

## PREVENTION AND CONTROL OF PUERPERAL SEPSIS : BACTERIOLOGICAL ASPECTS\*

BY

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Under the name of puerperal sepsis we have to include bacterial diseases due to a number of different infecting organisms, and dissimilar both clinically and in the manner in which the infection is spread. The organisms concerned in the more severe forms of puerperal sepsis are fortunately few in number. They are:

(i) Haemolytic streptococcus (Lancefield's Group A). Haemolytic streptococci belonging to Groups B, C, and G are much less common, and the infections caused by them are seldom severe.

(ii) Anaerobic streptococci.

(iii) *Bacillus coli*.

(iv) Staphylococcus.

(v) *Bacillus welchii*, and other spore-bearing anaerobic bacilli.

(vi) Pneumococcus.

For purposes of prevention and control of sepsis a knowledge of the common sources of the infecting organisms is of more importance than knowledge of the clinical features of the disease.

### Two Groups of Organisms

The organisms enumerated above fall into two clearly defined groups. The first group, with which I shall deal first in order to dismiss it, contains the anaerobic streptococci, *B. coli*, and *B. welchii*. These organisms are all normally present in or near the genital tract—the anaerobic streptococci in the vagina, and *B. coli* and *B. welchii* in the faeces and therefore probably contaminating the skin of the perineum. The explanation why such infections are not more common appears to lie in the fact that these three organisms do not multiply readily in normal lochia or serum; but their growth is favoured by the presence of necrotic tissue such as may be found when there has been severe trauma or when fragments of placenta or membranes have been retained. The passage of the organisms into the uterus is of course facilitated by the introduction of hands or instruments into the uterus. The influence of injury or interference on such infections is shown by figures from Queen Charlotte's Hospital Isolation Block. During the four years 1933 to 1936, out of thirty-eight consecutive cases of anaerobic streptococcus septicaemia only four had normal labours without severe trauma or interference such as manual removal of the placenta or self-induced abortion. This is in striking contrast to the haemolytic streptococcus septicaemias during the same four years, when, out of eighty consecutive cases, no fewer than forty-four followed normal delivery with no interference or trauma.

These figures, with similar ones which can be obtained, on a smaller number of cases, for the *B. coli* and *B. welchii* infections, clearly support the view that infections by these organisms are mainly those of complicated obstetrics, and I would suggest that the control of such

infections lies more in the hands of the obstetrician than of the bacteriologist. I do not propose to go into the large question of antiseptic technique from the bacteriological point of view. From the medico-legal aspect it is doubtful if infections by these three organisms are of much importance. They do not appear to be commonly transmitted from patient to patient, and, in any case, proof of such transmission would be hard to obtain in view of the frequency with which they are normally found in or near the genital tract.

In infections due to the other group of organisms—the haemolytic streptococcus, the staphylococcus, and the pneumococcus—we are faced with a very different problem. I propose to deal with the haemolytic streptococcus alone first. It was shown by Lancefield and Hare in 1933 that in a series of 855 vaginal swabs taken from normal women at the beginning of labour no haemolytic streptococci belonging to Lancefield's Group A were seen. There is as yet no record of these organisms being found in the normal vaginal swab before delivery. It is an interesting fact that of the patients at Queen Charlotte's isolation block infected with the haemolytic streptococcus about 40 per cent. have negative vaginal swabs before discharge from hospital and almost all are negative within a month after discharge. This suggests that the normal genital tract is not a favourable situation for the survival of the haemolytic streptococcus, Group A.

In the absence of evidence to the contrary we are justified in assuming that these infections are introduced from some extragenital source. That this is often the case has been shown by the researches of J. Smith and of Dora Colebrook, both of whom found streptococci, serologically identical with those infecting the patient, in some extragenital source, in the patient or a contact, in about 75 per cent. of cases examined.

We have then, as one of the fundamental principles in the investigation of haemolytic streptococcus infections, to face the fact that practically all are introduced from some extragenital source during labour or in the early days of the puerperium. There are two other important facts, which I shall give in the form of figures taken from the records of Queen Charlotte's Isolation Block for the seven years 1931 to 1937. These are: (1) of all cases of puerperal pyrexia admitted, only 33 per cent. were infected with the haemolytic streptococcus; (2) of all fatal cases of puerperal sepsis, 70 per cent. were haemolytic streptococcus infections.

### Sources of Haemolytic Streptococcus Infections

If we consider the chief possible sources of haemolytic streptococcus infections we find the following three broad groups:

1. Infections from the respiratory tract, or rarely some other septic focus, of an attendant or other contact.

2. Infections from the respiratory tract, or some other septic focus, of the patient herself.

3. Infections transmitted from another septic case by attendants, dressings, instruments, or dust.

How may such infections be prevented? I feel strongly that it is only through close co-operation between the obstetrician and the bacteriologist that success can be achieved. If I appear to stress the importance of bacteriological investigation too much it is for two reasons: first, that as a bacteriologist I am naturally biased; and, secondly, that the two recent well-known cases in which legal action has been taken and heavy damages have been awarded have shown so clearly the dangers of neglecting

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to make such investigations. The point for consideration, then, is to decide what measures to take in order to avoid doing too little on the one hand or, on the other hand, trying to do too much, so that the whole matter of bacteriological investigation becomes impracticable and absurd.

#### Infection from Contacts

In the first of the three groups mentioned above we have infections from attendants or other contacts. It is clearly too much to attempt frequent routine examinations of all nurses and doctors engaged in midwifery practice, and it is extremely doubtful if any valuable results would be achieved by such measures. On the other hand, it is essential to take swabs from the nose and throat when there are any symptoms suggesting respiratory tract infection or any history of a recent infection of this kind. This should in my opinion apply not only to medical attendants but to any member of the patient's family who is likely to be in the house at or near the time of delivery. Not only is respiratory tract infection to be watched for, but also any septic focus, on the skin and, in children especially, any aural discharge. I would suggest, too, as a reasonable precaution, that a throat swab should be taken from any nurse before she starts maternity work, especially if she has been recently engaged in general medical or surgical nursing. At Queen Charlotte's Hospital all new nurses and resident medical officers have throat and nose swabs taken before they start their duties.

#### Infection from an Extragenital Source in the Patient

In the second group—that of the infections from the respiratory tract, or other focus, of the patient herself—we are on more difficult ground. It is probably neither necessary nor wise to swab the throats of all patients as a routine, but when there is any history suggestive of recent respiratory tract infection this should certainly be done. This affords protection for the patient, for if the swab be positive special precautions can be taken, such as the wearing of a mask by the patient and the sterilization of her hands by dettol cream. It is in such cases, too, that the prophylactic use of sulphanilamide at the beginning of labour might be expected to be of use. The doctor may also receive some protection, for if the patient should develop puerperal fever no claim for damages would be likely to succeed if there were definite evidence that she had haemolytic streptococci in the throat before delivery.

#### Infection Transmitted from Patient to Patient

In the third group we are faced with the problem of what must be done when a patient develops puerperal sepsis to safeguard the other patients. First, a vaginal swab must be taken and examined as soon as possible. I would emphasize this apparently obvious point particularly, because there is a tendency at the present time to swab the throats of all attendants and take no steps to find out the nature of the patient's infection. Since it is only in haemolytic streptococcus infections of the patient that the question of infection from the throats of attendants arises, and since only about one-third of the cases of puerperal sepsis are due to that organism, this practice is, to say the least, irrational. While waiting for the report on the vaginal swab the patient must, of course, be regarded as a suspect case and be strictly isolated, and those in attendance should not attend clean cases. If the swab is found to be positive for the haemolytic strepto-

coccus, then, and then only, is it necessary to investigate contacts. Apart from this investigation of contacts *efficient* sterilization of the room and everything it contains must be carried out before admission of another case—another obvious point which is sometimes overlooked. It is not always recognized that the haemolytic streptococcus can survive in a dried form in dust for a long time. This was conclusively demonstrated in 1936 by White, who showed that the dust of single-bedded rooms in which patients infected with the haemolytic streptococcus were nursed was always infected with that organism. She also showed that a human infection could be caused by infected dust, and that the streptococci could live in the dust for as long as ten weeks.

#### Throat Carriers

The question naturally arises as to what is to be done with nurses who are found to be throat carriers of haemolytic streptococci. In my opinion there is only one possible answer—that they must be kept away from maternity work until negative. In view of the natural variations that occur in the amount of growth from a swab two consecutive negative results should be obtained before return to duty is permitted. There are, I know, those who hold different opinions from this, who believe that haemolytic streptococci in the throat are of no importance if the throat is clinically normal. This view has the advantage of putting the onus on the clinician, presumably a laryngologist, instead of on the bacteriologist, but the dangers from the medico-legal point of view must be great. It is difficult to imagine the line of defence in an action for damages where it was known that a nurse present at a delivery was a carrier, even if a "healthy" one, of haemolytic streptococci.

#### Co-operation between Clinician and Bacteriologist

Finally, I must deal with the question of co-operation between clinician and bacteriologist. Speed is essential in all these investigations, and in order to help the bacteriologist a definite request for an examination for the presence of haemolytic streptococci should be made instead of the usual vague request "for bacteriological examination" or, even more briefly, "? orgs." It must be remembered that a complete bacteriological examination of a swab from the throat or vagina may take many days; a provisional report on the presence or absence of haemolytic streptococci can, however, nearly always be given in the morning after the day on which the swab is received, and the bacteriologist must be prepared to help by giving such provisional reports by telephone. If "grouping" of any streptococci found is to be done, a further twenty-four hours will be required, but the number of cases infected by groups other than Group A is so small that a provisional report of "haemolytic streptococci present in large numbers" is sufficient evidence on which to take all necessary steps of isolation, specific treatment, and examinations for the source of infection. I may mention here that the haemolytic streptococcus in the vaginal swab in puerperal sepsis is nearly always present in overwhelming numbers or is absent, so that there is seldom much doubt as to the nature of the infection.

#### Commentary

It may appear that I have laid great stress on the haemolytic streptococcus infections. There are three reasons for this. First, as already mentioned, they are responsible for the majority of fatal cases; secondly, they

are the infections in which we know that the organism is introduced from an extragenital source, and in which, therefore, the possibility of spread from attendants or from patient to patient has to be considered; and, thirdly, they are the infections for which we have now a specific method of treatment in sulphanilamide and its derivatives, so that early diagnosis is important for the patient herself as well as for others who may run the risk of infection transmitted from the same source.

From the bacteriological point of view, then, the issue is clear. We have first to investigate every case of puerperal pyrexia by taking a swab from the vagina (a cervical or intra-uterine swab is not necessary) and examining primarily for haemolytic streptococci. May I interpolate at this point my belief that there is no substitute for this examination, and that evidence gained from the clinical state of the patient can never give an accurate answer to the all-important question, "Is this a haemolytic streptococcus infection?" Having received a positive report on the swab, steps must be taken to find the source of infection, both in the patient herself and in attendants and other contacts. The finding of a source in the patient is of little use in preventing the spread to others, as she will in any case be isolated, but from a medico-legal point of view it may be of use as a line of defence. If the vaginal swab is negative for the haemolytic streptococcus no investigation of contacts is necessary, since other infections, with the possible exception of the very rare staphylococcal and pneumococcal ones, are not generally transmitted from an outside source.

This much is clear, but the problem still remains of how to get the necessary examinations carried out quickly and accurately. There can be few places in this country that are not within easy reach, by post at least, of a laboratory, but because of the necessity for speed it is essential that the laboratory should contain at least one full-time experienced bacteriologist. If haemolytic streptococci are to be "grouped"—and this is important, especially in examination of throat swabs, to avoid suspending nurses unnecessarily—the difficulty is greater still, as the number of laboratories in which this can be done is still small. At the Research Laboratories at Queen Charlotte's Hospital we attempted to fill this gap by instituting a service for the examination of any swabs from maternity cases or their contacts for haemolytic streptococci only, and for the grouping of any such organisms found. If a few more laboratories would undertake similar work in some of the large towns throughout the country so that practitioners resident anywhere in England could be sure of obtaining accurate, cheap, and, above all, quick reports, there would no longer be any excuse for attempting to solve the problems of a bacterial disease by clinical data alone.

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Standard specifications for protective clothing, respirators, gloves, and other articles of personal safety equipment may result from a meeting called recently at the request of the National Safety First Association and the Associated Slate Quarries. The meeting was attended by both makers and users of safety equipment, as well as by representatives from employers' organizations, engineering institutions, trade unions, voluntary associations, and Government departments. A resolution was carried asking the General Council of the British Standards Institution to set up a representative industry committee to deal with all personal safety equipment. There are already B.S.I. committees dealing with individual articles of safety equipment, such as boots and goggles. The proposed industry committee would take over control of these committees, and would also deal with any future requests for the standardization of personal safety equipment.

## TREATMENT OF UNDULANT FEVER WITH PRONTOSIL

BY

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The remedies which it has been proposed to use for the treatment of undulant fever are so numerous and varied that the natural conclusion is that few or none are really consistent in their action. Vaccines, so far, have proved of limited use, except in a few cases where they were injected intravenously and where the curative effect may be ascribed to shock therapy. In my experience the results of vaccines, with few exceptions, have been disappointing. The severe and uncontrollable reactions accompanying intravenous vaccine therapy militate against the general acceptance of this form of treatment.

When trypaflavine was introduced great hopes were entertained and good results were claimed. Certainly some patients recovered fairly rapidly after the dye, but in others no result was forthcoming. The same may be said of mercurochrome. Both these drugs are relatively toxic, and their direct introduction into the blood stream increases any potential danger. I have used foudin, a trivalent antimony preparation, in a few cases, but the number is as yet too small to arrive at any conclusion. Good results have been reported by Manson-Bahr and by Young.

A great desideratum would be an effective remedy that could be administered orally and that did not exert any undue toxic action. If the claims put forward in the cases described below are confirmed, then prontosil and its congeners would be ideal remedies in undulant fever.

### Cases Treated by Injection

In Cases 17 to 20, prontosil was administered intramuscularly, the dosage being one injection of 5 c.cm. on alternate days. The urine was stained red within a few minutes, which showed that the excretion was very rapid. With the dosage adopted, concentration of the drug in the blood, was not likely to be high enough to influence the disease, and in three cases the results were disappointing. The first of these (Case 17) was that of a youth aged 18; as soon as his Widal reaction proved positive in a titre of 1 in 150 he was given a *melitensis* vaccine every third day in gradually increasing amounts. After three weeks he still ran a high fever and I decided to inject prontosil. He was given 5 c.cm. every other day for another three weeks. At the end of one and a half months of persistent treatment the patient was still feverish and suffering from rheumatic pains. The other two (Cases 18 and 19), young children 3 and 4 years old, failed to respond after more than three weeks' treatment by prontosil injections. The fourth case (No. 20) was that of a boy of 6. During the first week of his illness his temperature was as high as 104° F., the blood-serum reaction was strongly positive to *Br. melitensis*, and he was then treated with intramuscular prontosil injections on alternate days; at the third injection the temperature was 100° F. in the evening, and he was completely afebrile on the tenth day of treatment. No second wave of pyrexia occurred, although the patient was kept under observation for six months.

It will be realized that in three of these cases the results were meagre, while in the fourth the normal