

Typhoid bacilluria / by C.J. Lewis.

Contributors

Lewis, C. J.
Royal College of Physicians of Edinburgh

Publication/Creation

Edinburgh : Young J. Pentland, 1901.

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By C. J. LEWIS, M.D., D.Sc. (Pub. Health), F.R.C.P.Ed.

*Reprinted from the EDINBURGH MEDICAL JOURNAL. Edinburgh and
London, Young J. Pentland, September, 1901.*

R37986

TYPHOID BACILLURIA.¹

By C. J. LEWIS, M.D., D.Sc. (Pub. Health), F.R.C.P.Ed., *Edinburgh*.

TYPHOID BACILLURIA is one of the complications of enteric fever, the importance of which has only recently been accorded its full significance. Its essential feature is the presence of the *Bacillus typhosus* in the urine, either alone or, it may be, associated with other organisms.

For a long time it has been recognised that the fæces of enteric fever patients contained the means of spreading the disease, and it has been the routine practice for these to be disinfected in all cases, but it has not been the custom to disinfect the urine passed independently of the fæces. The recent acquisition of knowledge concerning typhoid bacilluria suggests that the consideration of the propriety of similarly disinfecting the urine is a question for every practical physician, and more especially for those engaged in the preservation of the health of the public. As a contribution to the study of this question, I shall briefly describe the symptoms, onset and duration, the infectivity, diagnosis, frequency, and treatment, both personal, and for the prevention of the spread of enteric fever.

THE SYMPTOMS.—First and foremost, it is necessary to emphasise the fact that there may be no symptoms to call attention to the condition, and unless the physician is aware of this, and on the look-out for the condition, it may be present without recogni-

¹ Read at a Meeting of the Stirling, Kinross, and Clackmannan Branch of the British Medical Association, June 20, 1901.

tion. This is specially true during convalescence, when all is going well, and nothing occurs to excite suspicion. On the other hand, there may be symptoms which should at once direct attention to the urine; in a considerable proportion of cases pyuria is present; the pus is not necessarily present in large quantities, but if the urine be examined microscopically, pus cells as well as bacilli are present. In these cases the urine is faintly acid, certainly not alkaline, and contains no sediment and no albumin, or such a small quantity as to render its recognition a matter of delicate testing.

This is the condition which may be regarded as typical typhoid bacilluria; there is little or no frequency of micturition, no discomfort in the region of the bladder; the urine is acid when freshly passed, and contains large numbers of typhoid bacilli in pure culture, along with some pus cells and no albumin.

If the fresh urine be transferred to a test tube, and held up to the light, it is seen to be very slightly turbid throughout, and if the tube be shaken a peculiar "shimmer" is seen, such as may be seen sometimes in a broth culture of certain organisms after a few hours' growth. A different type of the disease is occasionally met with, in which the urine is very cloudy, thick with urates and pus, but seldom alkaline in reaction; the typhoid bacillus may be present in pure culture, but usually there are other organisms also present, notably the *B. coli communis*. This form is accompanied by pain and discomfort in the bladder, frequency of micturition, and is a cystitis with its usual phenomena. There is often albuminuria, and the shimmer is absent.

ONSET AND DURATION.—Typhoid bacilluria is rarely present in the early stages of the fever; it may come on in the second or third week, not usually before the third week, and may then continue for a varying length of time. Sometimes it only lasts until a few days after the temperature has become normal, or it may persist for several weeks during convalescence, or even months after the illness commenced.

If its duration does not long exceed the period of fever, the organisms disappear from the urine very rapidly, being present in large numbers one day and entirely absent a few days later. On the other hand, the bacilluria may not begin until convalescence is progressing, and may then last a long time.

The urine in typhoid bacilluria is in fact a culture, more or less pure, of the *B. typhosus*, which is present in enormous numbers. From 5 to 170 millions are reported as present per c.c., and the c.c. being little more than a quarter of a teaspoonful, the number passed per diem is prodigious.

The condition is believed to arise in the escape of a few organisms through the kidney, and their multiplication in the bladder. They have been found in the glomeruli of the kidney, but the balance of experimental evidence is in favour of the view that some breach of excretory membrane is necessary for their escape, and that there is no true elimination by the kidney.

INFECTIVITY.—Proof that the typhoid bacillus is excreted in the urine, in a condition capable of infecting other persons, has been very definitely forthcoming. Picture to yourselves a khaki-clad warrior returned from South Africa to his village home, after a severe attack of fever, micturating in the privacy of his own garden, the drainage from which was thoughtfully directed into a well water supply. An epidemic breaks out in the houses supplied by this well, and an alien and virulent *B. typhosus* finds a suitable environment for its ravages.

The evidence directly connecting the outbreak with the soldier's return is circumstantial and probable, if not actually proved, but actual proof of the infectivity of typhoid bacilluria is, like the toys, "made in Germany." Petruschky relates the case of a nurse who contracted the disease by drinking out of a drinking-glass which a patient, then suffering from bacilluria, had in an urgent moment used as a urinal!

FREQUENCY.—Concerning the prevalence of the bacilluria, there is much difference of opinion, some observers finding the bacillus present in all the enteric urines examined, and others in very large percentages; other observers have failed to find them in any case examined, and the truth is hard to find. The dubiety is due to the similarity which the typhoid bacillus bears to certain other organisms, especially that very ubiquitous organism, the *B. coli communis*.

All the early observations are ruled out by the fact that the distinguishing tests between these organisms have only been recently perfected. Horton Smith in London, and Richardson in America, whose observations are worthy of credence, on account of their careful bacteriological execution, agree in stating that 25 per cent. of cases of enteric fever show typhoid bacilluria: I have no doubt that they are correct as to their cases, but I think that even a smaller percentage may be found correct in other cases.

Petruschky's results give a percentage of 6; he found it three times in fifty cases, and his work also is bacteriologically indisputable. Carver met with no instance of it in sixteen cases, and others report varying percentages.

I have recently examined forty-five cases occurring in the Edinburgh City Hospital, involving a large number of specimens, and found the condition present in only one of the forty-five. The explanation appears to me to lie in the gravity of the cases investigated. Enteric fever in London has a higher mortality than in Edinburgh, and typhoid bacilluria is certainly more often associated with grave attacks, even though non-fatal, than with mild ones. If all the mild cases were examined, as well as the severe ones, I think the percentage would not exceed 10 per cent.

As a confirmation of this view, Kuhnau's researches on the presence of the typhoid bacillus in the blood appear to support this view; he states that the blood in enteric fever only contains the bacillus in 25 per cent. of cases; now, in order to reach the

urine, it must be present in the blood; and it is hardly likely to reach the urine in every case in which it is in the blood, since the kidney does not eliminate it. I set aside the suggestion that the bacillus may reach the bladder direct from the bowels, as the evidence of organisms doing so, during life, is inconclusive.

DIAGNOSIS.—The main element in diagnosis is, that the practitioner shall be aware of the condition, and on the look-out for it. The urine should be watched, and any cloudiness in an acid urine, especially if it appear suddenly some day, should insure further investigation. Look out for this, and for the "shimmer," and examine the urine microscopically. The drop of urine examined with a high power will show large numbers of small, very actively motile, organisms, and possibly some pus cells. It is no use to examine in this way urine which has been passed for some time, it is always swarming with cocci; but if a fresh acid urine, examined directly it is passed, reveal organisms, the practitioner may be fairly certain that he has to deal with a bacilluria. Unless he is able himself to cultivate the organism and decide its nature, it is then advisable for him to obtain a specimen of the urine, passed into a sterile flask, either direct or per catheter, and send it to a laboratory for report.

An ordinary specimen is not satisfactory unless some such precaution is taken; the typhoid bacillus, owing to its cultural and other characteristics, being very difficult to obtain from an impure culture.

TREATMENT AND PROPHYLAXIS.—*Personal.*—To cure a case of typhoid bacilluria, there are available two methods—internal treatment and injections into the bladder.

Drugs.—The best internal remedy is *urotropin*; it should be given in doses of 10 grs., thrice daily, and continued for a few days; its effects require watching, as it may not agree with the digestion, or may even cause hæmaturia, and the dose may require modification; usually, however, it is readily retained and assimilated. The urine should be watched during its administration, and it is likely that in a few days the organisms will have entirely disappeared; but it is not well to trust to their having done so finally, as they may recur again, so the urine must still be watched, and perhaps smaller doses continued for a few days. On any recurrence the full dose must be resumed.

Formalin is a powerful germicide, and urotropin is believed to be eliminated by the kidney in that form.

Injections.—As bacilluria is a bladder condition, the injection of antiseptics may be useful, though usually the internal treatment is effectual, and more acceptable to the patient.

A weak solution of corrosive sublimate is much superior to any other injection; though boracic acid is very commonly used, and is good, it is not so effectual; so that, if there is no contra-indication to the use of mercury, weak corrosive is best, as fewer injections are needed, and there is less chance of recurrence.

Prophylaxis.—The prevention of the spread of enteric fever by

means of the urine, is to be accomplished by efficient disinfection—inefficient disinfection is worse than useless, since it engenders a false feeling of security. The best disinfectant in typhoid bacilluria is *heat*. The urine should be boiled to insure destruction of the bacillus, though it is killed even at lower temperatures than boiling point. This method is impracticable in all cases, but in a fever hospital it would be possible to provide a cauldron in which urine could be boiled, allowed to cool, and then discharged into ordinary drains.

All vessels and urine receptacles should likewise be disinfected, and for these, as well as for the urine itself, where heat is not available, disinfectants must be used.

Admixture of the urine with the disinfectant must be thorough to be effectual; and, after mixing, it must be allowed to stand for half an hour before discharge into drains, to give the disinfectant time to act.

Equal quantities of 1–20 carbolic acid and urine should be mixed together, to obtain sterility in that time, or, if perchloride of mercury be used, a sufficient quantity must be added to give, with the urine, a solution of strength 1–1000. After this has been allowed to act, the mixture may be diluted before discharging it down ordinary drains. Izal is also useful, if used as directed for carbolic acid.

The quantities of disinfectant required, and the intelligent labour required in their use, contribute to render disinfection by heat preferable.

Finally, let us consider the question, Should disinfection of the urine be a routine practice in all cases of enteric fever? and answer it in the light of our present knowledge of the condition of typhoid bacilluria.

Looking to the fact that the majority of cases of enteric fever never have bacilluria, the routine disinfection of all enteric urines would entail a large amount of unproductive labour, and may be omitted; *but*, on the other hand, looking to the fact of its occurrence and infectivity, detection of all cases must be aimed at, and then the urine must be rendered innocuous. The detection of the condition lies, in the first instance, in the hands of the general practitioner and those in charge of fever hospitals. I recommend that, for one fortnight before the return of all enteric patients to communal life, the doctor should each day inspect the urine for cloudiness, and satisfy himself that there is no bacilluria, before allowing the patient to leave his supervision.

In this way the chances of the spread of enteric fever by this method may be greatly minimised. If, in any case, the medical attendant suspects bacilluria, it would be well to send a specimen for examination by a bacteriologist; it is not necessary here to go into the distinctions between the *B. typhosus* and the numerous organisms which closely resemble it, microscopically and culturally. It is sufficient to say that the organism must answer to a large

number of tests, only possible in a laboratory, before it can be undeniably asserted to be the *B. typhosus*. *When in doubt*, the practitioner would be wise to disinfect the urine, while awaiting the bacteriologist's report.







