

A CONTRIBUTION TO THE BACTERIOLOGY OF POST-SCARLATINAL DIPHTHERIA.

By H. CUMPSTON, M.B., B.S., D.P.H.,
Assistant Medical Officer Western Fever Hospital.

(From the Lister Institute of Preventive Medicine.)

THE basis of this paper is the analysis of the bacteriological examination of the fauces of a series of 1019 patients admitted to hospital as cases of scarlatina and a consideration of their subsequent clinical histories. A practice was made of swabbing the fauces of scarlet fever cases without any selection on their admission to hospital. In all cases one bacteriological examination was made and in a number of the cases the examination was repeated.

Method of carrying out the Examination and Criteria employed for determining the presence of Bacillus diphtheriae.

The fauces were swabbed with a sterile cotton-wool swab while the patient was still in the receiving room, so as to obviate any possibility of infection in the hospital. The swab was immediately rubbed well on the surface of a solidified blood serum tube. The tube was incubated at 37° C. and examined after 18 hours. Films were made and stained with Löffler's methylene blue, and in those cases in which there was a doubt as to the character of an organism resembling the diphtheria bacillus separate films were made and stained by Gram's method, by Neisser's stain and by toluidene blue. With this last stain true *B. diphtheriae* stain, light blue, the granules being a deep purple and very definitely outlined. Diphtheroid organisms show polar staining of much less definite character—in most cases staining almost uniformly.

Results of the Examinations.

Of the 1019 cases the throat was examined in 1017 and the nose in 165. The examination of the nose was omitted in the majority of the cases. It is recognised that the results would have been more valuable had such an examination been made throughout the whole series.

Of the total 1019, *B. diphtheriae* were found in 75 cases and diphtheroid organisms in 12. That is to say 7·36% of cases of scarlet fever examined on admission showed the presence of *B. diphtheriae* in the nose or throat on one examination and 1·07% showed diphtheroid organisms (*B. Hofmanni*).

These occurred thus.

In the throat 1017 cases examined :

59 or 5·8% showed *B. diphtheriae*.
7 or ·68% showed diphtheroid bacilli.

In the nose 165 cases examined :

21 or 12·72% showed *B. diphtheriae*.
8 or 4·84% showed diphtheroid bacilli.

Comparative results are available. In two of the other hospitals of the Metropolitan Asylums Board the following results were obtained.

In the throat: (a) One series of 203 cases. 5·41% with diphtheria bacilli and 1·2% with diphtheroid¹.

(b) A series of 87 cases. 6·8% with diphtheria bacilli².

In the nose: (a) A series of 202 cases. 12·37% with diphtheria bacilli and 53·7% with diphtheroid¹.

(b) Lambert Lack (1898), in a series of 100 cases in the out-patient department of a large general hospital, found diphtheria bacilli in 13% of the noses examined and diphtheroid organisms in 52%³.

These results agree closely with those obtained in the present series as far as true diphtheria bacilli are concerned, but the presence of diphtheroid organisms in more than half the noses examined is not in agreement with the results obtained during the present investigation. This discrepancy is probably due to a wider interpretation by these writers of the term "diphtheroid." The term diphtheroid in this paper refers to the class of micro-organisms usually known as Hofmann's bacillus.

¹ *Report Metrop. Asylums Board, 1900.*

² *Trans. Epid. Soc. London, vol. xv.*

³ *Med. Chir. Trans., vol. LXXXII.*

That is to say, then, that of the 1019 cases 75, or 7·36% were harbouring the diphtheria bacilli and 12 or 1·07% other organisms, presumably (in the absence of further bacteriological examination) of the same type.

932 cases were free from such organisms as far as could be seen in one examination.

Subsequent History of the Cases Examined.

Of the 932 cases six developed clinical diphtheria.

Five of the faucial type on the 9th, 22nd, 46th, 48th and 50th days of scarlet fever.

One of the laryngeal type on the 38th day—this required tracheotomy but recovered.

These six cases, or 64% of "bacilli free" cases, were presumably cases of hospital-contracted diphtheria.

Of the 75 cases which showed the presence of diphtheria bacilli on admission four cases, or 5·3%, developed clinical diphtheria, three cases occurring on the 4th, 5th and 31st days—the last one of which died of diphtheria. The fourth case is interesting in that it showed diphtheria bacilli in the nose only and not in the throat. It developed typical faucial diphtheria on the 7th day.

There were three other cases which are worth mentioning.

(a) Diphtheria bacilli in the nose only on admission—on the 31st day there were diphtheria bacilli in the nose and throat—on the 44th day pharyngitis occurred, with no formation of membrane.

(b) This case was certified as diphtheria but was diagnosed scarlet fever on admission and showed diphtheria bacilli in the nose only. There was some paralysis of the soft palate on 44th day.

(c) Diphtheria bacilli in the throat only on admission—the patient developed tonsillitis with no membrane on the 26th day.

The throats of these 75 cases presented on admission no evidence on examination of the presence of the bacilli—they differed in no way from the ordinary variety of throat conditions seen in scarlet fever.

Of those cases, then, which showed no bacilli on admission 64% contracted diphtheria, while of those which had already diphtheria bacilli in the throat or nose 5·3% contracted diphtheria. This may be interpreted as indicating that many of those cases of post-scarlatinal

diphtheria apparently contracted in hospital are not really cases of hospital infection, but are due to an attack on the organism by bacilli already present—the scarlet fever having possibly produced a condition of lowered resistance. It is, further, interesting to note that the cases which had diphtheria bacilli on admission developed the clinical manifestations on the 4th, 5th, 7th and 31st days of scarlet fever, while those which were “bacilli free” showed clinical diphtheria at later stages, viz. 9th, 22nd, 46th, 48th and 50th days. Whether this interpretation be accepted or not, the results are sufficiently striking to justify the routine bacteriological examination of every case of scarlet fever admitted and the continuance, in those cases in which bacilli are present, of routine throat treatment well into the stage of convalescence and even right up to the time of discharge from hospital. That one case should have bacilli in the nose only and yet develop faucial diphtheria supports the routine examination of the nose as well as of the throat.

It is striking that of the 75 cases which had diphtheria bacilli on admission only four, or 5·3% (or if we include the three doubtful cases mentioned above seven, or 9·3%) developed clinical diphtheria. That is to say that the possible effect of scarlet fever in raising the virulence of the diphtheria bacilli (or lowering the resistance of the patient) was only seen at the outside in 9·3% and only definitely in 5·3% of the patients in which all the conditions for such a result were already present.

Of the 12 cases which showed Hofmann's bacilli on admission four showed these organisms in the throat only; five in the nose only; and three in both throat and nose—in none of these cases was there any clinical manifestation that could be associated with their presence, nor were any true diphtheria bacilli found in these cases on repeated examinations.

Persistence of the Bacilli.

In 29 cases repeated examinations were made to determine how long the bacilli remained in the throat while daily treatment of the throat was being carried out with antiseptic lotions. The periods during which the bacilli remained present were in days: 2, 2, 2, 2, 2, 3, 3, 4, 5, 9, 9, 11, 11, 15, 16, 16, 17, 18, 19, 22, 23, 23, 26, 28, 31, 32, 33, 34, 43. In none of these cases did there develop any clinical evidence of diphtheria. In 11 cases the bacilli disappeared under treatment before the 10th day, and in 19 cases before the 20th. In six other cases, however, the bacilli were still present after 16th, 26th, 38th, 43rd, 45th and 122nd days. In these cases it was not possible, because of the

transfer of the patients to a convalescent hospital, to continue the examination to determine the time of disappearance of the bacilli. In only one of the six were there any clinical signs, that is the one in which they were still present after 43 days—this was the same case referred to above, in which tonsillitis occurred on the 26th day.

The conclusion is, then, that in most of these cases the bacilli quickly disappear under treatment, but that in other cases they may remain long periods, in one case so long as 122 days.

There is still another aspect to be considered. That is that of the 932 cases which showed no diphtheria bacilli on admission there was a total of 28 cases (including the six cases of clinical diphtheria) which subsequently showed the presence of such bacilli.

These 28 cases can be sub-divided thus:

A. Nineteen cases in which the nose was not examined but no diphtheria bacilli were present in the throat on admission.

(i) In 5 cases diphtheria bacilli were found associated with purulent rhinorrhoea on the 8th, 35th, 41st, 44th and 62nd days of scarlet fever.

(ii) In 11 cases diphtheria bacilli were found in the throat, five cases with no clinical signs but bacilli found on the 2nd, 3rd, 13th, 14th and 43rd days.

Six cases, as above with clinical diphtheria on the 9th, 22nd, 38th, 46th, 48th and 50th days of scarlet fever.

B. Nine cases which showed no diphtheria bacilli in nose or throat on admission.

(i) Two of these showed bacilli in both nose and throat on the 30th and 61st days of scarlet fever respectively.

(ii) Five showed bacilli in the nose only on the 34th, 42nd, 45th, 48th and 51st days—all of these had purulent rhinorrhoea but no ulceration or membrane on the septum or the turbinates.

(iii) Two showed bacilli in the throat only on the 29th and 61st days respectively—the latter of these showed the persistence of the bacilli in the ear discharge till the 139th day.

It may be objected that the comparison above of 5·3% of clinical diphtheria cases in which bacilli were present on admission with 64% of apparently hospital-contracted clinical diphtheria is not a just one, but that all bacteriological infection, whether followed by clinical diphtheria or not, should be regarded as of hospital origin.

Even if this is done and the whole 28 cases included it makes 2·75% as against 5·3%, and there is abundance of reliable authority for assuming

that the bacilli were probably overlooked on the first examination, and in 19 of the cases it is possible that the bacilli were present in the nose.

Conclusions.

The most interesting facts brought out by this investigation are :

1. That of cases of post-scarlatinal diphtheria with clinical signs the percentage of those which come into hospital with bacilli already present is more than eight times as high as the percentage of those which are presumably infected in hospital.

2. That while in the majority of the cases which are harbouring diphtheria bacilli on admission, the bacilli rapidly disappear under treatment yet, in a certain small percentage, the bacilli may persist for a long time, though not necessarily producing clinical manifestations.

3. That of those cases which had diphtheria bacilli present on admission less than 10% (on the widest calculation) developed clinical signs and only 5·3% developed typical diphtheria.

REFERENCES.

- GOODALL (1896), Post-scarlatinal Diphtheria in the Hospitals of the Metropolitan Asylums Board. *Trans. Epidem. Soc. London*, 1895-6, p. 68.
- LACK (1898), Fibrinous or Membranous Rhinitis and its Relation to Diphtheria. *Medico-Chir. Trans.* vol. LXXXII. p. 1.
- PUGH (1900), The Diphtheria Bacillus and its significance in Cases of Scarlet Fever. *Report Metropolitan Asylums Board*, 1900, p. 201.