The control of puerperal sepsis / Ministry of Health.

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MINISTRY OF HEALTH

THE CONTROL OF PUERPERAL SEPSIS

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MINISTRY OF HEALTH

Memorandum on the Control of Puerperal Sepsis.

General.

The primary object of this memorandum is to explain the nature of puerperal sepsis, how it is spread, and how to identify and group the streptococci responsible. It may, however, be useful to draw attention to the question of treatment as a preliminary to consideration of the bacteriological aspect. As indicated in Circular 1765 of the 14th March, 1939, the Minister regards it as most desirable that welfare authorities should make available facilities for investigation and treatment for the benefit of patients unable to secure adequate treatment for themselves. Welfare authorities are empowered, with the sanction of the Minister, to make provision for the special treatment of women suffering from puerperal pyrexia, for consultation with an obstetric specialist, for skilled nursing, or for institutional accommodation. Everything possible should be done to meet the requests of medical practitioners for special assistance for women suffering from serious pyrexia.

The increased knowledge of the nature and sources of puerperal infections gained during recent years provides a firmer basis for administrative action than has hitherto been available.

The Ministry has evidence that this knowledge is not being applied either in maternity institutions or in domiciliary practice with the promptitude and purpose required to prevent the spread of infection. Outbreaks of puerperal infection in institutions, attributable in part to the lack of appreciation of the dangers of the position and the need for immediate action, still occur. In domiciliary midwifery practice ill-advised steps are frequently taken and a midwife is sometimes suspended needlessly or for an unduly long period. In addition to the dislocation of the midwifery service which results, unnecessary anxiety and personal inconvenience are caused both to the patient and to the midwife.

It has been shown that the most dangerous puerperal infection—infection with haemolytic streptococci—is rarely, if ever, due to latent infection of the vagina before parturition. It is brought to the genital tract from outside sources at the time of confinement or shortly after. The streptococci which give rise to puerperal fever belong to the same serological group and exhibit the same division into serological types as those responsible for scarlet fever, tonsillitis, adenitis, otitis media, cellulitis, etc. Their chief habitat is the human upper air passages, and

it is thence through a variety of agencies—fingers, instruments and possibly even the air—that puerperal infection is derived. The ideal environment for the parturient woman is one from which all carriers of haemolytic streptococci are excluded, but there are so many apparently healthy human carriers, and streptococci are so easily transferred from one person to another that the ideal is impossible of achievement. In large measure, however, the risk of infection with the most dangerous strains can be removed by the elimination from the environment of all persons with inflammatory conditions of the upper air passages caused by or favouring the multiplication of haemolytic streptococci.

The general measures which are of importance in the prevention of puerperal sepsis have been discussed in detail by Colebrook,* and need not be enumerated here.

The problem as it affects the Medical Officer of Health in relation to the conduct of maternity homes and domiciliary practice is how to apply preventive methods without interfering unnecessarily with the smooth working of the services. How far, for example, is it practicable and necessary to exclude nose and throat carriers of haemolytic streptococci from the environment of the parturient woman? To search for and exclude all carriers of haemolytic streptococci is not practicable. Nevertheless, there is a sufficient volume of evidence now available to indicate how the risks to the parturient woman may be minimised by the intelligent use of bacteriological methods.

The question has to be considered from two standpoints: (1) in the absence of puerperal pyrexia; (2) on the occurrence of puerperal pyrexia.

(1) In the absence of puerperal pyrexia, swabbing of the midwife in attendance should not be undertaken, unless she shows signs of an acute or chronic inflammatory condition of the tonsils, pharynx, nose or middle ear. Every midwife should be instructed to report any symptom of such a condition at once, whereupon she must be suspended from duty and swabs must be taken for bacteriological examination. In the event of a positive swab being obtained, there may be some doubt whether the haemolytic streptococci found are responsible for the clinical condition or are merely temporary invaders. Though the distinction is important, as experience shows that where they are actually producing inflammatory conditions the streptococci are more dangerous, there is no known bacteriological method of making this distinction; the number of colonies is no certain criterion of the presence or absence of an infective process. It is

* The Journal of Obstetrics and Gynaecology of the British Empire, 1936, Vol. 43. p. 691.

advisable, therefore, to suspend every midwife who has reported naso-pharyngeal symptoms and has been found to be a carrier of haemolytic streptococci; if it is found by the laboratory that the streptococci belong to Group A, she must not resume duty until she has recovered completely and three negative swabs at daily intervals have been obtained.

To prevent future hardship, candidates for training as pupil midwives should be examined clinically and those suffering from a chronic infection of the tonsils or sinuses with haemolytic streptococci should be advised that a persistent disability of this character is likely to preclude them from engaging in the practice of midwifery.

(2) On the occurrence of puerperal pyrexia, steps should be taken at once to ascertain the cause of the rise of temperature, and until the existence of infection of the genital passages with haemolytic streptococci has been excluded, the attendant contacts must not conduct a labour or nurse any other puerperal woman. Recent experience has shown clearly that whenever there is streptococcal infection of the body of the uterus the organisms will be present in the vagina. If the infection is limited to the vagina or perineum (though it very rarely is), there is nothing gained, but the contrary, by passing a swab into the cervix uteri. A vaginal swab should therefore be taken in every case of puerperal pyrexia, unless the practitioner can be quite certain that the fever is not due to infection of the genital tract. This involves the examination of a large number of swabs—many of which will not yield haemolytic streptococci. In some districts this may necessitate the extension of the bacteriological services. Nevertheless the bacteriological examination of a vaginal swab in puerperal pyrexia is a precaution which can rarely be omitted with safety. If the vaginal swab yields haemolytic streptococci—the report should be available in 24 hours—an attempt should be made to ascertain whether any of the attendants was the possible source of infection. To this end, swabs should be taken from the nose and throat and from any skin lesion of the doctor or midwife who was in attendance on the patient during her confinement or subsequently. If, however, streptococcal infection of the patient is suspected from the outset, swabs from the attendants should be sent for examination at the same time as is the patient's vaginal swab. The bacteriological examination of contacts will as a rule be limited to those persons who might in the course of their duties carry infection to other parturient women, i.e., primarily doctors and midwives.

Any attendants found to be harbouring haemolytic streptococci must cease to attend labours or to nurse other puerperal women until three negative swabs taken at daily intervals from both nose and throat have been obtained and clinical signs,

if any, have disappeared. This rule is subject to certain exceptions depending on the results of further bacteriological investigation. If the strains from any contact are found not to belong to Group A (Lancefield), the carrier condition of that contact may be ignored.

It is not at present possible, except in a few research laboratories, to carry the identification of a haemolytic streptococcus beyond the stage of defining its group (Lancefield). Since, however, it is agreed that all Group A strains must be regarded as potentially pathogenic the determination of type is not of importance in practice. Type determination is, however, essential when it is desired to trace the actual source of infection.

In the present emergency, maternity beds have been established in many reception areas in which few laboratory facilities are normally available. The Medical Research Council in collaboration with the Ministry of Health has established an Emergency Public Health Laboratory Service, particulars of which have already been circulated to Medical Officers of Health. The laboratories of this service will be prepared to assist in carrying out all types of examination referred to in this memorandum.

Evaluation of Results of Swabbing.

Vaginal Swab.—The finding of beta haemolytic streptococci in a vaginal swab (or in the uterine discharges) of a case of puerperal pyrexia should always be taken as presumptive evidence of a streptococcal infection of the genital tract. In an acute infection cultures are invariably profuse and nearly pure, but if only sparse colonies are obtained there may be uncertainty as to their pathogenicity, and it will be necessary to do the Lancefield grouping test (see group-precipitin test below).

Swab from upper respiratory tract.—A report on a throat or a nasal swab should give the approximate numbers of colonies of beta haemolytic streptococci yielded by it on a blood agar plate incubated for 18-24 hours in proportion to colonies of other organisms. If the swab yields 50 per cent. or more of colonies of haemolytic streptococci the existence of an active streptococcal infection of the upper air passages may be assumed with reasonable certainty. The existence of such an active infection, however, cannot be excluded even when much less profuse growths are obtained; after an acute infection of the throat the streptococci may occasionally diminish in numbers very rapidly; there is, moreover, the possibility that the swab was taken after the use of a local antiseptic, or with insufficient care to ensure proper contact with the tonsils or post nasal space and the obtaining of a representative sample of the organisms therein.

Group-precipitin test.—When there is any doubt as to the probable pathogenicity of a haemolytic streptococcus obtained from a swab it will be necessary to test it by the Lancefield precipitin method. Since 1933, when this serological test for the differentiation of groups among haemolytic streptococci was introduced, numerous investigations have shown that streptococci belonging to Group A are epidemiologically of major importance in human infections, and that other groups of haemolytic streptococci, viz., B, C and G, though not entirely without pathogenicity for man, may be ignored as a factor in puerperal sepsis. In practice a positive report on the presence of haemolytic streptococci in a swab will almost invariably be required to be supplemented by a statement as to whether the streptococci found belong to Group A or not. The group-precipitin test is a relatively simple procedure and the result may be obtained as a rule in 48 hours from the taking of the swab. A positive Group A reaction provides satisfactory evidence of the status of a streptococcus as a true beta haemolytic streptococcus and as a potential pathogen.

Identification of serological type.—The haemolytic streptococci of the human pathogenic Group A do not form a homogeneous group but are divisible into serological types, the number of which is as yet uncertain but without doubt exceeds thirty. These numerous and well differentiated types among strains of *streptococcus pyogenes* or Group A make it possible in favourable circumstances to trace the probable source of infection in an outbreak of puerperal sepsis. When it is required to carry out such an investigation, it is essential first to obtain the puerperal strain in culture for comparison with any strains obtained from the throats, skin lesions, etc., of suspected contacts. The identification of streptococcal type is made by agglutination with specially prepared antisera, and is, unlike the Lancefield group-precipitin test, impracticable as a routine procedure on account of the technical difficulties of its performance. The agglutination test of the type of a haemolytic streptococcus must therefore be limited at present to research laboratories. In such circumstances it has already demonstrated the importance of pharyngeal carriers of streptococci in the epidemiology of puerperal sepsis.*

Laboratory Methods.

Examination of swabs.—The swabs should be cultured on horse blood agar plates prepared as follows:—to nutrient agar (made with trypsinised meat broth) 5 per cent. of fresh oxalated horse blood is added; the mixture is poured into Petri dishes in

* "The Source of Infection in Puerperal Fever due to Haemolytic Streptococci" Dora C. Colebrook. Medical Research Council Special Report Series, No. 205, 1935, His Majesty's Stationery Office, London.

which a thin layer of agar without blood has been allowed to set. Fresh sterile oxalated horse blood is obtainable in bottles containing 25 c.c., which is sufficient to prepare 40 plates of 3½ inches diameter. Prior to inoculation the plates should be dried in the incubator at 37° C. for 30 minutes.

The inoculated plates should be incubated aerobically at 37° C. for 18-24 hours (anaerobic plates have been recommended as giving more marked haemolysis); it must be remembered that considerable experience is required to recognise true beta haemolytic colonies by inspection. If colonies of haemolytic streptococci appear, a preliminary report should be made immediately. Colonies of haemolytic streptococci from positive plates should be picked off for further investigation into (*a*) 5 c.c. of 10 per cent. horse serum broth in order to test for the production of soluble haemolysin, (*b*) 20 c.c. of 1 per cent. glucose broth (made with trypsinised meat without added peptone) for the Lancefield group-precipitin test, and (*c*) 5 to 10 per cent. blood broth or other suitable medium to be stored (after incubation) in the refrigerator in case further investigations are required.

Soluble haemolysin test.—The formation of soluble haemolysin among groups of haemolytic streptococci so far found in man is limited to members of groups A, B, C and G. It is recommended therefore that a test for soluble haemolysin be carried out on all strains of haemolytic streptococci; only strains producing soluble haemolysin need be subjected to the group-precipitin test. The test for production of soluble haemolysin is carried out as follows:—equal volumes of a culture of the streptococcus, grown for 12 hours at 37° C. in 10 per cent. serum broth, and a 5 per cent. suspension in saline of horse red cells are incubated at 37° C. for 2 hours; a positive result is indicated by complete haemolysis.

Group-precipitin test.—The Lancefield precipitin test classifies the haemolytic streptococci into groups and depends upon the presence in the organisms of reacting " C " substances, carbohydrate in nature and characteristic for each individual group. The test therefore identifies strains as belonging to a particular group, but takes no account of immunological differences among the strains within that group. Eleven groups—A, B, C, D, E, F, G, H, K, L and M—have now been identified, but members of Groups E, L and M have not so far been found in man. Strains belonging to Groups B, C and G, occasionally cause infection to man, but there has not been any evidence of epidemic spread and they are not considered to be of epidemiological importance. Specific grouping sera for Groups A, B, C and G have recently been put on the market; with these the precipitin test can be carried out in any

laboratory possessing a centrifuge. The technique of the modified Lancefield precipitin test as used in the Ministry's laboratory is as follows:—

(1) Inoculate the strain of haemolytic streptococcus into 20 c.c. of 1 per cent. glucose trypsinised meat broth without added peptone and incubate for 18-24 hours at 37° C.

(2) Centrifuge the glucose broth culture and discard the supernatant.

(3) Add to the centrifuged deposit 0·4 c.c. N/20 HCl and mix well.

(4) Test the pH of (3) on congo-red paper (pH range 3·0-5·0 blue-red); if a definite blue colour is not produced add tiny loopfuls (diameter 1 mm.) of N/1 HCl until the mixture is acid to congo-red.

(5) Place the acidified mixture in a boiling water bath for ten minutes.

(6) Cool in cold running water for 3-5 minutes.

(7) Centrifuge the mixture and take off the supernatant.

(8) Neutralise the supernatant to litmus paper by adding 0·015 c.c. N/1 NaOH, and then, if necessary, tiny loopfuls (diameter 1 mm.) till no colour change occurs in the red or blue litmus paper. At the neutral point the extract becomes opalescent due to the formation of a floccular precipitate.

(9) Centrifuge the neutralised extract and take off the supernatant discarding the deposit.

(10) With a Pasteur pipette put two drops from (9) into a clean Dreyer agglutination tube: add one drop of a known group precipitating serum allowing it to run down the side of the tube.

(11) A positive result is shown by a white ring precipitate at the junction of the extract and the serum. The precipitate, which is visible to the naked eye or may be seen with a hand lens, usually appears immediately and final results are read not later than 30 minutes after layering. Until the technique has been mastered, it is advisable to carry out the test on a culture of a known Group A strain as control.

Identification of type by agglutination.—The streptococcal colony cultures in blood broth are sown into 6 c.c. of trypsinised meat broth, either plain or with the addition of 5 per cent. of bovine or rabbit serum. After incubation overnight the broth culture is concentrated by centrifugation to 0·25 or 0·5 c.c. according to the amount of growth, and is examined by the slide method for agglutination against the type-sera. Growths of haemolytic streptococci of the first generation in plain broth are often too granular for an agglutination test, but they may become suitably homogeneous after

several successive passages in broth. In serum broth growth is more often uniform but there is the disadvantage that agglutination with serum broth suspensions of certain streptococcal types may be inhibited. Besides the frequent difficulty of obtaining agglutinable suspensions there is the liability to confusion owing to cross-reactions between the different type strains and sera. This source of confusion is due to the presence of group-specific in addition to the type-specific agglutinins in the antisera, and cannot be completely removed by treatment of each type serum with heterologous streptococcal strains. There is, moreover, a further obstacle in the way of type diagnosis; it appears that some strains even in the first subculture from the primary plate colony may lack the type-specific antigen necessary for the determination of type. The above factors account for delay which may occur before a report on the type of a haemolytic streptococcus can be obtained.

Ministry of Health,
Whitehall, S.W.1.

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(20721—26) Wt. 4245—8889 5000 12/39 P. St. G. 372

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