War Medicine Series

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DYSENTERY AND DIARRHOEA IN WARTIME

BY

Sir P. H. MANSON-BAHR, C.M.G., D.S.O.,
M.D., F.R.C.P.

To parody Napoleon's famous dictum, "An army does not march, but may crawl, on its stomach." According to the Medical History of the war of 1914-18, bacillary dysentery took second place in importance among war diseases, and therefore it is up to us not to neglect the lessons taught. In this respect I think there is no need for us to repeat many of the mistakes that were made, some of which I will mention. Among those who directed the medical laboratory effort in that war were some who had had no previous experience of this problem, its many difficulties and pitfalls, so that we were fortunate to come out as well as we did on that occasion.

Classification of the Dysenteries

There is no such disease as "dysentery," and it no longer appears as such in Army and other returns. Dysentery connotes blood and mucus in the stools, diarrhoea, and abdominal colic. These appearances are produced by many different causes of ulceration of inflammation of the large intestine. One wonders sometimes why the Almighty in His wisdom created maladies so similar in their external and so dissimilar in their internal aspects as this group of "dysenteries."

We can classify it as follows: The first, the most important in wartime, is acute epidemic bacillary dysentery. It was of serious importance in operations in the Near and Far East; it was the main cause of the Gallipoli failure. No fewer than 120,000 casualties were evacuated from the Peninsula from July to November, 1915, and they were mostly due to bacillary dysentery, although other views commonly prevailed at that time.

It has been known as a very important war condition since Napoleon's retreat from Moscow; it was a factor, too, in 1870, in the South African War, and in many others.

The second group is the protozoal. This form, amoebic dysentery, on account of its more or less tropical distribution, appears to have attracted more attention than is its due. It is not the fatal disease that opinion supposes it to be. Amoebiasis is infection with *Entamoeba histolytica*; it is usually a chronic endemic disease. The complications are many because of the metastatic phenomena of this organism in its passage through the human body. Intestinal amoebiasis is originally the cause of hepatic or liver abscess; but *E. histolytica* is really a friend of man, endeavouring to live on the best of terms with him, and it is possible to harbour this parasite for the greater part of one's life without dire results.

Then there is a curiosity—*Balantidium coli*. This has been only once described in Great Britain, and that was in a mental patient, but it is said to occur among those who associate with pigs. Another form of dysentery is giardiasis (produced by *Giardia intestinalis*), a sort of spasmodic diarrhoea. It is extremely common in school children in this country, but has no real bearing upon the dysentery problem.

The next group is "helminthic dysentery," which is due to the *Bilharzia* genus of flukes. There is only one that is of vital importance—*Bilharzia mansoni*, named after Patrick Manson, who discovered it in 1903, and a common parasite of the Egyptian fellaheen. Since that time our knowledge of the life history of this parasite has become so complete and our methods of prevention so reliable that I do not think it is likely to figure in any future war. *Bilharzia haematobia*, in Upper Egypt and the Congo, may occasionally be the cause

of dysentery; and in the Far East there is *Bilharzia japonica*, which, however, is much more a Chinese than a Japanese infection.

The differential diagnosis is very important, because in a country where we may encounter the whole gamut of dysenteries it is very necessary to distinguish one from the other. There are all these enigmatical forms of colitis which, when they occur in the tropics, are continually being ascribed to one or other of the better-known dysentery germs. I should put mucous colitis down as "sinner No. 1." It is common among business and intellectual people in this country, and very common in tropical countries as a manifestation secondary to bacillary dysentery.

Again, there is "ulcerative colitis," which is so common in this country at the present moment and is found also in most tropical countries. I do not think that this is a result of war, except that people who are being incessantly worried and bombed are more apt to reproduce this enigmatical disease, which is commonly associated with mental disturbances. In the last war I saw a number of people who suffered from symptoms of ulcerative colitis which lasted for some time, until the nervous shock passed off. It is extraordinarily like bacillary dysentery in its course and in the appearance of the mucous membrane when viewed through the sigmoidoscope. But it is really quite distinct from bacillary dysentery.

Next we have the great bogey of malignant disease. Carcinoma of the sigmoid flexure or rectum may give rise to blood and mucus in the stools, and because the patient is in the tropics or subtropics and passes blood and mucus in the stool his doctor very likely jumps to the conclusion that he has amoebic dysentery, especially if the stools contain Charcot-Leyden crystals, which tend to suggest amoebic origin. Malignant disease may give rise to this phenomenon and may simulate amoebic dysentery, but may also be a sequel to it.

Another condition to be considered is tuberculosis of the large intestine. This happens to be much more common in the tropics than in this country, and insemination of the tubercle bacilli in the mucous membrane, secondary to some other form of dysentery, takes place and is extremely difficult to differentiate except by sigmoidoscopic examination. Polyposis also produces blood and mucus in the stools; it has a Mendelian incidence, and nearly always terminates in malignant changes. The intestinal mucous membrane is studded with polypi, which resemble bunches of grapes. Simple polypus in children, especially in India and other endemic areas, is apt to be mistaken for one of the dysenteries. Digital or proctoscopic examination will often settle this point immediately.

Another condition which often produces blood and mucus in the stools in older men is diverticulitis: in those who complain of alternating diarrhoea and constipation and other uncomfortable phenomena it is advisable to keep this in mind.

Mercurial poisoning has also to be considered. Page and Wilson (*Lancet*, 1940, 1, 640) recorded the occurrence of acute ulcerative colitis after cystoscopic examination of the bladder, the instruments having been washed in mercury oxycyanide. This has now been definitely proved to be due to mercurial poisoning; so that ulcerative colitis, which resembles that condition, may in reality represent an effort of the body to get rid of some toxin—not, of course, a metallic toxin—through the walls of the gut.

In the last war we had a lot of trouble, in differential diagnosis, with paratyphoid B, which is the cause of ulceration of the large intestine and blood and mucus in the stools. Subtertian malaria may produce an acute enteritis with intestinal haemorrhage and may be mistaken for amoebic dysentery. Another cause may be foreign bodies in the rectum or internal haemorrhoids, which may give rise to blood and mucus in the stools and be confounded with dysentery.

The Bacillary Dysenteries

Bacillary dysentery is a very large subject. Rather it should be called the "bacillary dysenteries." These occur in large epidemics; they have a seasonal distribution, and spread like wildfire. Epidemics of considerable magnitude often occur at the present day in Malaya, the Pacific islands, India, and Brazil. Nearly every new-comer to the tropics contracts bacillary dysentery at some time or other, children being especially

susceptible. Bacillary dysentery is endemic in nearly every mental hospital, and thousands are spent year after year in order to prevent it.

Most bacilli of dysentery have now been found in this country. I myself have isolated Shiga's bacillus in London. This organism was discovered in 1898. It produces definite biochemical and serological reactions, it is a most important organism in war, and it is the one against which we require the most potent anti-Shiga serum—which has now been prepared. Next comes Flexner's bacillus, discovered in 1900. Since that time, however, it has been found not to be one organism, but many. Bacteriologists had been devoting some of their energies to splitting up this bacillus until, at the end of the last war, they had found a great many varieties. That, of course, is *reductio ad absurdum*, and since then much good work has been done on reclassification. Flexner's bacillus is now considered to consist of six antigenic varieties, all having a connecting link. The anti-Flexner serum on the market is prepared from these six varieties.

The last-comer in this series is Sonne's bacillus, discovered in 1915, and which until recently had been rather neglected. Sonne's bacillus ferments lactose slowly and is a common organism in this country. It sweeps the community in epidemic form, producing diarrhoea with blood and mucus in the stools or a syndrome resembling food-poisoning. It is now known to be the organism concerned in infantile diarrhoea and in many endemic fluxes in all tropical countries, but occasionally it may reproduce the dysenteric syndrome as severe as in Shiga infections.

The Shiga bacillus produces acid out of glucose; the Flexner group, acid out of mannite. They all give rise to specific agglutinins in the blood of injected animals. There are difficulties in serological diagnosis. Thus it is of no use in the acute stage of Shiga infections; one does sometimes get a high agglutinin content from about the third week of the disease onwards in titres of from 800 to 1,000. The Flexner group is not nearly such a good "performer"; and here the results are always somewhat problematical, so that the only real value of serological diagnosis is in the chronic form of infection, in which the organism has produced chronic ulceration of the large intestine. In Sonne dysentery agglutination tests are usually more reliable. The stools are at first diarrhoeic and then mucus mingled with blood, resembling redcurrant jelly. The organisms are not always easy to isolate from the stools; they produce a sort of blue-grey colony, quite different from many other organisms on the plate that give rise to red colonies. Microscopical examination of the cellular exudate in the stools affords a rapid and ready means of diagnosis. The preponderating form of cell is the polymorphonuclear, but there are also large macrophage cells which closely resemble amoebae and cause considerable confusion. In acute bacillary dysentery with death within thirty-six hours of onset the mucous membrane is cherry-red and friable, and one can almost rend it in pieces like damp blotting-paper. The last four feet of the ileum and the whole of the large intestine from the ileocaecal valve down to the anal margin are in this condition. The next stage of coagulative necrosis is often very puzzling. These cases are known clinically as fulminating. Sometimes the necrosis is patchy and the appearance of the intestinal canal is that of islands of mucous membrane in a necrotic sea, and it is from these that regeneration eventually takes place. In the next stage the necrotic mucosa peels off like diphtheritic membrane. It is dead, and beneath it lies granulation tissue.

Difficulties in Diagnosis

The fact that dysentery bacilli disappear so quickly from the stools gives rise to difficulties in diagnosis. It enforces the plea that to work satisfactorily on these problems and to obtain rapid results and equally rapid cures we must place laboratories as near to the front as is possible, because when these cases arrive in a casualty clearing station or in a stationary hospital diagnosis can be rapidly made and measures be administered at the first possible moment so as to save the patient's life. An identity disk should be tied to the patient, stating that he has bacillary dysentery, and describing the treatment that has been given.

In microscopical sections a regular array of dysentery bacilli can be detected along the muscularis mucosae, and especially in the solitary follicles. Others taken later in the disease may show cystic degeneration of the mucous membrane, which is often a sequel to bacillary dysentery. An interesting point is the explanation of what is known as the "carrier state" in bacillary dysentery. Out of every hundred people affected about twenty become "carriers" for several months and the starting-point of fresh epidemics—for instance, they are considered to be the central point of every new outbreak of bacillary dysentery in India, and the bacilli persist in the mucous secretion of retention cysts in the bowel wall.

The appearance of the intestine in chronic bacillary dysentery is significant, reminding one of the cobblestones of some old French country town. It looks very much like chronic ulcerative colitis as encountered in this country, and has given rise to confusion between these two diseases. On taking cultures from these ulcers in the submucous sinuses the dysentery bacillus is usually found to be Flexner's. At one time thought to be a separate disease, chronic bacillary dysentery is one of the common causes of chronic diarrhoea in the tropics. It has been very difficult to know what to do in the way of effective treatment in such cases. In the last war the best results were forthcoming from surgical measures—appendicostomy or valvular caecostomy—but now sulphaguanidine is under trial.

Bacillary dysentery starts suddenly. It is an acute and toxic disease. Shiga's bacillus produces a virulent endotoxin, and the bacilli occur commonly only in the large intestine, but not in the blood stream, urine, or gall-bladder. Occasionally they have been isolated from the blood, but this is something of a fluke. They have also been found in the synovial exudate in dysenteric arthritis. A patient with acute bacillary dysentery usually has pyrexia. Therefore a dysentery with fever which commences suddenly is probably bacillary dysentery, and not amoebic, which is usually afebrile, as *E. histolytica* produces a cytotoxin, but not a toxin. A patient with bacillary dysentery often vomits, but this does not take place in amoebic dysentery because it is not sufficiently acute. If the patient is a child, convulsions usher in the disease. These come first; later, blood and mucus appear in the stools.

After the initial diarrhoea blood-stained mucus is passed in quantities; generally the patient loses sphincteric control. Rectal tenesmus is very urgent, as is also dysuria, or painful micturition, due possibly to the spread of inflammation to the urinary bladder. The pulse is rapid and the tongue furred. Weight is lost at a tremendous rate, owing to dehydration. When the hand is placed on the abdomen the patient winces with pain: this degree of abdominal tenderness is never seen in amoebic dysentery. In bacillary dysentery one can palpate the spastic and contracted large intestine, which feels like a rubber band or tube: especially is this the case in the sigmoid colon, and it is acutely tender. In the more chronic forms of dysentery, particularly amoebic dysentery, there may be isolated tender areas, but there is not the generalized tenderness which is so characteristic of acute bacillary dysentery. The stools may vary from twelve to twenty-four in the day, or they may be uncountable. It is not correct to call them stools, but exudates, and often serum leaks out of the anus. What we should do then is to discard the bedpan and pack with tow; in that way many lives have been saved.

Forms of Bacillary Dysentery

Bacillary dysentery may be divided into mild, acute, toxic or fulminating, and chronic forms. In the mild one gets diarrhoea, which lasts for forty-eight hours, with blood and mucus; and Flexner's or Sonne's bacillus can usually be isolated. Shiga infections are as a rule much more severe; but I do not believe that even in Gallipoli the death rate was ever more than 10% of those attacked. In the Fiji Islands and the Solomons in former days death rates of 40 or 50% were recorded among the natives, who blame the Europeans for its introduction. The fulminating form is so acute that the patient may die within forty-eight to fifty-six hours from the commencement. The stools contain dark clotted blood possessing a peculiar musty odour, but when green sloughs are visible prognosis is serious. One of the fatal signs in bacillary dysentery is hiccup. I personally have never seen

recovery in such a case. In children bacillary dysentery is an especially fatal disease, producing epileptiform convulsions, coma, and death.

Statistics regarding the geographical distribution of bacillary dysentery are often unreliable. For example, in one district of Central Africa statistics may record nothing but bacillary dysentery, and just a few miles away amoebic infections are said to predominate. Good and accurate statistics are returned by the British fighting Services, and there the two forms of dysentery are properly differentiated.

The great feature about bacillary dysentery is that it occurs in epidemics, which have a definite seasonal incidence. In North Africa, the Near East, and Iraq there are usually two epidemics during the year—one in the spring, and one, the more important, in the autumn, from August to November. There is also a good deal of evidence to show that bacillary dysentery is spread by house flies, and in their intestinal tract bacilli can be found; but there is no real evidence that it is carried by water, which appears to be the main vehicle of amoebic infection. There are milk-borne epidemics of Sonne infection in this country, but the starting-point in native communities is the carrier, and the passage of infection from one person to another by contact.

Complications of Bacillary Dysentery

The complications of bacillary dysentery are very characteristic. First of all conjunctivitis occurs about the tenth day, and iritis about the second week. There is also a dysenteric arthritis, which may be a poly- or a mono-arthritis. There may be synovial effusions, which begin suddenly, and all the joints of the body may be affected. The arthritis is often associated with pyrexia and rigors. It is curious that when the patient appears to be getting better and you think he is out of danger, then this sequel may make its appearance. Some observers say that they have seen hundreds of cases of bacillary dysentery and have never observed this; but it does not occur in every epidemic: in some the incidence is 25%. Sometimes dysenteric arthritis is confused with the gonorrhoeal form, which it somewhat resembles; but as a rule dysenteric cases clear up quickly and do not leave much disability behind. Then there is a dysenteric neuritis, and in the last war there was trouble with paroxysmal tachycardia, which occurred in convalescents and was probably due to the action of dysenteric toxins on the heart muscle.

(The concluding part will appear in our next issue)

RESEARCH IN THE U.S.S.R.

When the Germans attacked the Russians, the personnel of the U.S.S.R. Institute of Experimental Medicine gave up their long-term theoretical researches in favour of practical scientific problems. Last month they held a meeting, and Prof. Grashchenkov of the Moscow Neurological Clinic has cabled a brief report of the proceedings to this country. The main subjects discussed were the treatment of injuries of the nervous system and the control of certain epidemic diseases.

Treatment of Cerebral Lesions

Prof. Grashchenkov reported that in the last six months the neurosurgical clinic of the U.S.S.R. Institute of Experimental Medicine had treated 600 compound wounds of the head, in close collaboration with a mobile field hospital specially staffed and equipped, both surgically and radiologically, for neurosurgical work. As a result of this experience, Prof. Grashchenkov is strongly in favour of the use of sulphonamides. He recommends sulphanilamide, sulphapyridine, and sulphathiazole in varying mixtures and proportions depending on the variety of organisms disclosed on routine culture of the wounds. Brain abscess may supervene without at first giving rise to symptoms.

The treatment of aphasia and other focal brain lesions is carried out at a branch clinic of the Institute under Prof. Luria. Methods have been worked out for the restoration of normal functions. Prof. Kupalov, a pupil of Pavlov, considers that

damage at the highest level interferes with the synthetic action of large areas of the cortex, with the production of torpor and neurotic complexes. Prof. Rosenthal, another pupil of Pavlov, has reported on the elaboration of temporary conditioned reflexes in a person with brain injuries. By means of this method he is trying to determine the degree of disturbance of the cortical processes and to estimate by the speed with which the temporary conditioned reflex develops the degree of recovery of function which may be expected. Other members of Pavlov's laboratory have employed prolonged sleep therapy by means of drugs, and have found this method particularly effective in cases of cerebral contusion. Details of the methods employed are not given in Prof. Grashchenkov's report.

Peripheral Nerve Lesions

Prof. Lavrentjev has studied various aspects of the regeneration of peripheral nerves and claims to have found evidence for the "chemico-motor role" of the peripheral segment in attracting nerve fibres to itself. Investigating the value of fixed pieces of spinal cord as transplants for bridging gaps after nerve lesions, he finds that the best results are obtained by using formalinized nerve, since this "quickly vascularizes itself and delays the proliferation of the connective fibrous elements of the scar." No details are given of functional recovery in animals or men after this procedure. The only means found for accelerating nervous regeneration was heat. For preventing the outgrowth of nerve fibres and the formation of neuromas Lavrentjev suggests ligation of the vessels of the nerve. Prof. Magnitsky presents a study of the chronaxie of peripheral nerve after full and partial disturbance of its functions. Prof. Orekhovich has studied the metabolism of degenerating and regenerating nerves and finds special histolytic enzymes at work during regeneration.

Louse-borne Typhus

Reports on investigations in infective diseases are of equal interest. Levkovich reported on the work, carried out at the laboratory of Prof. Smorodintsev, on the specific prevention and early diagnosis of typhus of the classical louse-borne type. For the first time it has been possible to carry out, in an epidemic area, a large-scale investigation of the effectiveness of a vaccine prepared according to a modification of the Weigl technique at the All-Union Institute of Experimental Medicine (it will be remembered that the original Weigl vaccine was prepared from the intestines of infected lice). At the same time the Cox vaccine, prepared from growths of *Rickettsia prowazeki* in the yolk sacs of developing fowl embryos, and treated with phenol and formalin, was tested under epidemic conditions. This vaccine had been supplied by the representatives of the American Red Cross. In animal experiments these vaccines were compared with the Durand-Sparrow vaccine made from the lungs of infected laboratory animals; it was established that the Cox vaccine is the most effective and the simplest to prepare.

In the same laboratory, work was carried out on the early diagnosis of typhus by means of a complement-fixation test performed at low temperature. This reaction is stated to be very sensitive and strictly specific, giving positive results as early as the first or second day of illness. The importance of such a result can hardly be over-estimated. Bengtson¹ in America has obtained positive results in endemic (flea-borne) typhus with a complement-fixation test in which she used as antigen a suspension of *Rickettsia*; the reaction was positive as early as the sixth or seventh day of onset, and followed a course similar to that of the Weil-Felix reaction. A somewhat similar result was obtained in Q fever,² but these reactions were performed at 37° C. The earlier results in the Russian work are presumably due to the low temperature employed. These findings recall the work of Kahn,³ who has found that the reaction which goes by his name is intensified if carried out at 1° C. In this case, however, Kahn considers that the strong reactions at low temperatures are of "general biologic type" rather than "syphilitic type." A fuller account of the Russian work will be awaited with interest.

¹ *Publ. Hlth. Rep.*, Wash., 1941, 56, 649.

² *Ibid.*, 1941, 56, 327.

³ *Arch. Derm. Syph.*, 1940, 41, 817.