of practically every superficial vein of the right leg. A section of a vein was removed for examination and showed a firmly adherent clot, with slight thickening of the vein wall. Cultures made from the vein were sterile. An absolutely complete examination at this time failed to reveal any cause for the trouble. Further events in this case were thrombosis of a superficial vein in the abdominal wall, and of one or two other superficial veins of the trunk at intervals of two or three months, each attack being accompanied by a general febrile reaction. Finally, a year after the beginning of the illness, the right popliteal vein became affected. In this case no involvement of visceral veins took place; but recovery was very tedious, and the patient was only able to resume work about two years after the beginning of her illness. Various treatments, including colossal manganese and peptone, were employed, but do not require detailed comment.

It will be seen that the main feature of these cases is the tendency to metastatic extension, often at long intervals. The trouble commences in a segment of a peripheral vein, which becomes painful and tender. Redness and swelling ensue, and there is slight or moderate pyrexia. Soon the symptoms begin to subside, only to reappear in some portion of the same vein or of a distant vein. All four limbs may be involved, and with each recurrence of phlebitis there is a recurrence of pyrexia.

In association with the tendency to extension we note implication of visceral veins. Thus the pulmonary involvement with haemoptysis, noted in three of our cases, was referred by us to a process in pulmonary veins similar to that met with in the peripheral veins. Embolism was negatived by the definite absence of characteristic symptoms associated with this condition. In this connexion we would like to stress the conspicuous absence of embolic symptoms in our cases, though the patients were not confined to bed throughout their illness, and must therefore at one time or another have been in a condition most favourable to the production of embolus. In two of our cases symptoms of mesenteric thrombosis were encountered, and in one patient symptoms occurred which suggested involvement of a coronary vein. This implication of a coronary vein is unique so far as the literature is concerned, though it seems likely that the paroxysm of tachycardia in a case described by Legrand⁵ was due to this cause.

The etiology of the condition is obscure, though the local signs of inflammation and the method of spread suggest forcibly the presence of a blood infection. This view is strongly advocated by Vaquez and Leconte,⁶ and later by Legrand,⁷ in connexion with a series of analogous cases described by them under the title "subacute venous septicaemia." Legrand quotes two cases in which the streptococcus was isolated from the blood stream. In our cases blood culture was uniformly negative, but was not repeated with sufficient frequency to permit definite conclusions. In one case severe pyorrhoea was present. Apart from this no septic focus was found in any of our patients.

The disease follows a prolonged course with alternations of remissions, more or less complete, and of subacute recurrences. The ultimate prognosis seems to be favourable, though functional disability may persist. It is interesting, though perhaps inapposite, to draw attention to cases quoted by Buerger⁸ in which recurrent phlebitis of superficial veins was the precursor of thrombo-angiitis obliterans. Such a sequel has not been encountered by us, and it is likely that Buerger's cases did not belong to the group with which we are dealing.

Summary.

We publish four cases of phlebitis of extensive distribution and migratory character, showing involvement of peripheral and visceral veins, prolonged course, and relative benignity. We can throw no light on the etiology, but present our short paper in the hope that it will stimulate research which will elucidate the cause of this unusual but interesting malady, and place therapeutic efforts on a scientific basis.

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THE HISTORY OF AN OUTBREAK OF TYPHOID FEVER IN PRETORIA:

WITH SPECIAL REFERENCE TO THE DETECTION OF TYPHOID CARRIERS.

BY

ADRIANUS PIJPER, M.D.,

PATHOLOGIST TO THE PRETORIA HOSPITAL (AT THE TIME ACTING M.O.H. OF THE MUNICIPALITY OF PRETORIA),

AND

B. DAVIDINE PULLINGER, M.B., B.S.

THE history of this outbreak is of interest in that it illustrates the necessity of empowering medical officers of health to exercise a closer supervision of dairies than has been the case hitherto, especially so far as the native element in such places is concerned. It also shows the superiority of the complement-fixation test over the agglutination test of Widal for tracing the course of an outbreak and discovering carriers.

The total number of cases in this outbreak was twenty-eight, including seven among natives. Only one patient died, a European female child, one of the first to be infected. This low mortality is probably due partly to the prompt recognition of the disease in the later cases, when medical practitioners and the public were aware of the probability that slight illness in a family supplied by the incriminated dairy would probably turn out to be typhoid fever. The typhoid case mortality in Pretoria is ordinarily about 7.5 per cent.

The first patient was a European boy. The usual inquiries were made as to the supply of milk and food to the household, but since nothing suspicious was found, and it was said that the child drank very little unboiled milk, no further steps were taken. Quite a different light was thrown on the matter, however, when, two days after this child had been notified (complement-fixation test positive, Widal test positive, typhoid bacilli recovered from blood), the daughter of the proprietress of the dairy which supplied this household, who had been ailing for some time, was subjected to a typhoid complement-fixation test, and her reaction was found to be positive. This patient was removed to hospital as soon as the diagnosis was established, and on the same day blood specimens were taken from the eleven natives employed at the dairy, who were all "healthy" and at work. The result was surprising, for seven of them reacted positively to the typhoid complement-fixation test. Of these seven, five were strongly positive, one just positive, and one weakly positive. Widal tests were performed at the same time, but only two positive reactions were obtained: the serum of one boy, which was definitely positive with the complement-fixation test, agglutinated only in serum dilutions up to 1 in 20, while the serum of the boy whose complement-fixation reaction was just positive only reached 1 in 40.

This large number of positive findings made the position very difficult. From past experience we know that carriers as a rule give a positive complement-fixation reaction, but we also know that this test remains positive for a varying period after convalescence. It seemed absurd to assume that seven out of eleven natives employed at one dairy were carriers. A much more probable explanation of the situation was that there had been a local epidemic at the dairy among the native servants, and that we were concerned with the tail-end of this epidemic. Interrogation of the proprietress and the natives at first seemed to elicit facts which supported this view. There was a vague history of several of the natives having been down with "malaria" off and on during the previous weeks, and having been dosed with quinine for that reason; and there was also a tale of a young native who had been engaged two or three months before this trouble started, but who had never done any work and had been either malingering or ill most of the time. This rather imaginary young native had now disappeared, and all our attempts to trace him proved in vain. Moreover, the more we pressed for further details about the illnesses of the natives in the past weeks the more vague, confused, and unreliable the information became. There

evidently existed a marked reluctance to assist us in clearing up the position.

We therefore put our own construction on the matter and dealt with it in the following way. All the natives except one were removed to the isolation hospital on the same day on which their blood tests had been performed, on the strength of a magistrate's order procured for the purpose. The one native left behind gave a negative test, and had been employed at the dairy for sixteen years. It was assumed that when a native has worked at a dairy in town for that period, and is exposed to typhoid infection without harm, he is either naturally immune or has become so by having had the disease. That he was the carrier responsible for the whole outbreak was highly improbable for the same reason, and also because he gave a negative complement-fixation reaction. Moreover, as this boy had been in the dairy's employ for so many years, he would be very valuable to his employer, who was considerably disconcerted by the removal of all the other natives, and who naturally experienced great difficulty in carrying on her business. Still, this was better than closing the dairy altogether.

The rather drastic measure of removing all the natives was, in our opinion, warranted on the grounds that there evidently had been, or was at present, an outbreak of typhoid fever amongst the native employees, and that at any rate those who reacted positively had something to do with the outbreak; that there might very well be a carrier amongst them; and that, further, those four boys who gave a negative reaction might have become infected quite recently, so that removal of only the obvious cases would not have the desired effect of stamping out the infection. Taking away obviously infected natives and leaving behind a few possibly or even probably infected ones would have been a half-measure that might easily have undone whatever would have been achieved by the steps taken. It was also found that the native quarters at the dairy were not in good condition, and that when once infection had started there probably every native would fall a victim to it.

That the measure of removing all the natives was not too drastic became evident three days later, when two of the natives developed manifest typhoid fever at the isolation hospital. These were the two boys who had given a weakly positive and a just positive complement-fixation reaction.

The other measures taken to prevent the further spread were: disinfection of the dairy premises and the sending of a written warning to all the customers of the dairy to boil their milk. Naturally this last measure was not, strictly speaking, necessary. If the source of infection had been removed, as we believed it had, there was no need to boil the milk; it was thought, however, that with such a large number of infected natives at the dairy some infectious material might still persist, notwithstanding thorough disinfection of the premises, and that therefore the boiling of the milk might help to destroy any source of infection that remained.

It may be stated at once that the measures taken were quite successful, though the mischief had been done before they were put into force. During the ensuing fortnight an unusually large number of typhoid notifications reached the health office at Pretoria. These cases were investigated with particular care. With very few exceptions (and these were chiefly persons from outside the town) all the cases could be traced to the consumption of milk from the incriminated dairy. In all cases except one the patients were customers of the dairy; in that one case the patient was in the habit of drinking milk at a teashop which was supplied by the dairy. The large majority of patients informed us that they usually drank their milk unboiled; in two instances the only person in a household to contract the disease was the one who insisted on taking his milk unboiled, whilst the other members preferred it in the boiled condition. Still, considering the risks of infection run by the public in those days—as, for instance, the man who contracted typhoid through drinking milk at a teashop—one is impressed by the relatively small number of persons who contracted the disease. Even if allowance is made for a fairly large number of "ambulatory" and otherwise undiagnosed cases, the conclusion

is inevitable that there must exist a pretty widely spread immunity against the disease.

The removal of the natives had the desired effect of extinguishing the source of infection. A fortnight after the natives were removed the notifications came to an end. Several weeks later a child in a family supplied by the dairy was found to be ill with typhoid, but closer investigation showed that in this family another child had been ailing for many weeks, without the true cause being suspected, and that this other child had become ill at the same time as the large crop of victims of the outbreak. The dairy could therefore only be held indirectly responsible for this late case.

Notwithstanding the fact that only one case terminated fatally, the disease was not of a mild type. Relapses were fairly frequent, the disease lasted the usual time in most cases, and although, as always happens, some cases were very mild, there were also several in which the life of the patients was seriously endangered. A complement-fixation test was performed in all cases but one, and was uniformly positive. Blood cultures were attempted four times with a pure growth in each case. In addition, Widal tests were performed on four patients and were positive in only two.

To return to the natives who had caused the outbreak. It has already been stated that two of them showed manifest symptoms of typhoid infection three days after they were removed from the dairy; their disease ran a normal course. Of the other eight, the three who gave negative complement-fixation reactions at the start remained negative. Complement-fixation tests were performed once every week on all these natives; in addition to this, regular weekly examinations of the stools and urine were instituted.

The unpleasantness and difficulties of repeated stool examinations are considerably relieved by adopting the following technique. Strong glass rods are made, about 1 cm. thick and about 15 cm. long, with rounded ends. At about 1 cm. from one of the ends a hole, about 2 mm. wide, is drilled across the rod, care being taken that the edges of the hole are left smooth. The rods are inserted into test tubes, with a plug of cotton-wool in the mouth of the test tube, just like diphtheria swabs, and sterilized in this position by hot air. A sample of stool can now be obtained from any patient at a moment's notice by taking the glass rod from the test tube, inserting it into the patient's rectum (vaselining is not necessary), turning it round a few times, and, after withdrawal, replacing it into the test tube. Sufficient material will always find its way into the drilled hole.

It would have been of considerable interest if these stool and urine examinations could have been performed immediately after removal of the natives. Pressure of other work prevented this, and it was thought more advisable, both with a view towards preventing further spread among these natives and in order to make a possible carrier amongst their number harmless in the shortest possible time, not to lose time over examinations, but to institute preventive treatment without delay. In Pretoria we have so far obtained very good results from the use of the Besredka method of immunizing against typhoid. It seems to have definite prophylactic value, and also an undoubted effect on "stool carriers." On three consecutive mornings each person takes one bile pill, followed by a pill containing 40,000 million typhoid bacilli, killed by heat. (Paratyphoid bacilli are not included because this infection is practically non-existent in this region.) This treatment was given to the isolated natives a couple of days after arrival at the isolation hospital. It probably assisted in keeping the natives with negative blood tests free from infection, although here also the improvement in sanitary conditions, as compared with those obtaining at the dairy, must have had an influence.

When the first stool and urine examination was made it was found that not one stool of the eight yielded typhoid bacilli. In one urine typhoid bacilli were detected in large numbers. This native had been engaged by the dairy six months previously, and had acted as stable and delivery boy. As the infection had only spread from the dairy quite recently, it must be concluded that this native had arrived at the dairy in a perfectly sound condition, and that he had contracted the infection at the dairy. He had

a strongly positive complement-fixation reaction for typhoid, but his Widal reaction was negative from the start, and remained so for some weeks after. The three natives who persistently showed negative blood reactions and negative findings in both urine and stools were discharged from the isolation hospital after four weeks and returned to the dairy. It was thought that one might rely, if not on their natural immunity, then on the immunity acquired from the Besredka prophylactic treatment. This left five boys, one of them the urinary carrier, and the four others giving positive complement-fixation but negative Widal reactions, and negative findings in stools and urine. After the urine and stools had been examined five times, and it had been noticed that during these weeks their complement-fixation reactions had become weaker and weaker, it was considered that it was safe for them to return to work, and they were allowed to resume work at the dairy. The only one then left over was the urinary carrier; his blood gave a persistently positive complement-fixation reaction, and his urine every week showed typhoid bacilli. It was not to be expected that Besredka treatment could have had any effect on this condition. Treatment was therefore instituted with ordinary typhoid vaccine given under the skin, and large doses of urotropine, but after many weeks, although the typhoid bacilli in the urine showed signs of diminishing in number, they were still to be found. It took four months before they disappeared entirely and the boy could be discharged.

This constitutes the history of the outbreak. The moral of the story is that if the first case of typhoid at the dairy had been recognized as such—whether it was the imaginary stray young native or a member of the regular staff—much suffering and unhappiness would have been prevented. Our dairy by-laws place the obligation on dairy owners to notify the health department of any case of infectious or contagious disease occurring on their premises; it is evident that this is an unsatisfactory arrangement. The onus thus rests on the health department to prove that the dairy owner was aware of the fact that a disease amongst the personnel was infectious or contagious, and that will always be difficult. The whole responsibility should be transferred to the health department, provided that at the same time it receives the powers and facilities to examine all employees upon their being engaged by the dairy, and at regular short intervals thereafter. This examination should include a blood test for typhoid fever, and the foregoing record amply shows that for such work the complement-fixation test is superior to the Widal. If the Widal test had had to be relied on the urinary carrier would not have been detected with the same rapidity, and where two other natives at the time gave a positive Widal reaction the investigation would probably have stopped at that, and the chief culprit would have carried on his work.

It remains to give a brief description of the principles and technique of the complement-fixation test for typhoid. We have for many years insisted on the necessity of abandoning agglutination tests for typhoid in South Africa, as we have proved^{1,2} that the majority of cases cannot be diagnosed by this method. We have also obtained some evidence from animal experiments that this failure to develop agglutinins which we have demonstrated in South Africa is at least partly due to the prevailing excessive sunlight.² The complement-fixation test is positive in over 90 per cent. of cases, is as a rule not positive in persons who have been vaccinated against typhoid but are suffering from some other infectious disease, becomes positive at an early stage of the disease, and is much more helpful in the detection of carriers. Its only drawback is that it requires perfect technique and much more care than agglutination tests. Our present procedure is as follows.

The antigen is prepared by cultivating typhoid bacilli (there is no difference between typhoid strains for this purpose) on ordinary agar slopes for twelve to twenty-four hours and washing them off with saline solution, using about 4 c.cm. per slope. The suspension is heated in the water-bath at 57° for one hour, stored in the ice-chest for forty-eight hours, and filtered through a Berkefeld candle. The filtration must be slow and produce only a few cubic centimetres per hour. Suction may not exceed 16 mm.

of mercury. It is only by strictly observing these rules that a potent and constant antigen can be prepared. Each filtrate must be titrated afresh with each new haemolytic system to be used. This is done by employing diminishing quantities of filtrate, from 0.5 c.cm. to 0.05 c.cm., with 0.5 c.cm. of guinea-pig complement diluted ten times, making up to 1.5 c.cm. with saline solution, incubating for one hour, and then adding 1 c.cm. of haemolytic system. A control tube is required which contains only saline and complement; to this tube also 1 c.cm. of haemolytic system is added. The time is noted when this control tube has cleared, and ten minutes after this the tubes are again inspected. The tube which then shows complete haemolysis and contains the largest quantity of antigen indicates the quantity of antigen to be used in the test proper. The antigen is then diluted so that 0.5 c.cm. contains the suitable dose. As a rule we find that 0.3 c.cm. represents the quantity of antigen to be used.

If the filtrate is to be kept for more than a few days it is advisable to add 0.25 per cent. carbolic acid to the filtrate previous to titration. A good filtrate has considerable keeping qualities, and although we do not use it after it is fourteen days old we have found that it will keep its antigenic properties for at least thirty days.

We prepare haemolytic system by determining the minimum quantity of a sheep's cells-rabbit serum which, in the presence of 0.5 c.cm. of ten times diluted guinea-pig serum, will completely dissolve in two hours 0.5 c.cm. of a 5 per cent. suspension of sheep's cells, the total volume in each tube being made up to 2.5 c.cm. Four times this minimum quantity of serum is then used in the test proper. The serum is suitably diluted for this purpose with saline, and equal quantities of diluted serum and 5 per cent. sheep's cells suspension are mixed.

The patient's serum is inactivated, and 0.1 c.cm. is put up with 0.5 c.cm. antigen, 0.5 c.cm. complement 1 in 10, and 0.4 c.cm. saline. This is incubated for one hour, and then 1 c.cm. of haemolytic system is added. At the back of every patient's tube is a serum control, containing 0.2 c.cm. of the patient's serum, no antigen, 0.5 c.cm. complement, and 0.8 c.cm. saline. In addition an antigen control, containing 0.5 c.cm. antigen, 0.5 c.cm. complement, and 0.5 c.cm. saline, is put up.

Readings are taken when the antigen control has cleared, and then for every individual patient when his serum control tube has similarly cleared. Serums from the later stages of the disease show complete and lasting fixation; those from earlier stages show partial fixation, which is often not permanent. It is useful to include a known positive serum in the series, either from a previously tested typhoid patient or from an injected rabbit.

Human serum which produces complete fixation under these conditions will retain that quality when kept at room temperature for a considerable time.

By following this technique we have been able to make a positive serological diagnosis of typhoid fever in cases where the presence of the disease was established beyond doubt by positive blood cultures, but where Widal's agglutination test was persistently negative.

We have found the method particularly valuable in the detection of carriers. Here we also often found a negative Widal and a positive complement-fixation reaction, as illustrated by the case recorded in this paper.

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THE ROLE OF DEAD AND INFECTED TEETH IN AUTOGENOUS INFECTIONS.

BY

A. P. BERTWISTLE, M.B., CH.B., F.R.C.S.ED.

WHILE the literature teems with works on the evil effects of pyorrhoea alveolaris—and there can be no doubt as to its baneful effect on health—there is another dental condition which is but now receiving the attention it deserves—namely, the tooth which has died before or after filling, and which has subsequently become infected. That death may occur without pain makes the condition all the more unsuspected.

The bacteria in pyorrhoea pass into the mouth, where the majority are ingested by the salivary corpuscles; the rest pass on to the stomach and are destroyed, if the gastric juice is normal. In the case of the filled tooth the bacteria cannot regain the mouth by way of the original decay, but must enter the bone, from which they or their toxins may be disseminated by the blood stream to all parts of the body, when those tissues which are "below par" fall a prey to them. By the irony of fate it is those people who take care of their teeth, having no untreated caries, who