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AN OUTBREAK OF PUERPERAL SEPSIS IN NEW YORK CITY*

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DURING the months of January and February, 1927, there occurred in the Sloane Hospital for Women, New York City, a series of cases of streptococcal puerperal infection which in their number, in their mode of incidence, and in their severity constituted a veritable epidemic. As an occurrence of this nature is now happily rare it seemed to us that a detailed account of the facts regarding it ought to be put on record, and an attempt made to examine the possible factors concerned in the initiation and spread of the disease.

During November and the early part of December, 1926, the puerperal morbidity rate as shown by the numbers of cases with temperatures over 100.4° F. was higher than normal. As a result of this a review of our technic was made. Two of the chief changes made at this time were the discontinuance of the use of lubricant soap solution in "ironing out" the vagina in primiparae, and the insistence on the wearing of masks by all those in attendance at deliveries. At the same time an order was given that vaginal examinations were to be reduced to a minimum. Details of the technic used will be found in the appendix.†

During the latter half of December and the first half of January, the morbidity rate was an average one and there were no serious cases of infection.

*Read at a meeting of the New York Obstetrical Society, January 10, 1928.
†In the reprints.

SEQUENCE OF EVENTS

On January 18, there was admitted to the hospital Mrs. L., a multipara, in labor. She gave a history of having had a severe cold for a week before. She had no temperature on admission. She had a normal labor, in the course of which one vaginal examination was made, and was delivered in the east operating room without laceration. On the third day her temperature rose to 100.8° F., and on the fourth day it reached 103° F., and from then till her death on the seventeenth day it ranged between this and 105° F. Lochial and blood cultures showed a streptococcus hemolyticus.

On the night of the same day, January 18, cesarean section was performed on Mrs. J., in the north operating room. This patient had been admitted on January 17 and had had feeble pains and ruptured membranes for twenty-four hours. One vaginal examination had been made. Her temperature remained below 100° F. until the fourth day, when it rose to 103.6° F. Thereafter it was sustained between 104° and 106° F. until the thirteenth day when she died. Hemolytic streptococci were recovered from her blood before death and from the peritoneal cavity after death. She also had a terminal pneumonia.

On January 19, cesarean section was performed in the north operating room on Mrs. N., who had had a trial labor of twenty hours and had membranes ruptured for two hours. One vaginal examination was made. Within twenty-four hours of operation her temperature rose to 104° F. She died on the fifth day. Upon opening the abdomen peritonitis was found and a hemolytic streptococcus recovered.

On January 20, Mrs. C., was delivered by cesarean section in the north operating room. No vaginal examination was made. She had a temperature of 99.6° F. when she was admitted to the hospital on January 14, but thereafter until she was operated she had a normal temperature and blood count. On the night of operation she had a very rapid pulse and the following day her temperature rose to 105.4° F. This temperature was maintained until she died on the third day. Signs of double basal pneumonia were present before death. No autopsy could be obtained and no blood cultures were taken. This was the first death to occur, and it was ascribed to postoperative pneumonia but in all likelihood it was a true septicemia.

On January 20, Mrs. F. was delivered by forceps in the private operating room. No vaginal examination was made prior to the operation. She ran a perfectly smooth course until the fifth day when she had a chill and her temperature reached 104.2° F. This temperature was maintained with slight remissions for ten days when it reached normal. For the next eight days it was remittent and on the twenty-third day a pelvic abscess was opened per vaginam. She was discharged well on the fortieth day. Blood cultures repeatedly taken were negative but lochial culture and cultures from the pus of the pelvic abscess showed a hemolytic streptococcus.

On January 20, Mrs. E. had a normal delivery in the east operating room. She had had fever for three days before admission when her temperature was 99.4° F. For eight days after delivery her temperature was not above 100° F. except on the fourth day when it reached 102.8° F. On the ninth day it rose to 104° F., and remained there for two days after which it gradually dropped to normal. She was discharged well on the twenty-sixth day. A hemolytic streptococcus was recovered from her cervix on the twelfth day and from a small abscess in the buttock, the site of a quinine injection on the eighteenth day. Blood culture was persistently negative.

On January 14, Mrs. B. was admitted to a private floor. She had had a severe cold with a temperature of 103° F. at home. On admission the temperature

was normal but on two occasions, on January 18 and January 23, it reached 99° F. She was delivered in the private operating room on January 24 after a normal labor in the course of which the only examination or interference was the artificial rupture of the membranes at the vulva. Within thirty-six hours her temperature reached 104.6° F. and in the course of the second day it rose to 107.6°F. She died on the third day. Hemolytic streptococci were found in the blood during life, and a partial autopsy showed peritonitis with an abundant growth of streptococcus hemolyticus.

On January 26, Mrs. P. was admitted and had a normal delivery with a first degree laceration in the east operating room. One vaginal examination was made. On the third day the temperature rose to 103.8° F. and varied between this and 105.6° F. until the seventh day after which it fell to below 103° F. For the next thirty days it fluctuated between 99° and 103° F. Thereafter it was normal and she was discharged well on the fifty-first day. Repeated blood cultures were negative but vaginal culture showed a streptococcus hemolyticus.

On January 27, Mrs. D. had a normal delivery in the east operating room. One vaginal examination was made. She had a laceration which was repaired. Temperature rose to 104° F. on the eighth day with a chill. It gradually fell to normal on the tenth day. Blood culture was negative. Vaginal culture showed streptococcus hemolyticus.

On January 29, Mrs. T. had a normal delivery with a first degree laceration in the east operating room. Three vaginal examinations had been made. She had a temperature of 99.4° F. during labor. On the third day temperature rose to 104.6° F.; it was sustained with slight remissions until she died on the ninth day. Vaginal culture and blood culture showed a streptococcus hemolyticus.

On the same day, January 29, Mrs. W., had a normal delivery in the east operating room. One vaginal examination was made. Her temperature during delivery was 99° F. On the third day it rose to 103.2° F. It reached 106.4° F. on the fourth day and thereafter quickly fell to 102° F., and from there fell by lysis to normal on the fifteenth day. She was discharged well on the eighteenth day. Blood cultures throughout were negative. Vaginal cultures showed a streptococcus hemolyticus.

On January 20, Mrs. F. had a normal delivery in the east operating room. One vaginal examination was made on account of some bleeding at the beginning of labor. She was a diabetic. Temperature remained normal until the ninth day when it suddenly rose to 105° F. with a chill. It was sustained at this level for two days and gradually came down, by lysis, to normal on the thirteenth day. She was discharged well on the twenty-third day. The lochia showed a streptococcus hemolyticus which was still present on discharge. Blood culture was negative.

On January 31, Mrs. McG. had a normal delivery in the east operating room. One vaginal examination was made. Temperature remained normal to the fourth day when it rose to 101° F. It reached 104.4° F. on the fifth day. She died on the twentieth day. Blood cultures were positive for streptococcus hemolyticus and vaginal cultures showed the same organism.

On February 2, Mrs. R. was delivered in the east operating room by low forceps after manual rotation of the head. No vaginal examination was made before the forceps application. Temperature remained normal to the third day when it rose to 103° F. Her temperature was sustained about this level until the thirtieth day when it gradually dropped by lysis, and the patient was discharged well on the fifty-first day. A pelvic cellulitis developed but did not suppurate. Vaginal culture showed streptococcus hemolyticus but blood cultures were persistently negative.

On February 2, Mrs. C. was delivered in the east operating room by forceps after rotation of head. She had a temperature of 101° F. at the time of delivery; within a few hours it reached 104° F. and on the second day it rose to 105° F. with a chill. Thereafter it gradually fell and she was discharged on the fifteenth day. A hemolytic streptococcus was cultured from the vagina but none from the blood.

On February 4, Mrs. L. was delivered in the east operating room. She had a severe cold at the time of delivery and had a temperature of 99° F. On the second day temperature rose to 103.8° F. with a chill. It was sustained for two days at this level; gradually fell to 100° F. which it reached on the eleventh day. It was thereafter normal until her discharge on the twenty-second day. She had an inflamed patch on the right tonsil. On the fifteenth day some induration could be felt in both broad ligaments. This had entirely disappeared on her discharge. Vaginal and blood cultures were negative for streptococcus. Throat culture showed a nonhemolytic streptococcus.

On February 5, Mrs. B. was delivered in the east operating room. She had a normal delivery and sustained a second degree laceration. No vaginal examination was made. On the fifth day temperature rose to 103.4° F. It gradually dropped to normal on the twelfth day. She was discharged on the seventeenth day. Blood culture negative. Vaginal culture showed streptococcus hemolyticus.

On February 7, Mrs. M. had a normal delivery in the east operating room. One vaginal examination was made. Cultures from the vagina on the second day postpartum were positive for hemolytic streptococcus but she had no temperature until the fifth day when it rose to 105° F. with a chill. She ran a long course and died on the seventy-fifth day. During the course of her illness localized abscesses formed in the peritoneum; two of these were opened. At no time had she a positive blood culture.

On February 9, Mrs. S. had a normal delivery in the special delivery room on the sixth floor. One vaginal examination was made. On the fourth day her temperature rose to 102° F. at which level it remained for three days and then gradually fell to normal. She was discharged well on the sixteenth day. Vaginal culture showed streptococcus hemolyticus. Blood cultures were negative.

On February 9, Mrs. S. was delivered by cesarean section in the north operating room. No vaginal examination made. Temperature remained below 100° F. until the fifth day when it suddenly rose to 105° F. It remained between 101° and 104° F. until the tenth day when it fell by lysis to normal; it was persistently normal after the twentieth day. She was discharged well on the twenty-fourth day. The abdominal wound healed by first intention. Blood culture was negative throughout. Lochial culture showed a streptococcus hemolyticus.

On February 10, Mrs. B. was delivered by forceps in the private operating room. No vaginal examination before forceps application. She had had a hemolytic streptococcal infection of the nose a year before, and there was a recurrence of throat trouble with a temperature of 103° F. before admission. On the third day postpartum the temperature reached 104° F.; it reached this level again on the fourth day, fell by lysis and was persistently below 100° F. until the twenty-sixth day when it reached 102° F. and then went to 105.2° F. on the thirtieth day. At this time some induration was found in the cellular tissue of the pelvis. She ultimately made a complete recovery and was discharged on the fifty-sixth day. Blood culture throughout was negative. Vaginal culture showed the streptococcus hemolyticus.

On February 10, Mrs. C. had a normal delivery with a second degree laceration in the special delivery room on the sixth floor. On the fourth day temperature

rose to 102° F., it was sustained at this level for three days and fell by lysis to normal. Patient was discharged well on the thirteenth day. Vaginal culture showed streptococcus hemolyticus. Blood culture was negative.

Mrs. C. had a normal delivery on February 12 in the special delivery room on the sixth floor north. On the second day temperature rose to 103° F. It was remittent between 100° and 105° F. until the forty-first day. An inflammatory mass developed on the right side of the pelvis and in front of the uterus. This was drained on the forty-first day. This temperature gradually came down reaching normal on the forty-ninth day. Patient was discharged on the fifty-seventh day when there was still some thickening to be felt on the right side. Blood cultures and vaginal cultures were negative for streptococcus hemolyticus.

On February 13, Mrs. W. was delivered by low forceps in the private operating room. On the second day she had a chill and her temperature rose to 103° F. It returned to normal on the fourth day and did not rise again. Blood culture was negative; vaginal culture showed a hemolytic streptococcus.

On February 14 admission of patients to the wards of the hospital was stopped. A private patient, Mrs. S., admitted on that day, was delivered by forceps in the private operating room on February 18. Her temperature remained normal until the fourth day when it rose to 104° F. with a chill. It remained at this level for the next three days when it fell suddenly reaching normal on the eighth day where it remained until the eleventh day when it rose, suddenly, to 106° F. with a chill. By the twelfth day it had again reached normal and so remained until her discharge on the twentieth day. Repeated blood cultures were negative. Vaginal cultures showed a streptococcus hemolyticus.

The hospital was reopened on February 24.

On March 14, Mrs. F. was delivered by forceps in the private operating room. On the third day her temperature rose suddenly to 104° F. with a chill. She became very restless and soon was in a condition of acute mania, so that on the fifth day she was transferred to Bellevue Hospital. Streptococcus hemolyticus was cultured from blood obtained on the fourth day. She died in Bellevue on the seventeenth day. No autopsy was done.

SUMMARY

During the period January 16 to February 14 one hundred and sixty-three patients in all were delivered. Of these twenty-four, or approximately fifteen per cent, showed evidence of streptococcal infection. One case developed after February 14 and died. The number of deaths in the twenty-five cases was nine, a mortality of thirty-six per cent. During the same time twelve other patients had morbid puerperia with temperatures of 100.4° F. or over. In none of these were streptococci demonstrated and in none was there gross evidence of uterine infection. Five of them had evidence of pyelitis and all made a rapid recovery. Two patients with hemolytic streptococci in the vagina had no temperature.

The methods of delivery in the twenty-four infected cases were as follows:

Normal	13
Forceps	6
Cesarean section	4
Version in twins	1

Vaginal examinations were made as follows:

Normal cases	5 ——— no examination
	7 ——— one examination
	1 ——— three examinations
Forceps cases	3 ——— no examination
	3 ——— one examination
Cesarean sections	2 ——— no examination
	2 ——— one examination

In seven of the whole series, therefore, no vaginal manipulation of any kind was carried out.

Streptococcal Infections in Infants.—Only one infant had an infection during this period. It was the child of an infected patient, Mrs. P., and it was separated from its mother when it was four days old. It developed a general erysipelas on the sixteenth day and died.

Streptococcal Infections in the Staff.—Twenty nurses and two attending surgeons had hemolytic streptococci in the throat or nose during the period of the epidemic. Four nurses had tonsillitis.

On January 31 a nurse who was nursing an infected patient pricked her finger with a safety pin. In twenty-four hours the arm became painful, the temperature rose and she became very ill. She was transferred to the Presbyterian Hospital where later the arm and axilla were incised. A hemolytic streptococcus was obtained from the pus. Blood cultures were negative. She recovered.

On February 14 at 6:30 P.M. a nurse, Miss S., complained of feeling chilly. She was taken off duty and at 7:30 P.M. her temperature was 101° F. Her only complaint was pain in the back and legs. The following afternoon she complained of abdominal distress which soon became acute pain and her temperature rose to 104° F. She was transferred to St. Luke's Hospital. On the evening of February 16 the abdomen was opened. A general peritonitis was found with no primary lesion demonstrable. A hemolytic streptococcus was recovered from the peritoneal fluid. She ultimately made a good recovery. She had had no sore throat, but there was swelling of the glands of the neck. She had a negative throat and nose culture. She had not been in contact with infected cases in the wards, but on February 10 had assisted at the delivery of Mrs. B., who subsequently developed infection.

The sum total of the epidemic, therefore, includes twenty-five puerperal infections with nine deaths, one fatal case of erysipelas in an infant, one streptococcal cellulitis in a nurse, and one primary peritonitis in a nurse.

EPIDEMIOLOGY

Like some other epidemics the present one got under way and was in full swing before we realized what was happening. It is only on looking back and reviewing the various occurrences that we can piece together the story. In the three days, January 18, 19, and 20, seventeen patients were delivered in the hospital. Six of them developed

a virulent streptococcal infection and four of them died. Of these six patients three were delivered by cesarean section in the north operating room on the seventh floor; two had normal deliveries in the east operating room on the ground floor; and one was a forceps delivery in the private operating room on the third floor. These six patients before and after delivery were on different floors of the hospital, two of them in private rooms on the second floor, two in separate public wards on the third floor, two in separate wards on the fourth floor before delivery, and in the same ward after delivery. The three cesarean sections were performed by different operators but the operating room staff was the same in all cases. In the same operating room and with the same staff seven gynecologic laparotomies were performed between January 18 and January 21 and on the latter date another cesarean section. All of these patients had a perfectly normal convalescence. The routine gynecologic operating of the hospital was carried on in this operating room until February 9 with absolutely no untoward results. There were no wound infections or other evidences of sepsis in these patients.

The supplies for the north operating room, where the cesarean sections were done, were sterilized in the sterilizing room attached to it. The supplies for the east operating room and for the private operating room were sterilized in the east operating room. All sterilizers in the hospital are under clock control and are checked once a week by culture. Examination of dressings, sponges, gloves, etc., subsequent to the outbreak of the epidemic proved them to be sterile.

The sterile water supply is separate for each operating room. A check-up of this at a later date showed absolute sterility in the hot water supply throughout but from one of the cold water tanks a few organisms were obtained but no streptococci.

The senior resident assisted at all three cesarean sections and delivered the one patient in the private operating room, but he was not present at the two deliveries in the east operating room.

The attending surgeon who operated upon one of the cesarean sections had examined one of the other two vaginally two days before, but he was not present at the third.

The same intern delivered the two patients in the east operating room but took no part in the cesarean sections or in the delivery of the patient in the private operating room.

There is an interchange of nursing staff between the east operating room and the private operating room, but the north operating room staff is quite separate.

It, therefore, seems impossible at this stage to find a common factor applicable to all the cases.

The first likely clue we had to follow was that the next six patients to develop infection were all delivered at night. The night intern delivered five of the patients in the east operating room and gave the

anesthetic to the sixth in the private operating room. He had also delivered two of the patients among the first six infected. The night operating room supervisor assisted at all of them. Nose and throat cultures from the intern and the supervisor showed the presence of a streptococcus and both were taken off duty on January 31; that was thirteen days after the delivery of the first patient to show infection. The intern was sent on a vacation and did not return, as his term of service ended shortly after, so that no further cultures could be obtained from him. This was unfortunate as his organism eventually proved to be a streptococcus viridans. The organism from the nurse also was found by Dr. Meleney to be of a different strain from that of the infected patients.

Cultures from the throat and nose of the attending surgeon who performed the first, and examined the second fatal cesarean section, and later delivered the patient in the private operating room, who developed infection, were positive for hemolytic streptococci. Subsequent detailed examination of these cultures by Dr. Meleney showed the organism to be of a different strain from that of the infected patients.

All that we had to go on, therefore, at this stage was that certain individuals in the hospital were harboring streptococci in the nose and throat. These individuals were, therefore, excluded from contact with patients.

In spite of the change of the night staff, and the exclusion of others who were carriers, as they were found, three patients delivered in the east operating room during the following week became infected. This operating room was, therefore, closed and all deliveries were conducted in the clinic room on the sixth floor, one of the gynecologic wards being used as a first stage room. Three patients delivered there developed infections, as did also one delivered in the private operating room, and one delivered by cesarean section in the north operating room. We then seemed to be at the end of our resources and stopped admission of patients to the hospital on February 14.

The hospital remained closed for ten days and on February 24 was reopened. The first case admitted was a patient in labor who subsequently was found to have a gonococcal infection. She had a febrile puerperium but no streptococci were found. She gave us some anxiety until we were certain of the diagnosis. No other patient had a febrile puerperium until on March 17, Mrs. F., delivered by forceps in the private operating room on March 14, had a sudden rise of temperature with a chill. Streptococci were recovered from her blood on the fourth day of her illness. She developed acute mania and was removed to Bellevue Hospital where she died on the seventeenth day. Since that time there have been no streptococcal puerperal infections in the hospital.

Early in the epidemic it was noted that certain of the infected patients had had a temperature before delivery and it was thought possible that they might be harboring streptococci in some part of the body and that invasion of the uterus and generalized spread occurred in the early puerperium. Twelve of the twenty-four patients had a temperature of 99° F. or over before or during parturition; three of them had severe colds before their admission to the hospital and stated that they thought they had had fever. One patient was known to have had a temperature of 103° F. the day before she entered the hospital, on January 14. She was in a private room in the hospital for ten days before delivery took place. During this time her temperature rose to 99° F. on two occasions. She died on the third day following delivery of streptococcal infection.

In those early cases bacteriologic examination of the nose and throat was not made. In a large number of patients examined subsequently only one was found to have hemolytic streptococci in the throat. This, together with Dr. Meleney's later work which showed that the streptococci recovered from the fatal and severe cases were nearly of one strain, rendered it unlikely that the individual patient brought in her own organism.

While the epidemic was in progress, we heard from time to time of infections occurring in other hospitals both obstetric and surgical and we wondered whether 1927 might be a "streptococcal year" analogous to an "influenza year." Several aural surgeons informed us that during the early part of 1927 there was an unusual number of severe streptococcal sinus and mastoid infections in New York. With the hope of being able to throw some light on this a questionnaire was sent this autumn to a number of obstetric hospitals throughout the country asking if there had been noted any increased incidence or increased severity of streptococcal infections during the early months of 1927. Twenty-four hospitals replied and of these seven stated that the morbidity and mortality rates from streptococcal infections were distinctly higher than the average; seventeen stated that there had been no increase. Five of the seven hospitals which had noted an increase were in the area of greater New York or its immediate vicinity, one was in Baltimore, one in Philadelphia. One of the replies stated that there had been a thirty-three per cent increase over the average of streptococcal infections but no deaths. In one hospital there had been three deaths and in one six deaths. Five of the hospitals stated that there had been an increased incidence of streptococcal infection on the surgical services attached to or affiliated with them. In three there had been a noteworthy incidence of streptococcal infection among the members of the staff.

It would thus appear that during the early months of 1927 there was an increased incidence of streptococcal infection in the eastern part

of the country. Whether that increased incidence was due to the greater prevalence of the organisms, their greater virulence, or a general increase in susceptibility cannot be said.

It is interesting to note that there was an increased prevalence of scarlet fever in the United States during the later months of 1926 and the early months of 1927.*

Dafoe† reported an epidemic of puerperal hemolytic streptococcal infection with eight deaths in the months of January and February, 1924, in Toronto General Hospital. He states that these cases "were coincident with other cases of puerperal sepsis of a similar type in various other hospitals and in private practice. At the same time there was a marked prevalence of sore throats, sinus infections, and middle ear trouble throughout the city." In the investigation of this epidemic hemolytic streptococci were found in the noses or throats of the two house surgeons, in nine out of twenty-five students, and in fifteen per cent of the nurses.

The streptococcus recovered from the Sloane patients was an extremely virulent one. As Dr. Meleney will show in his paper, it was so constant in type in the different cases that it must have come from a common source. How it acquired its virulence or how it was first introduced we have failed to prove. The fact that it was recovered from the vagina of every infected patient seems to be proof that it entered the body by this route. In none of the patients examined in the latter part of the epidemic or in the three months following it were streptococci found in the vagina prior to delivery. The inference must be that the organisms got into the vagina at the time of labor or in the early puerperium. As the only place in the hospital where hemolytic streptococci were found was the throat or nose of certain doctors and nurses the inference is that the organisms were spread to the cases in this way.

MEASURES TAKEN TO CHECK THE EPIDEMIC

As soon as it became evident that infection was present in the hospital careful check was made on all technic. Vaginal examinations were forbidden except when absolutely necessary and were then made only by an attending or the senior resident after complete iodine preparation of the vulva and vagina and full sterile draping as for delivery. We had not used mercurochrome as a routine in the hospital and considered it safer to adhere to a technic with which we were all familiar and which had proved satisfactory in the past. (See appendix.) As previously mentioned bacteriologic examination of all dressings, gloves, and sterile water was carried out. Masks which had previously been worn had, in many cases, not fully covered the nose. On January 28 we asked Dr. Meleney to come to our assistance. He pointed out the importance of masking the nose completely as well as the mouth. From that date complete masking was carried out. The masks were worn not only in the delivery room but in the first and second stage rooms by all doctors and nurses. On February 5 every member of the attending, resident, intern, nursing, and domestic staff had throat and nose cultures taken and these were repeated at weekly intervals. No one with a positive culture of streptococcus

*Public Health Reports, xliii, No. 3.
†Edin. Med. Jour., xxxii.

hemolyticus was allowed to come in contact with a patient before, during, or after delivery. A certain number of nurses with positive cultures were assigned to nursing the already septic patients. All others with positive cultures were excluded from the hospital. Every nurse was masked when doing postpartum dressings. The night intern who had a positive culture was sent on a vacation. The two attending surgeons with positive cultures did not visit the general labor room or public wards. They did for a time visit their private patients but were completely masked when they did so. Students were excluded from the hospital.

After the first evidence of infection in the patients delivered in the north, east, and private operating rooms the walls and floors of these were thoroughly washed with soap and water and chloride of lime. As the cases still continued in the east operating room it was closed on February seventh, and thereafter all patients were delivered in the gynecologic examining room on the sixth floor north, one of the gynecologic wards being used as a first stage room. Of the patients delivered there during the next week three developed infection. It was then decided to stop all admissions to the hospital. This was done on February 14 and no patients were admitted from then until February 24. Meanwhile the operating rooms had been fumigated with formalin and completely repainted. The entire ward side of the hospital, including halls, stairways, and pantries, was painted. Every mattress and pillow in the hospital was sterilized and remade, new ticking being used throughout. All blankets were washed. These measures were evidently effective for after the reopening on February 24 no other cases occurred except the isolated one on March 14. The Superintendent has computed that, apart from the loss of revenue due to cancelled reservations, the cost of the epidemic to the hospital was over six thousand dollars.

For three months after the reopening of the hospital, cultures were taken from the vagina of every patient on admission, at the beginning of labor, at the end of labor, and on the second, fourth, and seventh days postpartum. During this time no hemolytic streptococci were found.

The precautions regarding vaginal examinations and the masking of nose and mouth by every one in the first and second stage rooms as well as in the delivery room have been adhered to. Every nurse before she enters the hospital must bring from her school a report that cultures have been taken from the nose and throat and that they are negative for hemolytic streptococci. Weekly cultures of the Staff are being taken during the winter months. It is interesting to note that so far this winter not a single hemolytic streptococcus carrier has been found.

ISOLATION OF INFECTED CASES

In the Sloane Hospital there is no isolation wing. Two of the wards at the end of the corridor on the fourth floor are used as septic rooms. They have their own utility room.

It was a rule of the hospital that when a patient developed a temperature of 100.4° F. or over she was removed to one of these wards. This rule was adhered to before and during the epidemic. As the cases increased other wards on the same floor were used for the infected cases. These were shut off from the rest of the floor by a door. After February first all attending surgeons and interns were excluded from this part of the floor, the Director and Obstetric Resident being the only doctors who visited or handled the patients, and they did not visit other wards or take part in the delivery of patients. Gowns, caps, and masks were worn by them while on the floor. Nurses were put under isolation rules and were made to change their dresses before leaving the floor. All bed linen and dressings were soaked in strong lysol solution before being sent from the wards to the laundry. All dishes were disinfected immediately after use. In the later part

of the epidemic cultures were made from the vagina of every patient before delivery, after delivery, and on the second, fourth, and seventh days of the puerperium. In three patients hemolytic streptococci were found on the first postpartum examination and these individuals were at once isolated. One developed infection on the fifth day and died; the other two showed no symptoms.

The experience we have gone through emphasizes the necessity for a self-contained isolation unit in every maternity hospital. Our improvised arrangements proved to be ineffective and, looking back now, we regret that we did not close the hospital earlier than we did.

CLINICAL OBSERVATIONS

Under this heading there will be discussed the mode of incidence of the disease, its general course, the blood picture, the occurrence of streptococci in the blood and in the lochia, and the terminal results.

Mode of Incidence.—The time after delivery at which the first rise of temperature occurred is of interest. In the great majority of cases this rise occurred suddenly to 103° F. or over and was accompanied by a definite chill. In two cases the rise occurred within twenty-four hours; in one, it was on the eighth day; and in one, on the ninth day postpartum. In the majority of cases the rise took place on the third, fourth, or fifth day, the average time for twenty-four cases being 3.75 days postpartum. This rather late appearance of temperature and especially the occurrence of the two on the eighth and ninth days made us think at one time that the infection might be getting into the patients not at the time of delivery but in the puerperal period, and this led to a very thorough investigation of the bedding and dressings which Dr. Meleney will mention in his paper. It may be said now that no streptococci were found anywhere in the environs of puerperal patients in normal wards. We have, therefore, no proof that infection occurred after delivery.

After the initial rise, the temperature was usually maintained with slight remissions for several days, and in those who recovered, the remissions became greater and a gradual fall took place while in the fatal cases the remissions became smaller with a gradual rise until death occurred. The highest temperature recorded was 107.6° F. on the second day postpartum. The patient died within twelve hours. The temperature curve was markedly influenced by serum and quinine treatment. In the patients who recovered there was a drop of several degrees after intravenous serum and after intramuscular quinine administration. The drop was not so constant or so great after blood transfusion.

At the time of the rise of temperature the pulse also rose and the two curves as a rule ran together. In the first patient who died after cesarean section the first indication of anything wrong was a pulse of 140 on the night of operation so that an internal hemorrhage was suspected. Her temperature did not rise until twelve hours later. In all the others, temperature and pulse rose at the same time.

Abdominal distention was a prominent symptom in fourteen of the cases. Of these, seven were fatal and seven nonfatal. Diarrhea was noted in three fatal cases and in four that recovered.

In six of the fatal cases signs of consolidation and friction at the bases of the lungs appeared. It was most constant and most marked on the left side. It usually appeared just about the time at which the first positive blood culture was obtained and, taken along with this, we came to regard it as a bad prognostic sign. In such cases as came to autopsy the bases of the lungs showed fibrinous pleurisy, sometimes with fluid, and a lymphatic interstitial pneumonia (see autopsy reports).

As a general rule the involution of the uterus was delayed, and there was never more than slight uterine tenderness.

In eight cases, all of which recovered, there was inflammatory exudate in the pelvis and in two of these, abscesses formed. In no case was there an excessively foul lochia but in eleven it was noted as fetid or slightly fetid.

Blood Picture.—In Table I a summary and average of all the blood counts in the twenty-four cases is given. The average leucocyte count at the beginning of the infection was 19,800 with 84 per cent polymorphonuclear, and 71.5 per cent hemoglobin. At the height of the disease the corresponding figures are 25,000; 88 per cent; and 57 per cent. The highest leucocyte count was 41,400 with 91 per cent polymorphonuclears. This patient was a diabetic whose illness began on the ninth day after delivery and she recovered. In only one case did the leucocyte count never reach 10,000. This was Mrs. B., who died on the third day after delivery. Her highest count was 9,800 with 86 per cent polymorphonuclears.

TABLE I. SUMMARY OF BLOOD FINDINGS IN 24 CASES OF STREPTOCOCCAL PUERPERAL INFECTION

		LEUCOCYTES	POLYMORPHONUCLEARS	HEMOGLOBIN
First blood examination after rise of temperature	Average	19,800	84%	71.5%
	Maximum	41,000	91%	78.0%
	Minimum	9,800	86%	54.0%
Blood examination at height of infection	Average	25,000	88%	57.0%

In four patients there was a sudden drop in the number of leucocytes in the course of the disease, three of these patients died and one recovered.

One of them, Mrs. J., had a drop from 19,000 with 93 per cent polymorphonuclears on the third day of her illness to 8,000 with 86 per cent polymorphonuclears on the fifth day. Two days later the count was 11,000 with 74 per cent polymorphonuclears. She died three days later.

Mrs. T., had a drop in her leucocyte count from 18,000 with 85 per cent polymorphonuclears on the second day of her illness to 8,800 with 90 per cent polymorphonuclears on the fourth day. The count rose to 25,000 with 92 per cent polymorphonuclears two days later and she died the following day.

Mrs. L., had a leucocyte count of 18,000 with 86 per cent polymorphonuclears on the first day after illness. Four days after it had dropped to 5,700 with 89 per cent polymorphonuclears. It rose to 15,900 in two days and then to 25,000 with 92 per cent polymorphonuclears in three days more. She died two days later.

Mrs. F., had a drop from 15,000 with 80 per cent polymorphonuclears on the second day to 7,000 with 79 per cent polymorphonuclears on the fifth day. In four days the count rose to 33,000 with 90 per cent polymorphonuclear leucocytes. About the same time a definite inflammatory mass developed in the pelvis which later suppurated, was drained, and she recovered.

There was a marked drop in hemoglobin values in practically all cases. The average value at the beginning of the infection was 71.5 per cent and there was an average drop of 14.5 per cent during its course to an average low reading being 57 per cent. The beneficial effect of transfusion is shown in Table II.

TABLE II

HEMOGLOBIN DETERMINATION IN TRANSFUSED CASES		
Total number of transfused cases		11
At beginning of infection	71.5%	
Lowest reading	52.5%	
Reading on discharge or death	60.1%	
HEMOGLOBIN DETERMINATION IN NONTRANSFUSED CASES		
Total number of nontransfused cases		14
At beginning of infection	73.25%	
Lowest reading	66.00%	
Reading on discharge or death	66.00%	

Blood Cultures.—Blood cultures were made repeatedly in all cases except one. From seven patients a hemolytic streptococcus was recovered. Six of these seven patients died. The one who recovered gave a single colony on the twenty-sixth day and none thereafter. It is interesting to note the first day postpartum on which the positive blood cultures were obtained, viz.: the second, fourth, eighth, tenth, eleventh, eighteenth, and twenty-sixth (see Table III). The late stages at which the streptococcus was culturable from the blood stream would suggest that the first dissemination of the organisms was by the lymphatics and that from there they reached the blood. This is supported by the findings in the cases which came to autopsy, in all of which there was direct evidence of lymphatic involvement. The occurrence of peritonitis in four, and of pleurisy in one, also is evidence of lymphatic spread. Of the sixteen patients who recovered eight developed an inflammatory exudate in the pelvis and two had symptoms of articular inflammation both of which are usually indicative of a lymphatic spread.

Vaginal Cultures.—In eighteen of the twenty-four patients a hemolytic streptococcus was grown from vaginal smears. In five no smears were

taken and one was negative. The material for culture was taken from just within the vaginal orifice. In one of the earliest cases the cervix was exposed by a speculum and the smear taken from inside the cervical canal. Within an hour she had a chill and the temperature rose to 104° F. although it had been below 102° F. for the previous two days. She ultimately made a good recovery, but thereafter we avoided taking intrauterine or cervical cultures. The number of positive findings proved the method adopted to be adequate for all practical purposes.

When it was realized that we were in the midst of a streptococcal epidemic cultures were taken from within the vaginal orifice of every

TABLE III. CASES WITH STREPTOCOCCUS HEMOLYTICUS IN BLOOD SHOWING DAY POSTPARTUM ON WHICH FIRST POSITIVE CULTURE WAS OBTAINED, THE RESULT AND AUTOPSY FINDINGS*

NAME	FIRST POSITIVE CULTURE	RESULT	AUTOPSY FINDINGS
Mrs. M.	None	Died on 75 day	Multiple abscesses throughout abdomen. Definite evidence of lymphatic spread
Mrs. T.	8 day	Died on 9 day	Diffuse peritonitis Lymphangitic pneumonia
Mrs. N.	None	Died on 5 day	Partial autopsy Diffuse peritonitis
Mrs. J.	10 day	Died on 13 day	Diffuse peritonitis
Mrs. B.	2 day	Died on 3 day	Diffuse peritonitis Lymphatic spread in broad ligaments
Mrs. L.	11 day	Died on 17 day	Diffuse peritonitis
Mrs. C.	None taken	Died on 3 day	No autopsy
Mrs. McG.	18 day	Died on 20 day. Had a pleurisy with streptococci	No autopsy
Mrs. R.	26 day (one single colony)	Discharged on 52 day Had pelvic cellulitis	
Mrs. F.	4 day	Died on 17 day	No autopsy

*Hemolytic streptococcus recovered from peritoneal cavity in all of above autopsied cases.

patient before delivery, immediately after delivery, and on the second, fourth, and seventh days of the puerperium. In no case did we find a hemolytic streptococcus before delivery but from three a hemolytic streptococcus was obtained on the second day of the puerperium. These patients were isolated. Two of them had afebrile puerperium. The culture from one of these was still positive on discharge from the hospital. The third, Mrs. M., after being afebrile for five days had a sudden rise of temperature with a chill, and after a long illness died on the seventy-fifth day. These cases are of interest and importance as showing that the organisms entered into the vagina during or immediately after delivery, that organisms may be present in the vagina and never infect the uterus, and that if the uterus is invaded three days may elapse before symptoms develop. No previous vaginal cultures had been

taken from the two patients who began their infection on the eighth and ninth day postpartum, these cases having occurred before the routine was begun.

Autopsy Findings.—In three of the fatal cases no autopsy examination was permitted; in three the abdomen only was examined; and in three a complete autopsy was made. In all the cases examined peritonitis with free fluid was found. In all there was fibrinous exudate on the intestines. In one there were multiple abscesses in the peritoneal cavity and cellular tissue of the pelvis.

In none was there any evidence of septic thrombophlebitis of the pelvic veins.

In the cases examined fully there was definite evidence of lymphatic spread of the infection in the form of lymphatic vessels chocked with polymorphonuclears and organisms; leucocytic infiltration of blood vessel walls; abscess formation in the uterine wall, in the ovaries, and in the cellular tissue of the pelvis; interstitial lymphatic pneumonia, and pleurisy.

These findings together with certain clinical phenomena already mentioned point to a primary lymphatic rather than a blood borne infection.

TREATMENT

In the treatment of this series of cases of streptococcal puerperal infection three main therapeutic agents were used, viz.: antistreptococcal serum, quinine bi-hydrochloride, and blood transfusion. In most cases a combination of two or of all three was used. Thus five cases, two fatal and three nonfatal, had all three; three, two fatal and one nonfatal, had transfusion and serum; eight, two fatal and six nonfatal, had serum and quinine bi-hydrochloride. (Table IV.)

Antistreptococcal Serum.—This was used in eighteen cases, six of which proved fatal and twelve of which recovered. Five of the fatal cases had a positive blood culture, and eleven of the nonfatal cases a negative culture; the twelfth case showing one colony of streptococci on the plate on one occasion only, late in the disease.

Two types of serum were used, one a polyvalent Lederle serum which was given as a rule in 100 c.c. doses intravenously. The other was a special concentrated serum of Parke Davis and Company, of which 10 c.c. is said to be equal to 100 c.c. of their serum as formerly prepared. This was given as a rule in 10 c.c. doses intravenously. Five patients were given 20 c.c. doses with no untoward result. Other deviations from the general dosage mentioned for both sera will be seen in Table IV. One patient had a 10 c.c. dose of Dochet serum. Three patients showed a marked reaction, two of them during the administration of the Lederle product so that it had to be stopped and one, a late reaction after the concentrated serum. All the others stood it well. The concentrated serum was given to ten patients with three deaths; the ordinary serum to six patients with two deaths. The ordinary and concentrated were both given to one patient who recovered, and the concentrated Dochet serum to one, who recovered.

The first dose of serum was given immediately on the rise of temperature in two cases, on the second day, i.e., within twenty-four hours, in eight cases, and on the

third day in six, on the fourth day in one case, and on the fifth day in one. Ten patients had one dose only, one of these died and nine recovered. Eight patients had two doses, two of these died and six recovered. One fatal case had three doses.

Only two patients had serum as their only treatment. It was given on the second day in each case. Both made rapid recoveries and were discharged, one on the fifteenth day and the other on the seventeenth day postpartum. In two cases transfusion was given along with serum treatment. One patient died and the other recovered.

Antistreptococcal Serum and Quinine Bi-Hydrochloride.—In thirteen cases serum was given in combination with quinine bi-hydrochloride administered intramuscularly in five grain doses. The preparation used was one put up in sterile ampules and it was injected deep into the muscle of the thigh or buttock. This combination of serum and quinine bi-hydrochloride was first brought to our attention by Luker who reported good results which we had confirmed. His routine was the administration of 30 c.c. of antistreptococcal serum on three successive days, and, after that, five grains of quinine bi-hydrochloride in 10 c.c. of sterile distilled water intravenously on the fourth, sixth, and eighth days; 5 grains of quinine bi-hydrochloride in 1 c.c. of water are given intramuscularly on the fifth, seventh, ninth, tenth, eleventh, and twelfth days. By this treatment he has reduced the mortality from 34.2 per cent to 5.6 per cent. Luker believes that the action of quinine bi-hydrochloride in those cases is a general one on the tissue cells.

This precise routine we did not follow. From Table V it will be seen that the quinine was given on the first day of temperature rise in eight cases, on the second day in four, and on the fifth day in two, and that when repeated it was usually, but not always, on alternate days with the serum. Of the thirteen patients treated in this way four died and nine recovered. Late transfusions were given in two of the fatal, and in three of the nonfatal cases. In two patients abscesses at the site of quinine bi-hydrochloride injection developed and from the pus a hemolytic streptococcus was recovered in each case. We have had a similar occurrence in two other cases treated elsewhere.

Blood Transfusion.—In this series of cases blood transfusion was given to eleven patients (Table VI). The direct method was used in four, and the citrate method in seven. The reason why the citrate method was used in the majority of cases was that the transfusion had to be done in the septic wards and it was thought that the donor would be exposed to a definite risk if the direct method were employed. In considering blood transfusion in puerperal septicemia two different aspects of the procedure have to be kept in mind, first, blood transfusions early in the disease as a possible means of increasing the patient's resistance to the invading organisms and their toxins, and secondly, as a supportive measure in long drawn out cases. At the beginning of the epidemic we were relying on the serum and quinine bi-hydrochloride treatment as already outlined because we had had as good results with it as with any other method of treatment in the past, but some of our patients had early transfusions. Five patients were transfused within the first four days of their illness, one on the first day, one on the second and sixth days, one on the second day, one on the third, fifth, and seventh days, and one on the fourth and ninth days. Of these five patients the first two mentioned died and the three others recovered. The two who died had positive blood cultures; the three who recovered had negative blood cultures. One of those who died had a direct, and one, a citrate transfusion. It is interesting to note that in all three who recovered there was a definitely localized pelvic inflammation in the latter part of the disease. Whether this localization can be attributed to the transfusion or indicates a limitation of the infection from the start it is impossible to say.

TABLE IV. TREATMENT

NAME	BLOOD CULTURE	TRANSFUSION		SERUM		QUININE	REMARKS	RESULT
		DAY OF DISEASE AND AMOUNT	METHOD	DAY OF DISEASE AND AMOUNT	SERUM TYPE OF	DAY OF DISEASE AND AMOUNT		
Mrs. B.	Positive	1st—600 c.c.	Direct				Normal delivery	Died on 3rd day
Mrs. J.	Positive	2nd—600 c.c. 6th—500 c.c.	Citrate	3rd—150 c.c.	Lederle		Cesarean section	Died on 13th day
Mrs. McG.	Positive			2nd— 20 c.c. 4th— 20 c.c.	P. D. conc.	1st—5 gr.	Normal delivery	Died on 20th day
Mrs. L.	Positive	12th—250 c.c.	Citrate	5th— 90 c.c. 9th—175 c.c. 14th—210 c.c.	Lederle	2nd—5 gr. 3rd—5 gr. 11th—5 gr. 12th—5 gr.	Normal delivery	Died on 17th day
Mrs. M.	Negative	8th—450 c.c. 24th—500 c.c. 55th—500 c.c.	Citrate	1st— 20 c.c. 4th— 20 c.c.	P. D. conc.	1st—5 gr. 2nd—5 gr.	Peritoneal abscess	Died on 75th day
Mrs. T.	Positive			3rd— 20 c.c. 4th— 20 c.c.	P. D. conc.	1st—5 gr. 2nd—5 gr. 4th—5 gr.		Died on 9th day
Mrs. F.	Positive	10th—500 c.c.	Direct	8th— 20 c.c. 10th— 10 c.c.			Acute mania	Died on 17th day
Mrs. C.	Not taken						Clinical diagnosis of pneumonia following Cesarean section	Died on 3rd day
Mrs. N.	Positive						Cesarean section markedly distended	Died on 5th day
Mrs. F.	Negative	2nd—600 c.c. 6th—500 c.c.	Direct	3rd—100 c.c.	Lederle		Pelvic abscess	Discharged 40th day
Mrs. B.	Negative	3rd—500 c.c. 5th—600 c.c. 7th—500 c.c. 29th—500 c.c. 31st—500 c.c.	Direct				Pelvic cellulitis	Discharged 56th day

TABLE IV—CONT'D

NAME	BLOOD CULTURE	TRANSFUSION		SERUM		QUININE	REMARKS	RESULT
		DAY OF DISEASE AND AMOUNT	METHOD	DAY OF DISEASE AND AMOUNT	TYPE OF SERUM	DAY OF DISEASE AND AMOUNT		
Mrs. R.	One colony on one occasion	4th—500 c.c. 9th—500 c.c. 14th—150 c.c. 24th—300 c.c.	Citrate	2nd— 10 c.c.	Lederle	1st—5 gr. 3rd—5 gr.	Marked reaction after 10 c.c. given	Discharged 51st day
Mrs. C.	Negative	5th—150 c.c. 10th—450 c.c. 17th—500 c.c.	Citrate	1st— 10 c.c. 5th— 10 c.c.	P. D. conc.	5th—5 gr.	Pelvic abscess marked late serum reaction	Discharged 57th day
Mrs. S.	Negative	14th—500 c.c.	Citrate	2nd— 20 c.c. 4th— 10 c.c.	P. D. conc. Dochet	1st—5 gr. 3rd—5 gr.	Cesarean section	Discharged 24th day
Mrs. P.	Negative	29th—100 c.c.	Citrate			2nd—5 gr. 3rd—5 gr. 5th—5 gr.	Trouble with donor	Discharged 51st day
Mrs. E.	Negative			9th— 20 c.c. 11th— 10 c.c.	P. D. conc.	5th—5 gr. 8th—5 gr. 10th—5 gr.	Streptococcal abscess at site of quinine injection	Discharged 26th day
Mrs. W.	Negative			2nd—100 c.c. 5th— 10 c.c.	Lederle P. D. conc.	1st—5 gr. 2nd—5 gr. 4th—5 gr.		Discharged 18th day
Mrs. D.	Negative			2nd— 40 c.c. 4th— 10 c.c.	Lederle	1st—5 gr.	Marked reaction after 40 c.c. serum given	Discharged 13th day
Mrs. L.	Negative			3rd— 10 c.c.	P. D. conc.	1st—5 gr.		Discharged 22nd day
Mrs. S.	Negative			2nd— 10 c.c.	P. D. conc.	2nd—5 gr.		Discharged 16th day
Mrs. F.	Negative			2nd— 10 c.c.	P. D. conc.	2nd—5 gr. 4th—5 gr. 5th—5 gr.	Had diabetes	Discharged 23rd day
Mrs. C.	Negative			2nd— 20 c.c.	P. D. conc.			Discharged 15th day
Mrs. B.	Negative			2nd— 10 c.c.	P. D. conc.			Discharged 17th day
Mrs. S.	Negative						Only medicine was "cholera mixture"	Discharged 20th day

TABLE V. CASES TREATED WITH QUININE AND ANTISTREPTOCOCCAL SERUM

NAME	QUININE DAY ON WHICH GIVEN	SERUM DAY OF DISEASE	OTHER TREATMENT	RESULT
Mrs. McG.	1	2, 4		Death 20th day postpartum
Mrs. L.	2, 3, 11, 12	5, 9, 14	Transfusion on 12th day	Death 17th day postpartum
Mrs. M.	1, 2	1, 4	Transfusions 8th, 24th, and 55th days	Death 77th day postpartum
Mrs. T.	1, 2, 4	3, 4		Death 9th day postpartum
Mrs. R.	1, 3	2	Transfusions 4th, 9th, 14th, 24th	Discharged on 51st day postpartum
Mrs. C.	5	1, 5	Transfused 5th, 10th, and 17th	Discharged on 57th day postpartum
Mrs. S.	1, 3	2, 4	Transfused 14th day	Discharged on 24th day postpartum
Mrs. E.	5, 8, 10	9, 11		Discharged on 26th day postpartum
Mrs. W.	1, 2, 4	2, 5		Discharged on 18th day postpartum
Mrs. D.	1	2		Discharged on 13th day postpartum
Mrs. L.	1	4		Discharged on 22nd day postpartum
Mrs. S.	2	3		Discharged on 16th day postpartum
Mrs. F.	2, 4, 5	2		Discharged on 23rd day postpartum

Transfusion treatment was begun in six cases after the fourth day of the illness and was repeated in two, who had been transfused earlier. Of these six patients three died and three recovered. We were influenced to a certain extent in our choice of transfusion by the fall of hemoglobin early or late in the disease. In Table II it will be noted that in the cases transfused there had been an average drop of 19 per cent in the hemoglobin before transfusion and an average recovery of 6.6 per cent after it. In the cases which were not transfused the average drop in hemoglobin was only 7.25 per cent but there was no rise during the patients' stay in the hospital.

Summary of Treatment.—The results of the three methods of treatment are summarized in Table VII. From this it would appear that the best results had been obtained by serum and quinine bi-hydrochloride, the next best by no treatment at all, and the worst by transfusion. These figures are of course fallacious. Our first treatment in the majority of cases was serum and quinine bi-hydrochloride. A considerable number of patients showed immediate improvement and no other treatment was given. Had our initial treatment been transfusion no doubt equally good results would have been got and the recoveries ascribed to serum and quinine bi-hydrochloride would have gone to the credit of transfusion. Which bears out what has been so often said before, that it is impossible to assess accurately the value of any one method of therapeusis in puerperal sepsis, because a considerable number of patients recover without any treatment and a certain number will die in spite of whatever treatment is used. In this connection a little interlude in the somber story already told may be introduced. One of the attending surgeons refused to believe that one of his private patients, Mrs. S., had the disease in spite of a high temperature with chills and leucocytosis. She had marked abdominal distention with diarrhea and the only treatment she had was

TABLE VI. CASES TREATED BY TRANSFUSION

NAME	DAY OF FEVER ON WHICH DONE AND AMOUNT OF BLOOD GIVEN	METHOD	OTHER TREATMENT	REMARKS	RESULT
Mrs. B.	1st—600 c.c.	Direct		Streptococci in blood	Died on 3rd day postpartum
Mrs. J.	2nd—600 c.c. 6th—500 c.c.	Citrate	Serum	Streptococci in blood	Died on 13th day postpartum
Mrs. M.	8th—450 c.c. 24th—500 c.c. 55th—500 c.c.	Citrate	Serum and quinine	Blood sterile	Died on 75th day postpartum
Mrs. L.	12th—250 c.c.	Citrate	Serum and quinine	Streptococci in blood	Died on 17th day postpartum
Mrs. F.	10th—500 c.c.	Direct	Serum	Streptococci in blood	Died on 17th day postpartum
Mrs. F.	2nd—500 c.c.	Direct	Serum	Blood sterile	Recovery Discharged on 40th day postpartum
Mrs. B.	3rd—500 c.c. 5th—600 c.c. 7th—500 c.c. 29th—500 c.c. 31st—500 c.c.	Direct		Blood sterile Before the second transfusion 300 c.c. of blood was withdrawn	Recovery Discharged on 56th day postpartum
Mrs. R.	4th—500 c.c. 9th—550 c.c. 14th—150 c.c. 24th—500 c.c.	Citrate	Serum and quinine	Blood sterile	Recovery Discharged on 51st day postpartum
Mrs. C.	5th—150 c.c. 10th—450 c.c. 17th—500 c.c.	Citrate	Serum and quinine	Blood sterile In first transfusion hematoma formed round the vein	Recovery Discharged on 57th day postpartum
Mrs. S.	14th—500 c.c.	Citrate	Serum and quinine	Blood sterile	Recovery Discharged 24th day postpartum
Mrs. P.	29th—100 c.c.	Citrate		Blood sterile Trouble with donor	Recovery Discharged on 51st day postpartum

TABLE VII. ANALYSIS OF RESULTS OF TREATMENT

	NUMBER	RECOVERED	DIED	MORTALITY PER CENT
Early Transfusion	4	2	2	50
Early Transfusion + Serum + Quinine	1	1	0	0
Late Transfusion	2	1	1	50
Serum + Quinine	8	6	2	25
Serum + Quinine + Late Transfusion	4	2	2	50
No Transfusion or Serum or Quinine	5	3	2	40
Total	24	15	9	37.5

something known as "sun cholera mixture." She made a rapid and complete recovery. The recovery of the diabetic patient is also noteworthy.

The startling thing in this series of cases is that every patient with a positive blood culture died with one exception, Mrs. R., from whom one colony was ob-

tained on one occasion late in her disease and who ultimately recovered. This high mortality is exceptional as we have all seen cases with positive blood culture recover. The rather late appearance of the positive blood culture in most of the cases and the postmortem evidence of a lymphatic spread may indicate that these patients were saturated with toxins long before blood infection occurred and that the latter was really a terminal phenomenon.

And so from this series of cases it is impossible to dogmatize about treatment, but we can give our impressions and outline a possible method of procedure in dealing with cases of fever in the puerperium. Our impression is that in a hemolytic streptococcal infection blood transfusion done early and repeated on alternate days is as good a form of treatment as any available. It counteracts the fall in hemoglobin and, apparently, in many instances acts as a nonspecific agent in increasing the resistance of the tissue cells to the infection. But many cases of puerperal sepsis occur in domestic practice where early transfusion may not be possible, and there are many cases of fever in the puerperium which subside rapidly, for which no cause is ever found, and in which immediate transfusion would certainly be out of place. For these reasons the following outline scheme of treatment is given, the details to be varied according to circumstances. On the first rise of temperature give five grains of quinine bi-hydrochloride intramuscularly. In many cases the temperature will be found to be normal or nearly normal next day, in which case no further treatment may be required. If temperature and pulse are still high after twelve or twenty-four hours, serum may be given intravenously, the dose being the equivalent of 100 c.c. This may be repeated in twelve hours. Meantime, provision for transfusion should be made. If there is a marked drop in hemoglobin, transfusion is more strongly indicated and should be done on alternate days, no more serum being given but the quinine bi-hydrochloride continued. If the patient shows definite improvement after serum and quinine bi-hydrochloride alone and there is no marked fall in hemoglobin, transfusion may not be required at all. If the case is a long drown out one, transfusion in the later stages materially helps convalescence.

In our present state of knowledge we have no specific treatment for streptococcal puerperal infection. All three therapeutic measures discussed are nonspecific agents which in some cases seem to have a definite action in increasing the patients' resistance but in a certain number they either do not do this or the virulence of the invading organism is such that all the resistance called forth is unavailing.

SUMMARY AND CONCLUSIONS

1. During the period January 16, to February 14, 1927, twenty-four patients, out of a total of one hundred and sixty-three delivered, developed streptococcal infection and eight of them died. One other died later. One baby died of erysipelas. One nurse got a severe streptococcal infection of the arm and recovered. One nurse developed a primary streptococcal peritonitis and recovered after laparotomy.

2. Cases continued to occur after treatment of the operating and delivery rooms with chloride of lime; after a change was made to a delivery room which had never been used before; and they only ceased when admissions to the hospital were stopped.

3. A complete bacteriologic investigation of the hospital failed to demonstrate hemolytic streptococci in the air, on the floors or walls, in the operating rooms, in dressings, supplies, or water.

4. The only place where streptococci were found, other than in the infected patients, was in the nose and throat of certain doctors, nurses, and members of the domestic staff.

5. The exclusion of these carriers from direct contact with patients failed to arrest the epidemic. This may have been because fresh carriers were always being discovered.

6. Masking of the nose and mouth of all in attendance on patients before, during, and after labor failed to arrest the epidemic.

7. Notwithstanding the above, the fact that streptococci were demonstrated in no situation other than the nose and throat of attendants makes it important to exclude streptococcal carriers from maternity hospitals and to insist on complete masking by all in attendance on parturient or puerperal women.

8. The data available are not sufficient to determine whether one or more of these carriers brought the infection in, in the first instance, or whether they picked up the organism from the infected cases. The latter is possibly true in some cases.

9. The occurrence of a primary peritonitis in a nurse shows that there may be points of entry for the hemolytic streptococcus other than the vagina and puerperal uterus, but the finding of the organism in the vagina of nearly all infected patients shows that this was the common portal.

10. The particular streptococcus in this series of infections was a very virulent one.

11. Every patient but one with a positive blood culture died.

12. The late appearance of streptococci in the blood of most of the cases and the postmortem findings point to a lymphatic dissemination.

49 East Fifty-Third Street.

(*For discussion, see page* 286.)

NEW YORK OBSTETRICAL SOCIETY

MEETING OF JANUARY 10, 1928

THE PRESIDENT, DR. WILLIAM P. HEALY, IN THE CHAIR

DR. B. P. WATSON presented a paper entitled **An Outbreak of Puerperal Sepsis in New York City.** (For original article see page 157.)

DISCUSSION

DR. A. C. BECK said that since the original influenza epidemic some morbidity and an occasional fatality occurred in the early spring months at the Long Island College Hospital. The nose and throat of nurses and physicians were regarded as possible carriers. All the patients who show a fever, are isolated in another ward of the hospital.

Last year three deaths occurred at a time when upper respiratory infections were prevalent, which were assumed as possible hematogenous infections from this source.

DR. O. P. HUMPSTONE said that during the first four months of 1927, 591 patients were delivered at the Methodist Episcopal Hospital of Brooklyn with four maternal deaths due to blood stream infection. Of these patients, three were ward cases, three multiparae, three had rectal examinations, and only one had a single vaginal examination. The membranes were ruptured within four hours of delivery in all and none of the deliveries were operative. Hemolytic streptococcus was obtained from the blood of each one. The patients were removed to the isolation ward at the onset of symptoms, and although there were other patients there no new cases developed in the isolation ward. The babies of these mothers were not affected. In no other cases did he recover the hemolytic streptococcus and felt that these were individual isolated cases, that contact was no factor, that although the delivery may have played some part in the development of the sepsis, it was doubtful if the infection entered by way of the vagina. Many other cases were delivered during the same period by forceps, version, induction by bag, and cesarean section, but not one of these developed a puerperal infection. Thus he felt that he was justified in keeping the wards open and considering these deaths as due to causes over which they had no control. Dr. Humpstone believed that if they had not been using the mercurochrome preparation for delivery, they would have had

DR. R. L. DICKINSON wanted to know if, as a means of prevention in all maternities, the throats of all attendants should be cultured once a week.

DR. G. H. RYDER asked how much of a safeguard a mask is. Suppose a person has a streptococcus in his nose and throat and then delivers a patient thoroughly and completely masked, how much danger is that patient under at the time?

DR. WATSON, in closing, spoke as follows:

"We have come to believe very firmly that the complete masking of nose and mouth is most important. It was not carried out in Sloane Hospital until November, 1926. As Dr. Meleney has pointed out the masking was not complete as the mask might or might not fully cover the nose. Since the epidemic, we have insisted on complete masking of both mouth and nose. The regulation is being carried out to the letter in the hospital now, not only during delivery, but in the first-stage room; every one in the first-stage room is fully masked, and every nurse doing a postpartum dressing is fully masked.

"Dr. Meleney will perhaps answer the question as to how much protection that mask gives. If the individual puts on the mask and then takes it off and puts it on the reverse way, it is, of course, a menace and not a protection.

"Isolation of patients has always been carried out in Sloane Hospital. Before the epidemic, whenever a patient developed a temperature, she was isolated in a special ward and kept under close observation. Isolation regulations were carried out in the wards before the epidemic began. The regulation has been more strictly enforced since then, if that is possible.

"I may say that it was a great comfort to hear that others in New York had had a somewhat similar experience to ours, because we in the Sloane Hospital passed through a time of great trial and tribulation.

"With regard to the treatment of the cases and as to what Dr. Stetson has said with respect to transfusion, I would say that I agree with him that transfusion was not tried out in a systematic way in those cases. As I stated in the paper, if it had been begun earlier and been given more frequently in all the cases, I am quite sure that a good showing would have been made for transfusion, but quite a number of patients recovered without it, and that is all I can say about it. I don't think our figures prove anything whatever in regard to any form of treatment. It so happened that we carried out a certain line of treatment and a certain number of recoveries took place. There is no question but that the organism in this particular epidemic was an extremely virulent one. Some of our patients, one of the first patients who died for instance, had a transfusion on the second day. She, nevertheless, died on the third day. Two had transfusions done, one on the second day and the other on the second and sixth day, while others had it on the fourth, the ninth, the fourteenth, the twenty-fourth days, etc.

"We have made it an absolute rule in the hospital that no nurse is admitted unless she brings from her school a certificate of a negative culture of the nose and throat for the hemolytic streptococcus, and we are making weekly cultures of all the staff for the hemolytic streptococcus. So far this winter not a single streptococcus carrier has been found, which is very remarkable, when we compare with that the figures which Dr. Meleny gave us for last year.

"I am in agreement with Dr. Humpstone that we have not proved whether or not the first point of entry of the organism is by way of the vagina. All we can say is that the vagina was the only place where the organism was found other than in the nose and throat of carriers."

DR. MELENEY admitted the truth of the remarks of Dr. Humpstone and Dr. Polak that we have not added greatly to the knowledge of the genesis of puerperal

fever epidemics. In order to find out anything about an epidemic of this kind in its preepidemic stage, it is necessary to have in the hospital an organization which could set the stage in anticipation of an epidemic. Of course, that might be done in many hospitals and an epidemic occur where no trap was set, but at the same time something of this nature should be done in every hospital. The purpose of these suggestions is to institute measures to prevent carriers from coming into the hospital and to discover carriers who may have picked up organisms while on service in the hospital. The culturing of the staff could be done every week. Those with positive cultures could be kept away from the parturient woman just before, during, and just after labor. All that we can do under the circumstances is to minimize the opportunity of the streptococcus from coming in contact with the vulnerable uterine tissues. Unquestionably there is a seasonal variation in the incidence of the streptococcus in the nasopharynx. The incidence of the streptococcus in the surgical operating personnel of the Presbyterian Hospital was studied over a period of a year, and it was found that the incidence ran up to 25 or 30 per cent in the late winter and spring months. April and May were the two highest months. There is a gradual increase from the beginning of January until the latter part of the spring. When there are carriers about, there is a wider distribution of the organisms. If these organisms are virulent, they are going to manifest themselves in some form of an infection. Answering the question as to why the epidemic started at this particular time, one can only say that it was a combination of factors of which the chief was the occurrence of a particularly virulent organism carried by a number of persons in close contact with parturient women in a season of high streptococcus incidence. How this organism gets from the carriers into the patient is the essence of the whole thing.

Dr. Meleney continued as follows: "I cannot say anything more definite about this epidemic, but I can say very definitely about the case we had at the Presbyterian Hospital. We were having a series of very severe hemolytic streptococcus wound infections in clean cases. We made a careful bacteriologic survey and found that all of the things that ordinarily would be suspected were innocent. We found, however, a very high percentage of streptococcus carriers in the surgical personnel. We had just finished taking a complete culture of all the staff when one more case appeared in a simple hernia. On the operating team for that case there were three individuals who carried hemolytic streptococci. These persons were masking the mouth, but not the nose, and the instrument nurse was found to have the organism not only in the throat, but in the nose. Curiously enough, the patient himself had hemolytic streptococci in his nose and throat. This fact gave us the opportunity of demonstrating whether the patient had infected himself through his blood stream in the damaged tissues of the wound or whether the organism had been introduced from the outside. By serologic tests it was definitely proved that the organism from the nurse's nose and throat was biologically identical with the strain from the patient's wound and that his nose and throat strains were entirely different. The organism must have been discharged on the sterile field and then introduced into the wound. I would like very much to have the opportunity of testing out in any case of puerperal fever two strains of hemolytic streptococci, one from the nose and throat of the patient and the other from the vagina to see if the strains are identical. I feel quite certain that in this series of cases the patients did not have the organisms in their nose and throat, at least in a quantity sufficient to be obtained by the ordinary nose and throat cultures.

"It may be that we have emphasized too much the operative period and not paid enough attention to the postpartum course. Even after the epidemic was in full swing I felt confident from observations made in the hospital that the nurses taking

care of postpartum cases were not completely masking the nose and mouth all of the time. I tested out various masks and found that a four-ply mask of fine meshed gauze prevents organisms from being blown or sneezed or coughed through it. If a nurse is wearing a mask all day long, unquestionably she must blow her nose and take it off from time to time. Dochez found from experiments carried on in the Army that masks were not effective if worn all day. I did not stress the point, but I believe that the staff should rigidly mask not only before and during but also the first two or three days postpartum when the uterus has not yet built up its cellular resistance against the invasion of organisms. With regard to the use of vaccine in the treatment of this disease, it seems to me to be irrational; particularly in the acute stage. It would seem to be adding fuel to the flames. In vaccinating rabbits with these dead organisms to produce agglutinating serum, we found that it was difficult to get protection against even small doses of living organisms. This suggests that serum therapy would likewise be of little use.''