. One cow was suffering from an injury, and was slaughtered. The other 19 were moved into stables belonging to the Council, and the daily milkings were discarded. Four of these cows developed ulcers on the teats. In one (Povelenski) virulent *C. diphtheriae* was isolated in pure culture, in one (Dolly) the presence of virulent *C. diphtheriae* was proved, though it was not isolated, and in two (Teeny and Swartje) *C. diphtheriae* was not found. The Council eventually sold the cows, free from sores, by public auction.

In this herd of 22 cows 14 were found at different times during 15 months to show the characteristic ulcers, and in 9 of these the diphtheria bacillus was recognized. No reason why the cows became infected in this manner was discovered.

KALK BAY OUTBREAK 1936

The only milk-borne diphtheria outbreak that has since been recorded in Cape Town is one that involved 8 cases in the Kalk Bay district of ward 14 of the Cape Town municipality and 2 in the adjoining Fish Hoek area of the Cape Division; all 10 took their onset between 28 June and 15 July 1936. The 6 households in which the cases occurred were all receiving their milk from a cowkeeper in the Fish Hoek area, whose customers numbered 55 in all.

On 10 and 11 July the cowkeeper's premises were inspected by the Cape Town Assistant MOH (the late Dr. F. O. Fehrsen) and the VO. Two Natives on the staff gave negative results on examination and swabbing of the nose and throat. Of the herd of 10 cows, 4 showed excoriation of the teats, from which swabs were taken. The swabs from 2 cows were negative; from those (3 in number) taken from the other 2 cows organisms were obtained on culture that were indistinguishable morphologically and by staining reactions from Klebs-Loeffler bacilli. Intradermal inoculation of a guinea-pig with the mixed culture gave reactions indistinguishable from those usual with highly virulent Klebs-Loeffler bacilli. The bacilli were not isolated.

The 4 cows with affected teats were isolated from the herd on 11 July; 2 were sent away to farms where no milk was sold, and the other 2 were returned to the herd when the excoriations had healed.

No further cases of diphtheria occurred among customers of this cowkeeper. There had previously been no other cases in Kalk Bay since April 1936.

ADDENDUM

All the outbreaks of milk-borne diphtheria recorded in this article took place before two important preventive factors came into operation in Cape Town, viz. (1) The compulsory pasteurization of milk sold to the public, and (2) anti-diphtheria immunization of the community. By 1936, the date of the last outbreak, immunizing had been practised in Cape Town for a few years, but a large proportion of the community still remained susceptible to diphtheria. The proportion has since been greatly reduced as progress has been made with immunization. The compulsory pasteurization of all milk sold to the public was brought into force in 1953, and since that time the danger of milk-borne disease in Cape Town has been greatly reduced, if not entirely abolished.

In none of the four outbreaks here recorded was any history obtained of a case of diphtheria having occurred in a person working or living on the dairy or cowshed premises involved.

REFERENCE

1. Greathead, M. M. and Bisschop, P. J. N. R. (1963): S. Afr. Med. J., 37, 1261.