BACILLÆMIA DUE TO INFECTION WITH B. FAECALIS ALCALIGENES.

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Clinical Notes by

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In epidemics of disease due to the enteric group of organisms, especially when occurring among troops under war conditions, many cases are met with which are more or less atypical, and in which a diagnosis can only be reached with certainty by bacteriological methods.

More especially is this true under present conditions, when the disease as seen is frequently modified by previous prophylactic inoculation. Without a well-equipped laboratory to aid in the diagnosis, by means of haemoculture and serological tests, many cases of pyrexia due to other causes would undoubtedly be confused with this modified type of enteric, while others which clinically do not resemble enteric but are proved bacteriologically or serologically to be so, would be overlooked.

In speaking of making a diagnosis in enteric infections, I refer to the three types—B. typhosus, B. paratyphosus A, and B. paratyphosus B—as one group, and as causing one disease, namely, enteric. I am not here concerned with making a differential diagnosis between the three members of this group—which, of course, can only be done in the laboratory—but rather of differentiating between such an enteric infection and the various other pyrexias of unknown origin.

During the past nine months at this hospital I have had occasion to make blood culture examinations of considerably over a thousand cases of enteric and suspected enteric infections. In the course of this work I have on several occasions, discovered in the culture of the blood of such cases an organism which has up to the present time been regarded as more or less non-pathogenic—namely, the Bacillus faecalis alcaligenes.

During the height of the enteric epidemic last summer this organism was isolated only on a few rare occasions—two or three times by myself and a similar number of times by my colleague, Lieutenant Willmore. Recently, however, it has occurred from whose blood I have isolated the same organism with almost sufficient frequency to constitute a mild epidemic, and quite frequently enough to identify it as playing a pathogenic part, and being the definite cause of a mild pyrexia in which the true condition is a bacillæmia. Further proof that the organism is the causative agent was given by testing the agglutination power of several cases against various strains isolated, after waiting for a sufficient length of time for specific agglutinins to be formed. In this way it was found that agglutination occurred up to a dilution of 1 in 32 of the patients’ sera with homologous and heterologous strains—in some cases even in higher dilutions—while control sera from normal patients failed to agglutinate the various strains, even in dilutions of 1 in 50.

During March and April eleven cases have occurred whose blood culture yielded this organism.

It is quite possible that several other cases of pyrexia, which were thought to be modified enteric, though in them no connection with the enteric group could be proved by blood culture, agglutination tests, or by examination of faeces, were really due to infection with this same organism. In this latter condition, as in enteric, blood cultures to be of value must be taken as early as possible in the pyrexial period. The initial pyrexial period is of short duration, lasting but two or three days. During the past two or three months most of the cases admitted to this hospital have come from camps more or less in immediate neighbourhood, the men having been ill for two or three days when admitted. All cases sent in as suspected of these infections by B. faecalis have been—blood cultures as soon as possible after admission, either on the day of admission or the day after. In any case the initial pyrexial period may easily have passed when this is done, so the blood culture in many of these would be sterile. Until recently, infection with this organism not being recognized as a clinical entity, no further steps were taken to establish a relation between these cases and the organism in question, but subsequent pyrexial periods showed that they were modified enterics, agglutination tests, and faeces examinations were carried out, but in several instances no connexion with the enteric group could be proved.

Some of these cases might well, then, be assumed to be unrecognized cases of infection with B. faecalis alcaligenes. This assumption is further borne out by the fact that since we have recognized that this was a definite pyrexia due to a definite pathological condition, I have tested the agglutination titre of the serum in some of the above-mentioned doubtful cases, and have found that in two or three of them the titre ran up to 1 in 400 for this organism, while for the members of the enteric group it was practically nil, what little agglutination for this group was present being no more than would be expected in inoculated subjects.

The points which I consider worthy of note in recording these cases are, first, that infection with this organism may clinically be mistaken for moderate enteric, from which it can only be diagnosed with certainty by haemoculture or serological tests; and secondly, that an organism which has hitherto been regarded as practically non-pathogenic may invade the blood stream, and produce a series of symptoms—a disease of which the dominant sign is pyrexia.

With regard to its pathogenicity, it is quite probable that in colder and more temperate climates the organism merely occurs as a harmless member of the intestinal flora, but that in climates such as this, where gastrointestinal disturbances are rife—especially among fresh troops who are exposed to unusual hardships before becoming acclimatized—the catarrhal condition of the bowel so set up provides a locus minoris resistentiae, and the organism, hitherto passive and harmless, now assumes an active part and invades the blood stream.

Macé, in referring to Petruschky’s original description of this organism, states: “Il se place tout un voisinage du Bacille typhique dont il a le mieux les caractères.” While Petruschky recognized its relation to the typhoid bacillus, the fact that it has so far been found to occur in the motions of healthy people and in contaminated matter, without, so far as I have been able to gather, being definitely described in relation to any disease, has undoubtedly led us to assume that it did not occur in a pathogenic part. Henderson Smith, in his recent article on the identification of the typhoid-colon group of bacilli, definitely mentions it as constituting a non-pathogenic group.

The characteristics of the strains isolated by me agree with those given by Petruschky in his original description of the organism with one or two exceptions—namely, a variability in its motility, and, in the case of one strain, a rapid tendency to peptonize litmus milk. On some occasions the strains would be freely motile, and then for no apparent reason would on other occasions lose their motility while still remaining alive, as shown by their power to be subcultured. Probably this variability depended on some slight variability in the composition of the media on which they were grown. Apart from this they agreed in all other respects—that is, they were Gram-negative bacilli growing abundantly on agar-agar as a thick slimy growth, producing intense alkalinity in litmus milk (with the one exception noted), and alkalinity in such of the carbohydrates and alcohols as were at my disposal to grow them on. In pepton broth and blood-meal broth tests, I found it necessary to centrifugalize the emulsion obtained by rubbing up the growth with normal saline, then to pipe it on the supernatant fluid, and filter it through a sterile filter paper.


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In this way a fairly homogeneous emulsion was obtained, but control tests in normal saline were always put up with an agglutinin in cases of enteric infection. It was usually found that a very small amount of pseudo-agglutination occurred in these controls—nothing to be compared to the very definite agglutination in those that were positive.

As noted I repeated the tests microscopically, and the process of agglutination became very apparent when watched under the microscope, thus eliminating any possibility of pseudo-agglutination being confused with the actual phenomenon.

The blood cultures were made as follows:

Five c.c.m. of the patient’s blood was drawn off aseptically from the median basilic vein and placed in 50 c.c.m. of a 2% per cent. solution of tryrocholal in a test tube, and this was incubated for twenty-four hours, then plated out on MacConkey plates, which were again incubated for twenty-four hours. The agar used in making the MacConkey plates was specially prepared with pancreatized bullock’s heart according to a formula by Lieutenant-Colonel Colonel Dadson.

Colonies from the MacConkey’s plate were picked off into milk, and using Salmonella typhosa culture being made to note the presence of gas, if any, as well as the reaction of the organism on the mannite.

The absence of any acidity on this medium with a gradual production of alkalinity was sufficient to differentiate the organism from the enterica group in the preliminary examinations, the further characteristics being worked out later.

Many of the strains isolated so far are agglutinated with stock (Lister Institute) typhoid or paratyphoid antiserum.

It might be as well to mention here that on the first occasion of its isolation I was rather inclined to think that I had recovered a Shiga-Kruse bacillus from the blood. Subsequent investigation showed that the organism was not connected with the dysenteric group, nor was it agglutinated by Shiga antiserum.

Since writing the above I have isolated this same organism from a further series of ten cases. In five of these I repeated the blood culture examinations five days after isolating the organism, and in two of these I again recovered the organism in pure culture. In the other three cases in which haemoculture was repeated the previous period was at the time of taking the second culture.

In two of these cases I have examined the urine bacteriologically, but in each it proved sterile. On first thought with these infections by B. faecalis, I was inclined to think they were cases of mild enterica in which the B. faecalis had entered the blood stream with an organism of the enterica group, and had outgrown the latter. But agglutination tests with the sera from these cases have failed to show any relationship with the enterica group, while, as stated above, a specific agglutinin is developed for B. faecalis. This, together with the fact that in all these cases the organism has occurred in pure culture in the blood, is, to my mind, sufficient evidence that a genuine and specific infection occurs with this organism.

I am indebted to Lieutenant-Colonel Ledingham, consulting bacteriologist to the Mediterranean Expeditionary Force, for the following notes on the characteristics of the B. faecalis group, as well as for the notes on previously reported cases of this infection, and for the table of references.

B. faecalis alcaligenes.

The organism to which the name B. faecalis alcaligenes was given by Petrenchitsch in 1896, in view of its intense production of alkali in litmus milk, was originally recovered by the same observer in 1888 from a specimen of stale beer, and later from human faeces. In many of the cultural tests at that time, the organism was differentiated from its property of rendering litmus milk alkaline. At a somewhat later period the controversy which arose over certain tests by German workers, tending to show the possibility of transforming B. typhosa into B. faecalis alcaligenes and vice versa, again drew attention to this organism; but, as the observations referred to were discovered to be due to contaminated cultures, the matter has only a historical interest for us.

In more recent years the biological properties of B. faecalis alcaligenes have been fairly well defined. Kreukner (1905), for example, found that no fermentation took place in media containing glucose or lactose, while Klimek (1907), who examined a fairly large number of strains, recorded the fact that alkali production only occurred in glucose, galactose, lactose, raffinose, arabinose, and dulcitol. It has also been established that the flagella of B. faecalis alcaligenes are always polar, and not peritrichial, as was originally stated by Petrenchitsch. (N.B.—The sugar reactions given by Castellani (1912) for this organism are incorrectly stated.)

At the present time B. faecalis alcaligenes may be defined as an organism occurring in human dejecta, particularly in diarrhoeal or dysenteric conditions, and either alone or in association with organisms of the typhoid-paratyphoid-dysentery group, or with non-lactose fermenters such as B. proteus vulgaris, Morgan’s bacillus No. 1, etc. It produces turbidity in broth, sometimes with pellicle formation; it produces no indol, and does not ferment saccharose, glucose, maltose, media containing which being rendered intensely alkaline, as also is litmus milk. Gelatin is not liquefied, and there is no pigment formation, though a brownish growth on potato has been described.

Pathogenicity for Laboratory Animals.—The organism possesses little pathogenicity for guinea-pigs and mice, except possibly when inoculated intraperitoneally in fairly large amounts.
Pathogenicity for Man.—Definite evidence of the pathogenicity of this organism for man is very scanty, although there is no reason to doubt the fact. The assumption of its association with a low form of gastro-intestinal disease. When found in the dejecta in diarrhoeal and typhoidial infections as the sole non-haemolytic fermenter, it has most commonly been regarded as simply an associated or contaminated organism which has overgrown the more specific organisms and rendered their recovery impossible. In more recent years, however, a few cases have been reported in which the organism has been recovered from the blood, and has apparently been accountable for the symptoms in the respective cases.

Thins Straub and Kraus (1914) record two cases, of which the following are brief notes:

Female, aged 19 years, admitted January 6th, 1915. Pain on defaecation, with two or three stools a day, since middle of December, 1912. Stool formed, but containing mucus. On January 2nd pains in the umbilical region. Since January 4th, vomiting of bilious watery material without blood. Littie appetite. Temperature 39° to 40° C, pulse 130. Herpes labialis. Heart and lungs normal; abdomen tender on percussion, no distension; spleen not enlarged. Temperature fell by lysis from January 5th, and patient was discharged on February 8th. From the blood a pure culture of an organism allied to the f. tetra group, but liquefying gelatine, was recovered. Total leukocytes 4,500, with relative lymphocytosis. Serum of patient did not agglutinate B. typhosus and the two paratyphoid bacilli.

Male, aged 19 years. Admitted April 24th, 1915. Took ill on April 23rd with headache and nausea, and continued at work till April 14th. He then received ambulant treatment till April 24th. On admission he complained of stomach pains in the chest, vomiting of bilious material and without dyspepsia. Stools were of a yellow colour. Temperature 39.9° C. Pulse 100. Spleen not palpable. Leucocytes 7,100, with 50 per cent. lymphocytes. Fever was continuous till April 24th, when a brief remission occurred. It continued, however, at 38° C till May 12th, when it became normal. Discharged on June 3rd. There is no record of haemoculture, but from the urine an organism giving all the characters of B. faecalis alcaligenes was recovered on May 15th. Twice during the pyrexia (April 24th and May 3rd) the urine had been found sterile. This organism did not liquefy gelatine, but did not agglutinate typhoid bacilli, and did not agglutinate the homologous strain of B. faecalis alcaligenes, as well as that recovered from Case 1, in a dilution of 1 in 1,000.

Rochaux and Marotte (1916) give a brief but concise account of two recent cases of benign typhoid-like illness in which typical B. faecalis alcaligenes was recovered from the blood.

The two patients complained of gastro-intestinal symptoms. Following two or three days the temperature oscillated between 39° and 40° C, then fell progressively to normal in ten to twelve days. Blood culture performed on the day following admission gave a pure culture of B. faecalis alcaligenes. Six days later a second haemoculture proved negative. The serum of the patient did not agglutinate paratyphoid bacilli, but agglutinated B. typhosus in 1 in 100 and 1 in 500 respectively. (Both cases previously vaccinated against typhoid.) The haemocultures organisms were, however, agglutinated by the serums of the cases in 1 in 200 and 1 in 500 dilutions respectively. Serum B. faecalis alcaligenes. Also the serum of the first patient agglutinated the organism recovered from the second case in 1 in 200 dilution, while the serum of the second patient agglutinated the organism of Case 1 in 1,000 dilution.

Two or three isolated and less authenticated cases are here omitted, and no evidence is on record of the occurrence of cases of this character in apparently epidemic form. The series of cases here recorded by Captain Shearman constitute the first record of such a disease which may be called an epidemic prevalence of infection due to B. faecalis alcaligenes.

Clinical Notes of Cases admitted into No. — General Hospital

Narly all the cases referred to by Captain Shearman were at first admitted into the Observation Ward of the No. — General Hospital, Egypt. This ward is one into which all cases of obscure pyrexia, in which no physical signs or symptoms are present to explain the occurrence of the fever when the patient presents himself and in which consequence there is a suspicion of enteric or typhoid fever, are received direct from the reception room. From this ward cases are weeded out day by day as an accurate diagnosis becomes possible. The symptoms this group of patients complained of may be briefly summarized. In nine out of the eleven cases there was a sudden onset with night chill, severe headache, usually frontal but sometimes also in the occipital region, nausea, occasional vomiting, and general aching of the limbs. Abdominal pains with constipation were also usually complained of. In two of the cases the onset was gradual, but the symptoms complained of were those above enumerated.

On examination after admission there was very little to note except in a negative way. In all cases the face was flushed, the tongue furred, and all the usual phenomena of pyrexia were apparent. The pulse was under 100, and not diartic; nothing of note was found in the chest; the abdomen was slightly distended and tender on palpation, but no enlargement or tenderness of either liver or spleen was found. The urine was normal, and in each case the diago tests were negative. In one patient there was a diffused uricarical eruption, which disappeared in twenty-four hours, but returned a few days later.

The type of temperature recorded was interesting. In nine cases there was an initial period of pyrexia of from two to five days' duration, reaching a height of from 101° F. to 105° F., and falling by lysis. This was followed by a period of normal temperature, to be tried or feverish; there was a second pyrexial period similar to the first, but lasting only two to three days, during which period there was a return of all the symptoms complained of at the beginning. In two cases there was a third rise of temperature similar to the first and second. In two cases no second pyrexial attack occurred.

BLOOD EXAMINATION from the bacteriological findings, throw no light on the condition. The white cell count, with one exception, was in each case examined under 10,000 per c.cm., averaging about 8,600, and the differential count was normal.

No spirilla or malarial parasites were found. In one case a leucocytosis of 16,000 was found. It is as probable that cases similar to these are occurring elsewhere, and as in other places where paratyphoid fever is prevalent they might easily be taken for mild and unusual forms of that disease, it is important to call attention to their existence. The diagnosis, of course, depends entirely on the bacteriological findings.

Typical temperature charts from two of the cases accompany this note (p. 894).

REFERENCES.


CYTOLOGICAL EXAMINATION OF THE JOINT FLUID AS AN AID TO PROGNOSIS IN PENETRATING GUNSHOT WOUND OF THE KNEE.

BY CAPTAIN W. S. LAZARUS-BARLOW, R.A.M.C.(T.C.).

The treatment of gunshot wounds of the knee-joint continues to be one of the most pressing surgical problems of the day. Consequently any method whereby a juster opinion of the future progress of the case can be made on its first examination is likely to be of considerable use. This fact must be my excuse for presenting a manifestly incomplete account of the method I have adopted at a base hospital in France for over a year.

The pathological principle upon which it depends is simple. Damage having been done to the joint, Nature sets about repairing the damage, and the first step consists in sending leucocytes to the synovial fluid. Now it is a fundamental fact in the pathology of inflammation that aseptic damage to a part is associated with migration of mononuclear leucocytes chiefly, septic damage with migration of polymuclear leucocytes. Moreover, up to a point where negative chemiotaxis comes into play, the heavier or more virulent the infection the greater the migration of polymucules. Fus, which consists of

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