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Puerperal infection

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Senior Thesis

Puerperal Infection.

W.H. Fairbanks.

PUERPERAL INFECTION.

The term 'Puerperal fever' was first suggested by Richard Morton in 1692 to apply to a febrile condition occurring in puerperal women. In its original application the term included a vast number of clinical entities many of which bore no relation to parturition. In modern medical usage the term Puerperal Infection is accepted as a more exact term and as one giving a more exact relation between clinical findings and pathology.

By definition puerperal infection is an acute febrile reaction occurring early in the puerperium with the pathological picture of acute endometritis which usually becomes associated with myometritis, salpingitis, parametritis, pelvic peritonitis, and may lead to general peritonitis, septicemia, septico-pyemia or pelvic abscess. -1

There are three modes of inoculation that may lead to puerperal infection. Contageon may occur in the same manner as scarlet fever, measles or smallpox. Metastatic infection may occur by dissemination from a septic focus within the body of the patient. Finally, infection may occur from direct inoculation of wounds in the birth canal. -2

Studies made of the vaginal secretions from febrile patients, both antepartem and postpartem show that a very small percent of cases harbor the causative organism before delivery and the conclusion must be drawn that the bacteria present in the vagina before delivery are a much

less serious danger than those introduced during or after delivery.

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During the Sloane epidemic of puerperal infection in 1927 extensive efforts were made to determine the source of the causative organism. The conclusions drawn after seven months of study were as follows: The organisms entered the genital tract just before, during or directly after delivery. The portal of entry was the vagina. The infection was not hematogenous and the patient did not carry the organism with her to the hospital. The organism was in all probability carried by one or more carriers and twenty-five attendants were found to be harboring streptococci in their throats. The organism was not found in any of the hospital rooms or in any of the supplies used.

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In the great majority of cases the infective agent reaches the tissues of the birth canal by direct inoculation either at the time of delivery or shortly after and hence puerperal infection must be considered as a wound infection identical with wound infection elsewhere. However infection of wounds of the genital tract must be considered as more dangerous than infection elsewhere because of the ready extension offered by the venous and lymphatic systems and because the traumatized tissues of the birth canal offer a fertile field for the growth of bacteria.

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That the streptococcus is responsible for the majority of cases of puerperal infection has been recognized since the studies of Mayrhofer in 1865. Recent extensive bacteriological

investigations of hospital epidemics has confirmed the work of Mayrhofer and the conclusion drawn after extensive research is that the streptococcus in a great majority of cases is the causative organism and in practically 100% of severe and fatal cases. The other pyogenic organisms such as the staphylococcus, colon bacillus and gonococcus do give rise to puerperal infection but the clinical course in such cases is relatively benign and recovery is the rule without extensive involvement.

In the Sloane epidemic 54 different strains of hemolytic streptococci were recovered from the vaginal secretions of febrile patients and of the seven fatal cases in this series six gave positive blood cultures at some time between the second and twenty-sixth day post partem. The late occurrence of the positive blood culture points to a lymphatic dissemination early in the infection with a late extension to the blood stream.

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The pathological anatomy of puerperal infection is primarily that of an inflammatory process which may involve only the placental site or the entire interior of the uterus. If the uterine reaction is sufficient and the virulence of the invading organism not excessive the process remains localized as an endometritis or metritis. If the local resistance is overcome invasion proceeds by way of the lymphatics and more or less diffuse infective processes occur resulting in parametritic exudates, progressive thrombophlebitis and occasionally pelvic peritonitis by

pure lymphatic extension. Very virulent infections rapidly overcome local resistance, leave little or no evidence of infection in periuterine structures, blood or lymph channels but flood the entire system with bacteria which rapidly multiply in the blood stream.

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J. Hofbauer has demonstrated specific types of cells in the cervix, in the lower uterine segment and more particularly in the parametrium at the base of the broad ligaments, which have specific phagocytic powers. These cells appear as early as the 3rd. month of normal pregnancy and increase in number as pregnancy advances. In the event of prolonged labor and of infection following labor the increase in the cell elements is very great. In addition to the above cells Hofbauer describes lymphoid bodies beneath the endothelium of the lymph spaces of the parametrium which he regards as primitive lymph nodes and credits them with phagocytic powers. Hofbauer believes that the formation of this lymphatic defense mechanism is due to a hormone and under the same control as that producing the changes in the breasts, ovaries and other organs of the pregnant woman.

In addition to the specific cells described it has long been recognized that there is a specific "granulation zone of leucocytes" in the decidua. In this layer the polymorpho-nuclear cells outnumber the mononuclear cells and it is believed that the polys ingest living bacteria while the mononuclear cells ingest cell detrius and to a less degree, living bacteria. It has been found that the density of this granulation zone is directly proportional to the

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ease with which extension follows from the initial focus in the endometrium. The virulence of the invading organism is a very important factor and upon the virulence of the organism and the local resistance to infection depends the severity of the reaction and the degree of extension of the infective process.

If the initial infective process is fairly well defined within the placental site the organisms grow in thrombi in the gaping venous sinuses. This thrombophlebitis process may remain within the body of the uterus or it may extend beyond the uterus involving the internal iliac or ovarian veins or both. Occasionally all venous trunks leading from the pelvis are thrombosed as far as the junction of the renal veins with the inferior vena cava. With the dislodgement of emboli from the thrombi, infective emboli enter the circulation giving rise to endocarditis and multiple abscesses in any part of the body. Large emboli may break away and lodge in the pulmonary vessel producing massive pulmonary embolism and sudden death. Small pulmonary emboli do not produce as serious results but usually result in secondary pneumonia or pleurisy that may prove fatal. Thrombophlebitis of the veins of the lower extremity may result from extension of the thrombotic process from the pelvic veins and writers agree that Phlegmasia Alba Dolens occurring before the tenth day of the puerperium should be regarded as evidence of infection even though no local focus is demonstrable.

With primary involvement of the entire interior of the uterus puerperal endometritis results. The more common complication of this type of infection is parametritis from lymphatic transmission of the infective organism to the periuterine structures. These subperitoneal structures of the uterus are of broad extent and may be divided into anterior, posterior and lateral parametria although they are directly continuous with each other and with the prevesical, retroperitoneal and iliac connective tissue strata. These anatomical relations and the course of the lymphatics account for the direction taken by infections entering the parametria from the endometrium. Thus infections along the base of the broad ligaments spread along the recto-vaginal septum, into the posterior parametrium and along the lateral pelvic wall. Those of the upper part of the ligament extend upward along the flare of the ileum and above the inguinal ligament. Prevesical infections progress along the bladder and to the space of Retzius.

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In a small percentage of cases there is involvement of the fallopian tubes by direct extension from the cavity of the uterus and direct inoculation of the peritoneal cavity may result by leakage from the fimbriated extremity. Usually however when there is tubal involvement the inflammatory changes occur at the lateral extremity indicating lymphatic dissemination rather than direct extension. Oophoritis is uncommon as a complication of puerperal infection although it occasionally occurs with the pathological picture of acute inflammatory edema which may be

arrested in this stage or go on to abscess formation.

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Puerperal infection gives rise to a fairly characteristic chain of symptoms at least in its early stages. In the typical case after the puerperium has progressed favorably for from two to five days the patient begins to complain of general lassitude, is irritable, has indefinite pains and usually headache. This prodromal period lasts for a few hours terminating in a definite chill of invasion. There is but one rigor as a rule followed by a rapid rise of temperature to 101 or higher at which point it is maintained with only slight remissions for several days. Coincident with the fever the pulse rate increases and the two curves run together. The lochial discharge is usually increased and may or may not be odorous. In highly virulent infections the discharges are apt to be scanty and without marked odor while less virulent forms are apt to give rise to profuse offensive discharge. Involvement of the uterus is delayed and there is definite tenderness on palpation. With delayed involution there is relaxation of the uterine musculature favoring extension of infection. Abdominal distention appears early as a rule and when associated with diarrhea and abdominal rigidity the likelihood of peritoneal involvement must be considered. With extension to the parametrium and adnexae there are the findings of inflammation in the pelvis - pain, rigidity, tenderness on palpation, and examination usually reveals definite pathological changes. The development of consolidation and friction rales at the bases of the lungs is evidence of extension to the

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lungs and pleura and these findings add gravity to the prognosis. Most fatal cases show evidence of lung involvement and at autopsy a fibrinous pleurisy and interstitial lymphatic pneumonia are found. The leucocyte count increases early to 20,000 or more and there is a relative increase in the polymorphonuclear cells. A sudden fall in the leucocyte count is indicative of an overwhelming infection and must be regarded as a bad prognostic sign. Blood cultures may not be positive even in fatal cases but the recovery of the organism from the blood stream is evidence prima facie of septicemia and in such cases the outlook is not favorable. Cultures from the vaginal secretions may be of value in early diagnosis in doubtful cases.

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The frequency of occurrence of puerperal infection is variously reported by medical statisticians but all reports agree that pregnancy and its complications is the second greatest cause of death in women from 15-45, tuberculosis alone showing a higher mortality rate; and of all deaths referable to pregnancy and its complications puerperal infection is responsible for the greatest number. Six or seven women out of every thousand confines die from causes directly related to pregnancy, labor and the puerperium and of these deaths 30-43% can be credited to infection.

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In an analysis of puerperal deaths in 1927 covering twelve states (New Hampshire, Rhode Island, Maryland, Virginia, Kentucky, Michigan, Wisconsin, Minnesota, Nebraska

North Dakota, Washington and Oregon) there were 2,650 puerperal deaths reported. Of this number 1076 or 41% were due to infection.

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Dr. J.W. Williams of Johns Hopkins states that puerperal infection is lowest in big cities because of good hospitals, next lowest in rural communities because the patients deliver before the doctor arrives, and highest in small cities because every doctor thinks himself as good an obstetrician as anyone and often does a great deal of harm.

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The mortality from puerperal infection is higher in the negro race than in the white - probably due to a lower racial level of resistance.

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In spite of extensive reserches in the treatment of puerperal infection there is as yet no specific and the treatment is at best inadequate and often ineffectual. Therefore prevention and prophylaxis are of utmost importance.

Since puerperal infection must be considered as essentially a wound infection there are two definite oints of attacks in its prevention. First - the prevention of wounds of the birth canal during labor and second - the prevention of inoculation of such wounds as may occur despite precautions.

Laceration of the maternal soft parts most commonly occur in prolonged labors and as a result of measures performed to expedite delivery. It has been demonstrated that typical puerperal infection is least frequent after uninterferred-with labor and in elective caeserian section. It must be remembered that parturition is a physiological

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process and as such should not be interfered with except on definite indications. Forceps operations, versions and other measures of accouchment force are attended with trauma to maternal soft parts and if undertaken on definite indications must be conducted in such a manner as to reduce injuries to the birth canal to a minimum.

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The immediate repair of lacerations that occur during the second stage of labor will remove potential sources of danger from infection and this procedure should be routine.

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The maintenance of firm contraction and retraction of the uterus after delivery imposed a barrier in the firm muscular wall of the uterus and the use of ergot and pituitary extract is to be advised if there is any tendency to relaxation.

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The prevention of inoculation involves many factors, some of which are readily controlled and others lending themselves to only partial control.

The discovery of foci of infection in the pre-natal period should be attended by efforts to remove those foci before delivery. Since parturition and the puerperium are necessarily periods of decreased resistance it is easily possible that foci harboring organisms of low virulence may flare up when bodily defenses are reduced and produce virulent infection at the site of least resistance, the traumatized and devitalized tissues of the birth canal. Teeth and tonsils ~~have~~ long been recognized as harborers of the streptococcus and such pathology as can be demonstrated should be cleared up early in pregnancy.

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In a study of 125 cases of cervical erosions in parturient women Miller, Martinez and Hodgton demonstrated that 11% harbored streptococci and 4% of cases yielded the hemolytic streptococcus on culture. They believe that erosions of the cervix are potential sources of puerperal infection in subsequent pregnancies. Proceeding on this basis they cauterized all erosions seen in patients before the 28th. week of pregnancy. In their series no cases of puerperal infection has occurred in patients whose erosions were cauterized while two severe cases occurred in comparable cases with erosions that were not treated. In 2000 cases they have found that cauterization does not interfere with cervical dilatation or result in increased susceptibility to cervical lacerations. They conclude that the treatment of erosions by cautery before the 28th. week clears up foci that are potential sources of danger during the puerperium. -19

Even though prenatal care is adequate and labor conducted with a minimum of trauma there still remains the highly important factor of prevention of inoculation during delivery and the early puerperium. If the mortality rate incident to puerperal infection is to be materially reduced every physician doing obstetrical work must develop an "aseptic conscience" in the conduct of his cases. -20

Vaginal examinations may carry organisms either from the examining hand or from the perineum into the birth canal. Especially in this true during labor but it applies as well to the last weeks of pregnancy when the maternal tissues

are congested and the cervix partially dilated rendering access to the cervical canal fairly easy. The employment of rectal rather than vaginal examination eliminates this source of danger and by practice rectal examination will become sufficiently enlightening for routine purposes. Certainly rectal examination gives adequate information as to the progress of labor and if vaginal examination is required to be sure of diagnosis the examination should be postponed until the patient has been draped and the obstetrician scrubbed up for the delivery, thereby reducing the danger of infection to a minimum.,

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The obstetrician himself must exercise every care that he does not carry infection from one patient to another by cross infection. General practitioners doing obstetrical work and treating all sorts of suppurating wounds, erysipelas and other virulent infections must exercise extreme caution. -21 The use of rubber gloves when dealing with infected material and the employment of the "knife and fork" method of dressing wounds will do much to reduce this source of danger. -22 Oliver Wendall Holmes in his classical treatise on puerperal sepsis in 1842 made three suggestions that aptly apply to cross infection as a source of puerperal sepsis;

1. Physicians doing obstetrical work should never take active part in post mortem examination of puerperal fever cases.

2. Physicians should use thorough personal cleanliness after attending infected obstetrical cases, he should change every article of dress and not attend another case within 24 hours.

3. He should exercise similar precautions if he is forced to treat erysipelas or perform autopsies on cases dying of erysipelas.

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Studies made of the Sloane hospital epidemic in 1927 proved that attendants harboring streptococci in their throats were liable to infect obstetrical patients, and that the masking of attendants minimizes the danger of infection from this source. The masking of all persons in attendance on obstetrical cases during labor and the early puerperium should be routine and such procedure will eliminate a formidable source of infection.

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The preparation of the patient for delivery should be such as to reduce the number of infective organisms on the perineum without employing any measures that may carry bacteria into the generative tract. Shaving of the pubic hair, soap and water cleansing, pithcher irrigation of the external genitalia with an antiseptic solution, and the covering of the vulva with a compress wet in antiseptic solution is adequate preliminary preparation. The employment of the antiseptic douche in preparing the patient is to be condemned as it has been proven ineffectual in germicidal power and apt to carry organisms into the posterior vagina and cervix. After the patient has been draped in sterile materials the compress may be removed and the vulva further prepared by the application of mercurochrome or picric acid solution followed by the application of a sterile towel. The anus must be excluded from the field as far as possible by sterile dressings. After delivery sterile vulvar pads should

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be applied and only sterile dressings used on the perineum during the early puerperium.

The obstetrician and his assistants should use the same means of hand preparation as for major surgical procedures and every effort made to avoid contamination of the hands during delivery. The wearing of sterile gowns and rubber gloves must be routine procedure.

Dr. John O. Polak has aptly stated that there are eleven sources of puerperal infection - the obstetrician's ten fingers and his throat.

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The curative treatment of puerperal infection is a subject upon which much has been written and a great variety of opinions expressed concerning the merit of the various measures proposed in its therapy.

As to local procedures the general agreement is that the least done locally the better are the chances for recovery. If lacerations repaired at the time of delivery break down and suppurate the stitches should be removed and the wound laid widely open to insure drainage, a cardinal principle in the treatment of suppurating wounds that is as important in this connection as elsewhere. Puerperal ulcers located about the vulva and lower vagina should occasionally be touched with pure carbolic acid or tincture of iodine and the parts kept as clean as possible.

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Curette, a measure formerly advocated as routine treatment, is universally condemned. If portions of placental tissue or debris is left in the cavity of the

uterus they may be removed by gentle manipulations with the gloved finger or with gauze held in uterine dressing forceps. Curretage breaks down the protecting leucocytic wall in the endometrium and may result in the dissemination of the infective process hitherto localized by tissue resistance. Usually in the severe forms of infection there is nothing that may be removed by curretage and nothing but harm can result from its routine employment.

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The use of the intrauterine douche is looked upon with disfavor and the only authority advocatind douches is Williams who uses a simple cleansing irrigation with normal saline solution. However Williams agrees that their chief field of usefulness lies in the treatment of putrid endometritis following abortions and that their utility in streptococcic infections is questionable.

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Surgical measures are very limited in the field of application during the acute manifestations of infection. Localized pus collections in parametrial structures should be opened through the vagina and drained rather than be allowed to rupture spontaneously. The technique should be that of local anesthesia and simple incision with ample drainage tubes that the patient may be spared as much shock as possible.

Hysterectomy is limited in application and is only justifiable in multiple abscesses of the uterus or gangrene of the uterus, conditions seldom diagnosed except at post mortem. After the infection has extended beyond the uterus hysterectomy will not stop the progress of the infection

and only adds to the gravity of the patient's condition. With tubal involvement it is advisable to wait until the acute manifestations are over before operation, especially is this true with virulent infections as the organisms retain their virulence for a long time even though acute manifestations have subsided. With extension of the infection to the peritoneum the question of drainage becomes vital. Since the peritonitis is pelvic, at least in its early manifestations, the concensus of opinion is that posterior colpotomy gives efficient drainage and avoids the shock incident to laparotomy and abdominal drainage.

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Adequate nursing care is highly important in puerperal sepsis and the nursing program must be so directed as to conserve the strength and increase the resistance of the patient. Hospitalization is advantageous and rest in bed must be enforced. Nursing of the child should not be permitted to further the best interests of both mother and child. Diet must be adequate, easily digested, and relatively high in carbohydrates to maintain the strength of the patient and combat the acidosis incident to toxemia and fever. Fluid intake must be increased by all routes to dilute toxins and favor adequate elimination. The employmeny of the Fowler position favors drainage from the genital tract. If there is constipation elimination is to be encouraged by enemata rather than catharsis. Extreme pyrexia is best controlled by ice caps, tepid sponges, and rectal irrigations. Sleep is easential and opiates should be given if there is

insomnia. Fresh air and sunshine are advantageous.

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The use of streptococcic vaccines and serums has been advocated since 1894 when serum therapy was first proposed by Marmorek. However the clinical results from serum and vaccine therapy has not been encouraging and certainly there is no vaccine or serum that is specific. In the Sloane epidemic vaccines were given extensive trial with inconclusive results. No essential reduction in the incidence of complications or mortality rate resulted from vaccine therapy and Watson concluded that this form of treatment was of little value. The fact that 54 different strains of streptococci were isolated in this series indicates the difficulty of preparing a serum of universal value although autogenous vaccines have given equally disappointing results. In an English series reported by Armstrong and Shaw 2000 cases were studied with a view to the determination of the efficacy of vaccines. In this series 650 cases were given serum whether febrile or not, another series of 650 cases were given serum if there was a temperature over 100.4 for 24 hrs., and a third series of 650 cases was given no serum whatever. They report no essential difference in incidence of infection or mortality in these three series of parallel cases and that if there was any difference the balance lay in favor of the series in which no serum was given. In another series studied by W.B. Dafoe from the Toronto general hospital similar results are reported although Dafoe believed that serum were of some value in post-abortal cases and in the early stages of puerperal sepsis due to the hemolytic streptococcus.

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Dr. H.B. White, an English investigator, attempted to determine the relation between the incidence of puerperal infection and sensitiveness to streptococcic toxin. He injected a small amount of diluted scarlet fever toxin intradermally in a series of 100 antenatal cases. He found that the patients reacting strongly to the local injection were those more apt to become infected during the puerperium and concluded that the presence of a positive reaction to scarlet fever toxin should be looked upon as a danger signal and special precautions taken to avoid infection in such cases.

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The intravenous administration of the analin dyes and mercurochrome has been advocated but indifferent results are reported. It has been shown that the highest concentration of these substances compatible with life is 1-10,000 and that even this dilution is irritating to the heart, liver and kidneys and results in definite pathological changes. Increase in the leucocytes does result from this form of therapy but the effect is transient and is seldom maintained over 24 hours.

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Similarly the use of foreign protein injection^s has been proposed to stimulate the defense mechanism of the body but results are not promising and in many cases the intense reaction to foreign protein in patients already febrile has done more harm than good.

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Blood transfusion is the one therapeutic measure universally conceded as of definite value. Transfusion is relatively safe in most cases provided matching is

accurate, and there is little shock or discomfort to the patient incident to the administration of whole blood. Transfusion raises the blood pressure, slows the pulse, acts as food, improves elimination, increases the alkalinity of the blood and body tissues and stimulates the blood forming organs to the production of new cells. The time best suited for transfusion is determined by the erythrocyte count and the hemoglobin percentage. 65% hemoglobin and 3,000,000 erythrocytes is considered as indication for transfusion. The indirect method should be used and small transfusions from different donors given repeatedly rather than a single ~~large~~ transfusion. Most authors recommend that the whole blood be diluted with an equal volume of Ringer's solution of normal saline. Hofbauer advocates the addition of a small amount of pituitary solution to the diluted blood to stimulate the reticulo-endothelial system and increase the parametrial defense mechanism.

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The use of quinine bihydrochloride intramuscularly in doses of five grains repeated every 12-24 hours to control the pyrexia while preparing for transfusion is recommended by many authorities. Often the immediate institution of this treatment with the onset of the fever results in symptomatic relief and transfusion may not be required unless the hemoglobin falls alarmingly.

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Summary.

1. Puerperal infection must be considered as a wound infection identical with wound infection elsewhere.

2. The streptococcus is the offending organism in the majority of cases and in 100% of severe and fatal cases.

3. Puerperal infection still remains the greatest single cause of death in pregnant women and is responsible for 30-43% of puerperal deaths.

4. The majority of cases are preventable, and the conduct of labor with a minimum of trauma, interfering only on definite indications, and the employment of strict asepsis will result in a material lowering of the present mortality and morbidity rates.

5. Recovery occurs by the development of the patient's resistance to the infection rather than by specific therapy.

6. Treatment is nihilistic, employing good nursing, surgical drainage of pus collections and blood transfusion.

7. Further reser^hch is needed, directed toward the immunization of pregnant women to streptococcic infections and the development of specific serum therapy.

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