

The importance of the lower segment of the uterus in these infected abortion cases has not been given due consideration. In many of our cases the upper segment is never involved, but rather the infection has struck directly on toward the parametrium through the richly supplied lymphatic circulation of the cervix. This is the type in which the true pelvic connective tissue abscess is found, which when drained is immediately cured. Could anything be more unreasonable than to curet in such cases? I think a point to be driven home is the extreme importance of exercising the most rigid asepsis when making vaginal examinations in diagnosing cases of abortion. The vaginal canal should be explored with the same aseptic regard as one would invade a knee joint or the abdominal cavity.

DR. H. G. WETHERILL, Denver: In the treatment of these cases it is important to determine whether one is dealing with a spontaneous abortion or a mechanically induced abortion. Infections of the genital tract are commonly retrograde infections if the abortion is mechanically induced, or if there has been gynecologic tinkering. If, on the other hand, it is an incomplete abortion, not of the mechanical type, then we certainly are justified in picking out with the placental forceps any retained portion of the product of conception which might otherwise give rise to sapremia. With this exception, I agree wholly with the principles of treatment set forth by Dr. Montgomery and I am heartily in accord with him in his strictures on the abuse of the uterine curet in such cases. So careful should we be in handling infected cases that a tenaculum or volsellum forceps should not be used to draw down and fix the cervix, as the small punctures made by the teeth of the instrument are sufficient to reinoculate a patient from the vaginal and cervical secretion.

For many years I have treated infections following abortions with alcohol after the method of Caruso. A double drainage tube of large caliber is inverted on itself, so that the solution cannot follow the tube. This tube is introduced to the fundus with strict antiseptic precautions and the alcohol which is used through it flushes the genital tract from the fundus outward with a nonpoisonous, antiseptic solution. Occasionally a solution of permanganate of potash or a diluted solution of iodine is substituted for the alcohol. In the treatment of such cases it is very easy to do too much and almost impossible to do too little. The majority of the patients will recover if let alone.

DR. E. E. MONTGOMERY, Philadelphia: I must confess that if called to a woman who had an abortion or was aborting, in whom a portion of the embryo had escaped, whom I had reason to feel was not an infected case, and in making a careful aseptic examination discovered a portion of the placenta projecting, I should be tempted at once to evacuate the uterus; but in cases such as one of the gentlemen mentioned in which the mass is situated within the body of the organ, the cervix, possibly, more or less contracted, the result of leaving the case to nature, treating it carefully, aseptically, will be attended with much less danger to the patient than would be the mechanical dilatation of the uterus and the removal of the structures within. I believe, also, in those cases of which Dr. Wetherill has spoken, in which a portion of the placenta remains and it is evident that sapremia exists, it is better to leave the condition undisturbed and trust nature to evacuate it rather than use mechanical measures.

Railway Accidents.—According to *Accident Bulletin 55* of the Interstate Commerce Commission, for the first quarter of 1915 the number of persons killed in train accidents on steam railways was 65, and the number of persons injured was 1,972. The total number of persons killed in all classes of accidents incident to railways was 1,650, and the number injured was 35,429. This includes 68 persons killed and 21,582 injured in so-called "industrial accidents," which are defined as accidents not connected with train operation, but occurring to railway employees, other than trainmen, on railway premises.

PLACENTAL BACTEREMIA*

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When the fetus is stillborn or the infant dies within a few days after its birth, frequently we are unable to determine the cause of death. This fact has been emphasized in the statistical analyses recently published from two American institutions. At the Sloane Hospital for Women¹ among 10,000 consecutive confinements there were 429 stillbirths and 291 infants which died within two weeks after they were born. Reviewing an equal number of confinements at the Johns Hopkins Hospital, J. Whitridge Williams² found 705 cases of stillbirth and early infant death. The fetal mortality in these clinics, it would seem, is practically identical. And in both series of statistics it is instructive to find that, although careful clinical observations and postmortem examinations were made, the cause of death was not ascertained in roundly 20 per cent. of the fatal cases.

Some time ago my attention was called to a cause of fetal death not widely appreciated and one which is left out of account in the reports just quoted. Whenever membranes rupture prematurely and the labor is prolonged, especially if repeated vaginal examinations are made, bacterial invasion of the placenta—placental bacteremia—may occur. This complication constitutes a serious danger for the fetus. Its relative importance as a factor in infant mortality is difficult to estimate but its practical significance is certain.

With reference to this question I have studied five hundred consecutive confinements under my care while connected with the University of California Hospital. Including infants over 40 cm. long the mortality was 5.4 per cent. (27 cases). The infant was stillborn in 21 cases; it died on the second day in 3, on the fourth in 2, and on the ninth in 1 case. A necropsy was performed in every instance. The causes of death were as follows:

	Cases	Per Cent.
Syphilis	7	26
Birth injury.....	6	22
Premature separation of placenta....	4	15
Placental bacteremia.....	3	11
Congenital heart lesion	2	7
Enlarged thymus.....	1	3
Toxemia pregnancy.....	1	3
Undetermined	3	11

A number of well-known factors combine to explain why the fetal mortality is higher in case labor is prolonged. With 62 of my patients labor lasted longer than twenty-four hours and in this group 8 fetal deaths occurred (13 per cent.). Three of the deaths were due to placental bacteremia. The mothers of these infants were not seriously ill and at the end of two weeks were discharged from the hospital in good health. Such results, it will be made clear, are not always to be expected. But before considering the experience of other observers I may summarize the histories of my cases, giving only the facts pertinent to the problem under discussion.

CASE 1.—Primipara; aged 20; generally contracted rachitic pelvis with diagonal conjugate measuring 11 cm. Presen-

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1. Holt, L. Emmett, and Babbitt, Ellen C.: Institutional Mortality of the Newborn, *THE JOURNAL A. M. A.*, Jan. 23, 1915, p. 287.

2. Williams, J. Whitridge: Limitations and Possibilities of Prenatal Care, *THE JOURNAL A. M. A.*, Jan. 9, 1913, p. 95.

tation right occipitoposterior. Duration of labor twenty-eight hours: membranes ruptured six hours before delivery by midforceps. Several vaginal examinations were made but the number was not recorded. Temperature during labor, 37.8 C. (100 F.); pulse, 70. Highest puerperal temperature, 37 C. (98.6 F.); pulse, 98.

The child, 48 cm. long, weighed 3,080 gm. It was easily resuscitated. Death occurred on the third day. At necropsy the umbilical stump was dry and clean. The abdomen contained 250 c.c. of seropurulent fluid which showed streptococci in cover slips. There were subpleural ecchymoses over the left lung, but no intracranial hemorrhage and no meningitis. The brain was normal.

Sections of the placenta and umbilical cord stained with hematoxylin and eosin were normal. Sections of the placenta stained by the Gram-Weigert method showed a few streptococci just beneath the amnion in the neighborhood of the fetal blood vessels. Bacteria were not demonstrated in the cord.

CASE 2.—Primipara; aged 23; normal pelvis. Presentation left occipito-anterior. Labor began with rupture of the membranes and after forty-five hours terminated normally. Six vaginal examinations were made. Temperature during labor, 38 C.; pulse, 108. Highest puerperal temperature was 38.2 C.; pulse, 110.

The child, 52 cm. long, weighed 3,540 gm. Resuscitation was difficult. Death occurred at the end of forty-eight hours. Shortly after its birth the infant bled from the mouth, and later patches of purpura appeared over the head, buttocks, scrotum and right knee. At necropsy a small blood clot was found on the parietal peritoneum adjacent to the umbilical vessels and another beneath the liver. The peritoneal cavity contained about 10 c.c. of uncoagulated blood but none was found in the intestines. There was no blood in the pleural cavity. Several hemorrhages the size of a pinhead were found at the base of each lung.

Sections of the placenta stained with hematoxylin and eosin were normal but the umbilical cord was infiltrated with leukocytes, most pronouncedly in the neighborhood of the vein. Stained by the Gram-Weigert method streptococci were demonstrated in the amniotic and chorionic connective tissue near the fetal surface of the placenta. Streptococci were also present in the cord.

CASE 3.—Primipara; aged 38; normal pelvis. Presentation left occipito-anterior. Membranes ruptured when the cervix was dilated 5 cm., twenty-four hours before delivery was effected by midforceps. Temperature during labor, 37.8 C.; pulse, 106. Highest puerperal temperature, 38.5 C. (101.3 F.); pulse, 115.

The child, 50 cm. long, weighed 2,980 gm. For an hour before delivery the fetal heart sounds were not heard. The necropsy findings were negative except for a small cerebral hemorrhage beneath the left occipital lobe.

Sections of the placenta showed partial thrombosis of many of the vessels which pass over the fetal surface of the placenta. Large numbers of bacteria were demonstrated, in the amnion covering the placenta and in the underlying chorionic connective tissue. Streptococci and also a short, stout bacillus, resembling the gas bacillus, were present. A few streptococci were found in the intervillous spaces but the chorionic villi were normal. A typical mixed thrombus almost completely blocked the umbilical vein. It contained streptococci as did also the wall of the vein and the surrounding Whartonian jelly. The walls of the umbilical arteries were slightly infiltrated with leukocytes but no bacteria were demonstrated there.

In all these cases organisms were demonstrated in the subamniotic connective tissue where they came in contact with the large fetal blood vessels which cross the surface of the placenta. In one instance it was possible to demonstrate bacteria in the act of penetrating the walls of these vessels. It is also noteworthy that in every case the epithelium which covers the villi was intact, the capillaries within the villi were of

normal appearance, and no bacteria were found either on the surface or in the interior of the villi. Evidently the infection did not proceed from the maternal circulation and did not pass through the walls of the villi. The bacteria entered the placenta by way of the amniotic membrane. Most frequently, as in these cases, placental bacteremia depends on the infection of the amniotic fluid; and generally the latter complication occurs because the membranes rupture prematurely, labor is prolonged, and repeated vaginal examinations are made.

From a knowledge of the anatomy of pregnancy it is obvious that, at least theoretically, the infection of the amniotic fluid is possible by three routes; (1) organisms may pass from the maternal circulation across the decidua, the chorion, and the amnion; (2) they may travel from the peritoneal cavity down the fallopian tubes, or (3) they may ascend from the vagina through the cervical canal. In a series of animal experiments the progress of an infection along each of these paths has been demonstrated by Hellendall,³ but only the third has a broad, practical significance in human pathology. It has not been established that the other routes ever play a rôle except under conditions that have been imposed experimentally. And yet, it is possible in human beings that hematogenous infection of the amniotic fluid may be the result of a maternal septicemia; and also that in case of acute inflammation of the appendix during pregnancy the responsible organisms may find their way down one of the fallopian tubes. At all events, in the cases I have observed, neither septicemia, appendicitis, nor peritonitis existed; on the other hand, ideal conditions prevailed for infection of the amniotic fluid by the vaginal route.

When the membranes have ruptured, an increased liability to infection is apparent; and some have taught that bacterial invasion of the amniotic cavity occurred while the membranes were intact. The evidence favoring the latter possibility, however, is not conclusive, as it has never been confirmed by bacteriologic examination. In the cases recorded by Lehmann, Carpentier, Briegleb, Lendanthal⁴ and others, the foul smelling decomposed amniotic fluid which escaped when the membranes ruptured may have been due, as these observers suggest, to bacterial putrefaction; but in the absence of cultures it remains to be proved that the unruptured membranes are not an effectual barrier against the passage of bacteria from the vagina to the amniotic cavity.

Although under suitable conditions a great variety of pathologic bacteria may invade the amniotic fluid, the streptococcus has been the predominating organism found in cases of placental bacteremia. Frequently colon bacilli are associated with streptococci. In the case of tympanitis uteri during labor the colon bacillus was regarded as the exclusive etiologic factor until, in one instance, Krönig⁵ demonstrated an obligatory anaerobic bacillus. Warnekros⁶ has isolated the gas bacillus from blood cultures in several cases of placental bacteremia. And in one of my cases placental sections showed a short, stout bacillus corresponding morphologically with the *Bacillus aerogenes capsulatus*

3. Hellendall: Beitr. z. Geburtsh. u. Gynäk., 1906, x, 320.

4. Lehmann, Carpentier, Briegleb, Lendanthal, quoted by Hellendall, Note 3.

5. Krönig: Centralbl. f. Gynäk., 1894, xviii, 749; *ibid.*, 1905, xxix, 1243.

6. Warnekros: Arch. f. Gynäk., 1913, c, 173.

though its identity was not established by means of cultures.

From the nature of the lesion in placental bacteremia, an infection within the uterus, generally limited to the amnion and the chorion and often most pronounced in the neighborhood of the large vessels passing over the fetal surface of the placenta, the associated clinical problem pertains both to the mother and to the child. Thus far, its maternal aspects have aroused the greatest interest. And this interest has been stimulated chiefly by a desire to determine whether a true uterine infection was responsible for intrapartum fever.

Glockner⁷ thought the existence of an infection was unnecessary to explain intrapartum fever. Frequently in these cases the temperature becomes normal immediately after delivery, or presents only a slight temporary rise during the puerperium. Consequently, Glockner assumed pathogenic bacteria were not present, and ascribed the intrapartum symptoms to prolonged and violent uterine contractions. Winter⁸ favored this view but also admitted that bacteria might be indirectly concerned. According to Winter's hypothesis the symptoms were occasionally explained by the absorption of toxins from a decomposing ovum. On the other hand, Hausen, Krönig, and Hellendall declared that intrapartum fever, like puerperal fever, depended on a bacterial invasion of the maternal tissues.

It occurred to Warnekros that this difference of opinion could be settled if cultures were made from the mother's blood in case her temperature during labor rose above 38.5 C. The procedure was adopted in 25 cases; the cultures from 18 cases were positive, from 7, negative. In 9 instances streptococci were isolated, in 3 staphylococci, and in the other positive cases colon bacilli, pseudodiphtheria bacilli, or anaerobic gas-producing bacilli; not infrequently more than one type of organism was isolated. Whenever a positive culture was obtained during labor, another was made on the day following delivery. The puerperal cultures were negative except in one instance—the case of a patient who died of a streptococcus septicemia on the third day postpartum.

In approximately 70 per cent. of the cases of intrapartum fever it was clear that a genuine, if temporary, infection of the mother existed. The cause of the fever in the other cases was uncertain. Consequently, the scope of the investigation was broadened, and sections of the placenta were stained for bacteria. In every instance, even though the blood cultures had been negative, organisms were found in the placenta. And, therefore, Warnekros concluded that intrapartum fever, unless attributable to some accidental cause, as tuberculosis, was due to an infection of the mother, often mild and temporary, and that a placental bacteremia was always demonstrable.

The character of the puerperium which will follow a febrile labor may best be predicted from the result of blood cultures taken the day after delivery. Generally, these are negative and a good prognosis is assured. On the other hand, positive cultures indicate the existence of a puerperal infection. Blood cultures at the time of labor have no prognostic value. Similarly, as a prognostic sign the degree of fever

at the time of labor is unreliable, for Winckel⁵ observed several patients who experienced a puerperal convalescence free from fever in spite of an intrapartum temperature above 39 C. (102.2 F.).

The puerperal morbidity in cases of intrapartum fever, an average based on the report of 944 cases by five observers, would seem to be about 63 per cent., the puerperal mortality 6.2 per cent.

RESULTS FOR THE MOTHER FOLLOWING INTRAPARTUM FEVER

	No. of Cases	Normal Puerperium Per Cent.	Slight Fever Per Cent.	Severe Fever Per Cent.	No. of Deaths
Ahlfeld ¹	62	35.5	29.8	35.5	3
Glockner ²	211	62.5	15.16	22.27	13
Ihm ³	190	58.43	25.27	13.69	8
Kronig ⁴	37	21.6	...	78.4	7
Hellendall ⁵	44	6.54	63.63	29.54	1

1. Ztschr. f. Geburtsh. u. Gynäk., 1893, xxvii, 494.

2. Ztschr. f. Geburtsh. u. Gynäk., 1891, xxi, 409.

3. Ztschr. f. Geburtsh. u. Gynäk., 1904, lii, p. 30.

4. Centralbl. f. Gynäk., 1894, xviii, 749; *ibid.*, 1905, xxix, 1243.

5. Beitr. z. Geburtsh. u. Gynäk., 1906, x, 320.

In case of intrapartum fever the outlook is much more serious for the infant than for the mother. The fetal mortality encountered by Ihm was 18 per cent., by Hellendall 19 per cent., by Winter 35 per cent., and by Kronig 61 per cent. These statistics include cases of toxemia of pregnancy, of placenta praevia, of pelvic contraction, and of malposition of the fetus. Therefore, the death of the fetus may have been due to one of several causes, and, lacking the requisite examination, it is impossible to determine to what extent the infection of the placenta was concerned.

At present I am content to emphasize the fact that intrapartum infection must be regarded as one cause of fetal death, and also to demonstrate that the umbilical vessels may be the path of the infection. Heretofore, it has been assumed that antepartum infection of the fetus depended on its swallowing or aspirating the infected amniotic fluid. At most, Krönig has said, blood-borne infections to the fetus are limited to cases in which the mother is suffering from septicemia, as in typhoid fever, pneumonia, tuberculosis or cholera. But another possibility must be reckoned with, namely this: If the amniotic fluid is infected, the bacteria may cross the amnion and invade the placental vessels which carry blood to the fetus.

In one instance I have noted an intense infection of the subamniotic connective tissue and have demonstrated streptococci in the vessels on the fetal surface of the placenta and also in the umbilical vein. In another, streptococci were found in the placenta and in the cord, not in the lumen of the vein but in its wall. As further evidence that the cord infection proceeded from the placenta rather than the fetus no inflammatory lesion of the fetal respiratory or gastro-intestinal tract was found in any case. Various fetal organs were stained for bacteria but none were demonstrated.

It is also instructive that an examination of the placenta for bacteria occasionally serves to establish the cause of fetal death. Until this examination was made, the death of one infant which presented at necropsy a general peritonitis was attributed to imperfect nursery hygiene. Obviously, that explanation was excluded by the demonstration of streptococci in the placenta. Again, in the second case of placental bacteremia, the clinical diagnosis was hemophilia, and human blood serum was administered; the

7. Glockner: Ztschr. f. Geburtsh. u. Gynäk., 1891, xxi, 386.

8. Winter: Quoted by Meyer-Ruegg in Handb. d. Geburtshilfe, ii, Part 3, p. 2375.

9. Winckel: Quoted by Kronig, Note 5.

necropsy added nothing to the clinical findings. Also, in the third case the cause of the death of the fetus was not established clinically nor by postmortem; without appropriate study of the placenta the diagnosis could not have been made.

Placental bacteremia is not always attended by the death of the fetus or the newly born infant. This would not be expected. Bacterial invasion of the amnion and the chorion does not mean that the fetal blood vessels will necessarily become involved. The invasion may advance in another direction. Furthermore, the period of time elapsing between the invasion of the amnion and the birth of the infant may be too short for the organisms to reach the blood vessels in question. Clinical evidence corroborates this view; in cases of intrapartum fever, at most, two thirds of the infants perish.

This series of cases is not large enough to justify an uncompromising estimate of the part placental bacteremia plays in infant mortality. The fact, however, that three of twenty-seven deaths were attributable to this cause shows that it must be taken seriously into account. Perhaps it explains an appreciable number of the fetal and infant deaths heretofore impossible of explanation. Therefore, it is pertinent to recall the frequency of certain phenomena which are usually associated with bacterial invasion of the fetus.

Premature rupture of the membranes was noted by Bassett¹⁰ five hundred times in 4,141 consecutive confinements and by Dmelin¹¹ four hundred times in 4,000 confinements. Thus, the frequency of this accident may be estimated to be between 10 and 15 per cent. On the other hand, Winkel and Krönig regard 3 per cent. as a fair estimate for the frequency of intrapartum fever. Basing a calculation on these statistics, it appears, if the membranes rupture prematurely, bacterial invasion of the placenta occurs in every fourth or fifth case. In view of these facts the routine study of the placenta for the purpose of demonstrating bacteria should be undertaken not only when the labor is febrile but also if it is prolonged after the membranes rupture.

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10. Bassett: Ztschr. f. Geburtsh. u. Gynäk., lxxiii, 566.

11. Dmelin: Quoted by Bassett, Note 10.

Swimming-Pool Sanitation.—A valuable contribution to this subject is contained in *Public Health Reports*, Sept. 17, 1915. It is by W. A. Manheimer, Ph.D., of the Department of Bacteriology of Columbia University, and details in tabulated form the results of a bacteriologic study of the water of a number of pools under various conditions of use, without and with the use of a number of chemical disinfectants. Among the conclusions reached were that the cubic capacity of a pool affects its sanitary condition, pools of small capacity being more difficult to keep in a satisfactory condition even with the use of chemicals; the process of adding dilution water is an efficient means of reducing the bacterial content; the supervision of the plant and the class of attendance are also important factors in pool sanitation; filtration is an adequate means of clarifying the water, which is a means of preventing accidental drowning. In pools in which refiltration is not practiced the water becomes so cloudy in one day that the bottom of the pool cannot be seen; chemical disinfection with calcium hypochlorite is effective, but if added too infrequently or in too small quantity its value is largely lost. A trace of chlorin should be constantly present; the best method of keeping a pool in safe and sanitary condition is by the combined method of refiltration and chlorination.

A MODIFICATION OF THE ABDERHALDEN TEST *

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In the course of the last two years the Abderhalden reaction has been brought to the attention of the medical profession so often that it is safe to assume that the fundamental facts discovered by Abderhalden are generally known. In short, Abderhalden, as does Ehrlich, assumes that normal cells of the body are able to assimilate only those substances present in the blood as its normal constituents. The changes brought about in the composition of the blood serum by introduction of foreign substances lead to disturbances in the processes of cellular nutrition and often to cellular death. The experimental study of the phenomena of assimilation of foreign material introduced directly into the blood stream revealed a number of facts pointing to the tendency of the cells to elaborate a special mechanism, by means of which the cells are able to protect themselves in a specific manner against the injurious effects of disturbances of their normal nutrition.

According to Abderhalden, this protective mechanism consists in the formation in the cells of new and specific ferments, which directly attack the foreign material. As in the case of the antibodies of Ehrlich, these specific ferments, according to Abderhalden's conception, at a certain stage of the process, may appear detached from the cells, and be found circulating free in the blood. The presence, in the blood of animals, of such specific ferments not existing there normally, may be taken to indicate that the parenteral digestion of foreign substances is taking place in the body. According to Abderhalden and his collaborators, the presence of such specific ferments may sometimes be demonstrated in the blood of experimental animals a few hours after the parenteral introduction of foreign substances.¹

As Abderhalden has shown, not only foreign substances introduced experimentally, or these penetrating in the tissues as a result of infection, but also autogenous substances arising in the animal body under physiologic conditions may cause the production of specific ferments as soon as such substances find their way into the blood stream. Thus for instance, he found that during pregnancy the animal body elaborates specific ferments capable of digesting placenta protein.² This finding led Abderhalden to propose a new method of diagnosis of pregnancy, whereby the condition of pregnancy is suspected in every case in which the blood of the individual contains specific ferments that are capable of digesting placenta tissue in vitro.³

A great number of investigators confirmed Abderhalden's findings, and some of them attempted to apply the method to the diagnosis of various pathologic con-

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1. Abderhalden, E.: *Abwehrfermente*, Ed. 4, 1914, pp. 77, 78. Heiner and Petri: *München. med. Wchnschr.*, July 15, 1913, p. 1530.

2. Abderhalden, E.: *Abwehrfermente*, p. 91.

3. Abderhalden, E.: *Abwehrfermente*, pp. 92, 93.