

1935

## Spontaneous rupture of the pregnant uterus

J. Byron Steward  
*University of Nebraska Medical Center*

This manuscript is historical in nature and may not reflect current medical research and practice. Search [PubMed](#) for current research.

Follow this and additional works at: <https://digitalcommons.unmc.edu/mdtheses>



Part of the [Medical Education Commons](#)

---

### Recommended Citation

Steward, J. Byron, "Spontaneous rupture of the pregnant uterus" (1935). *MD Theses*. 412.  
<https://digitalcommons.unmc.edu/mdtheses/412>

This Thesis is brought to you for free and open access by the Special Collections at DigitalCommons@UNMC. It has been accepted for inclusion in MD Theses by an authorized administrator of DigitalCommons@UNMC. For more information, please contact [digitalcommons@unmc.edu](mailto:digitalcommons@unmc.edu).

Senior Thesis.

Spontaneous Rupture Of The Pregnant Uterus.

April 26, 1935.

J. Byron Steward.

Table of Contents.

- I. Introduction.
- II. Classifications.
- III. Historical Outline.
- IV. Etiology.
- V. Symptoms.
- VI. Diagnosis.
- VII. Differential Diagnosis.
- VIII. Prognosis.
- IX. Treatment.
- X. Summary and Conclusions.

## Spontaneous Rupture Of The Pregnant Uterus.

### I. Introduction.

Experience contributes to the metaphorsis of progress. In scrutinizing any subject, and especially one of scientific nature, there is a consciousness of marked progress. If only the early and recent status of a subject were considered the connection would be hard to recognize. The chronological survey of any medical subject is of value in providing rational for present procedure and judgment for creative procedure. Reviewing the treatment for this obstetrical catastrophe, it is noted the first praiseworthy method of coping with ruptured uterus was gastrotomy. Such treatment was only possible after the discovery of aseptic and surgical technique, but it is interesting to note that this advancement also made possible cesarean section. The cesarean scar is considered etiological in rupture of the uterus. In this paper considerable attention is given to the corrolation of opinions regarding the dangers in this sequence. The subject as treated here deals with spontaneous rupture, to the exclusion of rupture after manipulative interference and the use of oxytocic substances.

### II. Classification.

Uterine rupture is roughly divided anatomically into two kinds. (1) Complete when the peritoneum is involved. (2) Incomplete when the tear enters the parametrium, but doesn't pass through. This type more frequently occurs from a tear extending up from the cervix. According to their location in the upper or lower segment they are referred to as high or low. Davis (6) has found complete to occur in 80% of the cases, 106 ruptures at the New York Lying-In reported by Asa B. Davis, 64 were complete, 18 incomplete. The lower

segment is by far the most frequent site of rupture.

### III. Historical Outline.

The earliest reference to the recognition and description of ruptured uterus was credited to Guillemeau (1550-1613) and referred to by Davis (6). Dewees (2) in reporting a large series of cases in Philadelphia Journal of Medicine in 1820, writes, the late Dr. Hunt considered it an act of wanton cruelty to disturb a patient suffering from this accident by attempting to deliver her, he considered her death inevitable. The authority of such men was so imposing in England and America that it became an undisputed point of doctrine. Opinion founded on error and perpetuated by force of education in Great Britian, not to give pain where no good could be done became an aphorism in the treatment of ruptured uterus. Barry (3) 1820 states that up to the beginning of the Ninteenth Century cases of the rupture of the uterus were practically abandoned as being beyond human aid. He cites a case with recovery delivered by Dr. Douglas in England in 1784 as the first example of artificial intervention. This success was impressive for a time but the infrequency of the accident and the force of preconceived opinions effaced it. Dr. Denman's essay on the rupture of the uterus (2) came to the following conclusions. When the uterus is ruptured at the time of labor both reason and experience show that the patient has a better chance of recovery, by resigning the case to the natural effort of the constitution than by any operation or interposition of art.

By 1848 there was a different tone to the trend of thought. Trask (4) reviewed all the cases reported up to that time. These included numerous examples of the various types of active treatment.

He concluded from his analysis that the principles upon which the profession almost universally acted were correct ones. The following examples from his works very plainly demonstrate how applauding the results were irrespective of type of treatment or if left to nature.

Of 154 cases delivered by artificial means 97 died, 57 survived. Of 89 abandoned undelivered 65 died and 24 survived. Of 31 delivered by natural efforts 20 died and 11 survived. These included instances of rupture of the os in which the peritonium was not involved. This shows 37 recoveries to 100 for interference compared to 27 to 100 in cases abandoned. This advantage would probably have been improved if the interference had not been delayed, relied upon as a last resort. Dewees (2) commented on the tendency of the doctor to avoid announcement of the true condition in case of rupture lest he be criticized for his part in producing it or at least his inability in not preventing it. M. Levret as quoted by Dewees in 1820 advocated laparotomy because the mother and the child are lost anyway, but continued what accoucheur would be bold enough to allow it to be executed without delay, Trask (4) quoted professor C. D. Mregs of Philadelphia as to type of treatment. Far more humane to extract the child by gastrotomy as the least painful and least mischievous. He admits the patient might recover if the child be left in the abdomen but such good fortune is never to be expected. Speedy removal of the child and secundines give in his opinion a chance not greatly inferior to that of cesarean section. Dewees (2) discredits the probability of any recovery by vaginium after the fetus has escaped into the abdomen although there are such reported. Difficulty would occur in the early

contracture of the uterus. This same author classifies the various types of cases and gives the accepted treatment of that time, 1820. To him there occurred three approaches.

1. Attempted delivery by vagina.
2. To attempt gastrotomy or the cesarean section.
3. To attempt nothing but leave the case to nature.

The first condition includes those cases where the laceration is confined to the body or fundus of the uterus but penetrates the peritoneum and the child escapes into the abdominal cavity. (a) If the uterus is contracted or if the pelvis deformed gastrotomy is indicated. (b) If the pelvis is normal and the uterus flaccid the fetus should be extracted by vaginium. (c) If the pelvis is deformed and the uterus flaccid the degree of deformity is the guide.

The second condition, those cases where the rupture is incomplete and the child has not perforated the peritoneum, indications are the same as the above, but it is obvious that the majority would be extracted by vaginium since the uterus would not be as firmly contracted.

Third, rupture complicated by prolapse of intestine. This condition should be ascertained and reduced by the hand in the uterus and by abdominal section if the uterus is contracted.

Fourth, condition as described by Dr. Dewees is included here for the description of the instruments as they were employed at that time. (a) If the laceration is in the fundus neck or vagina and the fetus is in part or entirely in the uterus. (b) If in a well formed pelvis and the head is in the superior strait forceps should be applied or version performed, if the internal os is dilated version is preferred if the waters have only recently escaped and the uterus is flaccid forceps, when the contrary conditions are present.

(c) If the uterus is contracted and the head low the forceps are applied if the child is alive, the crotchet if the fetus is dead.

(d) If a breech or any other presentation interference should be indicated as in a case uncomplicated by rupture but should be effected more rapidly. If such a presentation occurs in a defective pelvis the labor must be conducted with strict regard to the woman's safety. If the fetus is above the superior strait and the uterus, cervix or pelvis defective abdominal delivery should be employed. Dr. Dewee didn't describe any set of conditions that he would leave to nature.

This tendency to artificial intervention in all cases as advocated by Dewees is contrasted with the attitude of noninterference of a few years previous. Inspection of his analysis gives a conspicuous majority of the procedures to the vaginal route. This is not so surprising when it is noted that where gastrotomy was performed for rupture no attempt was made to suture the uterus, other details of the technique were likewise unrefined. The results were not good and therefore an abdominal approach to the catastrophe was slow to establish its merits. The tendency nevertheless was established and its advancement was progressive in ratio to the development of surgical technique in general.

#### IV. Etiology.

Baudelocque (3) 1823 in his text on Mid Wifery refers to the cause of rupture as given by the observers of a generation or two earlier. They considered rupture due to the extraordinary movements of the child. Baudelocque however considered the fetus no more of an instrument in producing the rent than any other similar solid body of the same shape and volume. He gave a true in-



terpretation to the final vital movements of the child when he considered it the result rather than the cause of rupture.

Spontaneous rupture of the uterus can be the result of many different factors, usually there are a combination of factors. In a majority of instances the history will elicit the cause in others observation at operation and still others only minute examination at post mortem, while frequently no single predominating cause can be accused.

Davis (6) classified the causes of rupture under three primary conditions. According to (1) their relation to the pelvis (2) to the uterus and (3) to the fetus.

#### I. Rupture due to deformity of the pelvis.

A faulty pelvis Davis considered a frequent cause of uterine rupture. The type most commonly responsible is not the high grade contracted pelvis, but one of moderate degree; either the just-minor pelvis or the simple contracted. These are the types most commonly overlooked and consequently the labor long. Davis, included the following collections of cases. Bandle found 19, 60% among his 32 cases, Wychgel observed 61% among his series, Freund 65%, Merz and Zweifel each 30%, Trask found 74 contracted pelvises in 417 cases or 18%, Lobenstine, 21 or 46%, of Kolaizek's 36 cases of rupture, 21 patients had generally contracted or simple flat the majority of mild degree while 10 possessed ricketic flat pelvises and in 5% deformed as result of osteomalacia. Neoplasms, of the pelvis and exostoses, causing dystocia may lead to rupture as may other pelvic growths including ovarian cyst and tumors but these causes are much less frequent.

#### 2. Rupture due to faulty uterus.

De Sa (1) spoke of the predisposing causes of spontaneous rupture as those conditions which produced weakness of the uterine wall. There are a variety of ways in which the integrity of the uterine wall may be reduced. These are variously classified. Davis (6) includes hyaline degeneration, inflammatory changes, glandular penetrations, pathological or faulty placental implantations and destructive decidual growths. In placenta previa, the thinning out of the uterine wall is especially to be feared. De Lee (7) included cesarean scar and comments upon it being frequent nowadays, from the scar of other gynecological operations, thinning of the uterine wall from manual removal of the placenta, especially if repeated; Hypoplastic uteri, malformed uteri, as single or double horned; displaced or adherent to the anterior body wall. Carcinoma and hydatid mole. Pregnancy however occurs only rarely where these neoplasm are present. According to a great many authors, only 10% of rupture occur in primagavidae which speaks for a degeneration of the musculature of the uterus, whether due to infection or invasion by portions of the fetal envelopes.

Banks (9) reports a case of rupture due to uterine contraction occurring after concealed accidental hemorrhage. Schenone (10) reported a case of dilation and curettage for incomplete abortion performed three years previously as an example of this not infrequently predisposing cause. Rosenfield (11) observed rupture with recovery four years following criminal abortion. Warfield Jr. (9) reported a case of cesarean section for eclampsia, a subsequent pregnancy terminated by rupture in the fundus at the site of cesarean scar. The muscle at this region was shown to be invaded by fetal elements indicating inclusion of endometrial tissue in the line of incision at the time of cesarean section. Rotton quotes

Schwarz in support of endometrial transposition of tissue. He reported a case that post cesarean complained of a small nodule in the abdominal scar which increased in size and became painful at times. Removal and microscopic study showed it to be typical endometrial stroma. He had found endometrial tissue incorporated in the musculature of the uterus in two other cases. Stevens (12) reported a case who had had four previous pregnancies, the first and second labors were normal, the third was terminated by craniotomy because the child was stated to have been very large, the fourth was an induced labor at 32 weeks; rupture occurred in the fifth labor the following histological findings were present. The fragment from the rent consisted of uterine wall with blood extravasated between muscle bundles. In one place a small artery contained an organizing blood clot and the muscle supplied by it was almost entirely replaced by edematous fibrous tissue. It would seem that the thrombosis of this vessel was the primary lesion causing partial infarction and fibrosis of a portion of the muscular wall which later ruptured. Beck (8) referring to rupture complicating hydatidiform mole comments on their being rare accidents and due to a marked thinning of the uterine musculature. Krellenstein was able to tabulate but four cases from the literature with two deaths. Murray (14) in 1933 reported a case of rupture during the second pregnancy with the following pathological report by H. E. Eggers. Microscopic section through the attenuated portion of the uterine wall showed a very thin lamina not over 2-3 mm. of uterine muscle and this considerably degenerated. Infiltrating and replacing the rest of the wall was placental tissue, in the outer portion it did not show any definite structural arrangements, deeper it contained

villi, this invasive infiltration was typical of chorioepithelioma.

The frequent association of cesarean scar with rupture has been alluded to. Many investigators have advanced theories and conducted research to determine the histology in the healing wound following incision of the uterine wall. Rotton (15) reviewed the works on this phase of the subject and discovered that for a long time it was commonly believed that the cesarean scar during a subsequent pregnancy stretches and sometimes yields when the uterus becomes distended.

Williams (16) says such a belief is erroneous; first observation of the unopened scar at time of repeated section, usually shows no trace of the former incision, or if present it is almost invisible. Histological examination shows that healing here as in all other non striated muscle, heals by regeneration of the muscle fibers.

Potter (17) emphasizes that incision of the uterine muscle is followed by scar formation, and not by replacement with muscle tissue. Healing as described by Convolaire, Schwarz and Paddock as quoted by Rotton (15) takes place first by deposition of fibrin and the fibro blastic proliferation. In the perfect scar there has to be good wound apposition. Then the line of scar is small and as it contracts it assumes the appearance of the normal uterine wall. Any interference with the healing will cause an abnormal amount of connective tissue which will result in a weaker scar. Rongy (23) believes that normal healing by first intention has its definite inflammatory reaction. No scar can possess the same anatomical and physiological characteristics. Nutritive powers are lessened. Postoperative febrile course, imperfect healing

of the endometrium or proliferation of the endometrial tissue into the musculature may produce weakness. Where the incision is into the placenta site due to the degeneration of the decidua serotina weakness results.

There is considerable evidence to indicate that implantation of the normal placenta over the scar of previous operation may contribute to local weakness of the wall. D'Acerno (38) refers to implantation of the placenta over the scar with atrophy of the decidua and absence of the spongiosa combined with exultation of the histolytic activity of the chorionic villi. Bell (27) found 18 out of 20 cases of rupture that the placenta was implanted over the scar, which would tend to bear out D'Acerno's theory. DeLee (7) states that 42 of 67 cases where the site of the placenta was noted the organ was situated on the anterior wall. This is the location of the incision in the classical cesarean section. These observations would speak for the advisability of lower placement of the scar to avoid the more frequent location of the placenta and consequent liability to rupture.

In certain cases a contributing factor may be of mechanical character as pendulous abdomen with anterior flexion of the uterus or prolonged dry labor with formation of a retraction ring. Credit for the first accurate explanation of the mechanism of rupture is given to Ludwig Bandl. 1875 and G. Odolf Michaelis 1798-1848. The mechanism is intimately bound up with the anatomic development and arrangement of the lower uterine segment and the formation of the contraction or retraction ring of Bandl. The upper or contracting portion is motor in activity, by an undulating type of motion it becomes thicker as labor proceeds while the lower part becomes thin-

ned out and stretched. The lower segment is loosely inverted with peritoneum and the muscle fibers are for the most part longitudinally arranged. Its action is passive merely serving as the passage-way through the uterine segment between the presenting pole and the pelvis while the fundus and uterine ligaments pull upward. He adds the condition never occurs in early dilation.

### 3. Cause of rupture due to the fetus and the fetal accessories.

Abnormalities of the fetus contribute to rupture in two ways; one by producing undue distension of the uterine cavity, and second by prolonging the labor. Davis (6) includes all malpresentations of the fetus; as transverse, lie, face or brow, malformations, particularly double monstrosities are occasionally predisposing. Hydrocepholus is more significant. H. E. Murray, Loffort and his co-authors included in Davis' reference report single cases; F. Miller recorded 5 cases of hydrocepholus in 108 ruptures and Merz 18 cases among 230. Trask 12 cases in 117 uterine ruptures 3%; Ames 6 in 100; Bandl 3 in 32 cases of rupture and Lobenstine 1 in 78.1, 3%. Keith discovered 16 ruptures had occurred in 74 hydrocepholic children. Polyhydramnion, fetal neoplasms and plural gestation are less frequent causes of over distension and subsequent rupture.

### V. Symptoms.

The indications of rupture may be mild and vague, to severe and sudden death. Those following cesarean section may be mild but are more apt to be severe in type. The signs of impending or threatened rupture are not based on the ordinary symptoms, of the contraction ring, but primarily on evidence of obstruction

or dystocia. Davis (6) included the following significant premonitory signs. (1) If the membranes are ruptured and there is no progress, should investigate for a cause. (2) The history of the previous labor is important. (3) A prolonged labor with progressively stronger and more violent pains. They may stop and return stronger becoming agonizing in nature. (4) An acceleration of the pulse rate from 70 or 80 to 120 or 160, may have slight temperature increase. (5) The contraction ring may ascend to a level between the pubis and navel and at times approach the umbilicus or higher. (6) There is general exquisite abdominal tenderness with marked tension of the lower abdominal region. (7) Excessive tension of the round ligament which causes them to stand out as tense firm cords. (8) The drawn and anxious facial expression of the patient showing an excessive degree of suffering. De Lee (7) describes the face as being red but the alae nasi are gray; the mouth and tongue are dry and red the patient complains of a desire to urinate frequently and bears down with the pain in a helpless sort of way and begs for relief incessantly. He considers the bearing down efforts as protective reflex due to overdistension of the lower uterine segment. (9) Gradual rise of fetal heart rate in the interval between uterine contraction which indicates circulatory embarrassment as a result of excessive pressure as often noted. (10) Swelling and discoloration of the pinched vaginal portion of the cervix. Grantz (18) describes the vaginal as being lengthened and the orifice of the uterus high, the pains are strong, leave little interval and do not advance the delivery. He adds however that these symptoms are too uncertain to take as the rule, for rupture may take place without being preceded by any of them. Schenone (10) reported a case

in which the symptoms were limited to a mild pain transversely in the lower abdomen and was attributed to stretching of old post operative adhesions by the distending uterus. The symptoms of complete rupture may come on at or near term the regular pains suddenly cease.

Warfield Jr. (9) describes the pain in ruptured uteri as sudden violent, sharp located in the epigastrium and followed by nausea and vomiting. The abdomen is generally sore and tender, there is weakness, shortness of breath, thirst, faintness and free perspiration. Rotton (15) on examination the respirations are shallow, entirely costal, the skin is pale, cold and clammy, the pulse very rapid with low tension and volume with a systolic blood pressure of 90 mm. of mercury. The temperature at the start is subnormal, later rising as infection starts. The facies presents an anxious expression of pronounced mental despondency or despair. As a result of shock and hemorrhage the face pales, the lips whiten or become cyanotic, the features sink in. De Lee (7) wrote, hemorrhage from the genitalia is usually present but not profuse after rupture occurs. If the blood distends the broad ligament pain runs down the legs; if it is free in the abdominal cavity it may seep under the liver and cause shoulder pain. Rotton (15) describes the abdomen as changing from the normal contour of pregnancy so that where the wall is thin the bulk of the tumor mass will be found high with a smaller mass the contracted uterus lying above the symphysis, the fetal heart sounds cease and there is no evidence of uterine contraction, the normal intermittent pains are replaced by a constant pain. Palpation reveals the fetal small parts unusually distinct. The presenting part has slipped away from the superior strait and has



become movable. If rupture occurs during pregnancy, as they do not infrequently, there is usually no history of labor. There may or may not be vaginal bleeding and although the picture of shock is present in the patient a diagnosis of appendicitis may be made. Jacobs (21) points out that unless the placenta is detached, the pulse rate which is fast may not vary. The amount of intraabdominal hemorrhage depends on the location of the perforation. If over the placenta it is great. If not over the placenta, it may be moderate depending on the amount of vascular damage. Or the rent may take place gradually and the symptoms be correspondingly mild so much so as to give rise to more or less confusion of diagnosis. Such patients not entering the hospital for a few days as often happens present a picture of abdominal catastrophe, vomiting with a tender distended abdomen so ridged as to prevent palpation of small parts even though the fetus may be free in the abdominal cavity. Antoine (31) spoke of the increased difficulties in diagnosing the atypical case for there are hardly any symptoms. He also emphasized the importance of immediate recognition.

#### VI. Diagnosis.

Threatened rupture: is vitally important that the diagnosis of dangerous thinning of the uterus be made before the rupture occurs, because if any thing is to be done to save the patient it must be done at once. The findings on examination are (1) a restless, excited, anxious patient, high pulse, irregular respiration. slightly elevated temperature. (2) Strong uterine contractions without proportionate advance of the presenting part. (3) The uterus hard and drawn up over the child which lies in the lower dilated uterine segment. The fundus thick and the lower uterine segment

soft, it bellows out during the pain, allowing the fetal body to be outlined with startling distinctness. The latter seems to lie under the skin. This finding is possible under anesthesia, the exquisite tenderness prevents it otherwise. The distance of the contraction ring above the pubis may be used to estimate the degree of thinning and stretching of the lower uterine segment. The round ligaments inserted high on the uterus are tender hard and wiry like, particularly the one on the side which is going to burst. The lower uterine segment is so sensitive that the woman will hardly allow it to be touched, internal examination will reveal the cervix, either imprisoned in the pelvis and swollen, black and blue or drawn up out of the pelvis with the vagina on the stretch, taut around the presenting part and hot and dry. De Lee (7).

Actual rupture: occurring spontaneous during labor a history of hard contractions followed by sudden sharp pain then a replacement of the recurrent labor pain by one continuous pain, is almost diagnostic. Jacobs (17). The finding in cases of rupture, however, vary with the time of labor when it occurs and whether or not the child is in the uterus or the belly when the examination is made. They are collapsed with all signs of anemia and of shock, uterine action stopped or very weak, external hemorrhage mild or severe rarely absent. Abdominally the child can be felt with surprising distinctness, lying right under the belly wall while the empty uterus is pushed to one side or behind where it is not palpable. If the fetus has partly escaped, the uterine tumor is heart shaped. Internally, the ragged rent may be palpable and intestines or omentum may fall into the hand. The presenting part disappears from the inlet or becomes freely movable. If in doubt abdominal paracentesis is done and aspiration of free blood attempted. If positive this

procedure should prove valuable for it indicates complete rupture with intra-abdominal hemorrhage, and of course leaves no question as to the type of treatment.

#### VII. Differential Diagnosis.

The symptomatology of rupture of the pregnant uterus as evident from the discussion above is extremely variable, depending on the degree and location of the tear of the uterine wall the character of its contents and other factors. Such a maize simulates other obstretical conditions and often differential diagnosis is a problem. As a rule during labor little or no difficulty is experienced. Collapse during or after labor may be due to something else, but rupture of the uterus is the first to be thought of. Sometimes abruptio placenta, placenta praevia extra-uterine pregnancy or threatened abortion must be considered. Schenone (10) reported a case that on examination revealed a closed cervix, membranes intact, and vertex high. She complained of mild lower abdominal pain for two hours, then suddenly took on the picture of shock, no vaginal bleeding and diagnosis of placenta praevia made. Her general condition was too precarious to empty the uterus and the true condition was discovered only at post mortem. Smylie (22) described a case of rupture at one and a half months gestation, which had been diagnosed as threatened abortion. A case of this type would be considered unusual as rupture rarely occurs before the last trimester and threatened abortion most commonly occurs during the first and second trimester therefore little difficulty will occur.

The following symptoms help to make a differential diagnosis between abruptio placenta, placenta praevia and ruptured uteri.

Abrupto placenta	Placenta praevia	Ruptured uteri
1. Uterus enlarged, tense, symmetric.	Uterus usual size.	Uterus small at one side with neighboring tumor, the fetus.
2. Sudden stormy onset.	Rather quiet onset	May be sudden or quiet.
3. Uterus contracting.	Uterus soft.	No uterine pains.
4. Hemorrhage, usually severe, internal or external, usually one hemorrhage.	First hemorrhage generally mild and always external. Several or history of several.	Hemorrhage usually severe, internal or mild external, usually one hemorrhage.
5. Symptoms of more severe hemorrhage than amount of external blood shows.	Symptoms proportionate to amount of blood lost externally.	Symptoms profound.
6. Cessation of fetal movements and heart sounds.	No change	Cessation of fetal movements and heart sounds.
7. Vaginally feel fetus through the os.	No change.	No presenting part, uterus contracted and empty.
8. No tear palpable.	Placenta palpable in isthmus uteri.	May feel the rent and sometimes the gut.

In some cases it may be necessary to open the abdomen for diagnosis and treatment. Ectopic gestation is indicated by the history, the finding of the empty uterus alongside the eccentric, and asymmetric tumor and in the absence of contractions in the uterus.

In peritoneal irritation following rupture of a hollow viscus, the tenderness is more in the flank, while in abruptio placentae it is over the uterus. Davis (6) concluded that incomplete rupture is probably more severe than complete but less often recognized. De Lee considered it important to diagnosis which is present after delivery for treatment depends on this. Abdominally little can be found, rarely hematoma may be outlined, exploratory puncture may help, vaginally the presence of intestine or omentum is of course conclusive but prolapse is usually prevented fortunately by contraction of the uterus. The internal examination alone can be relied on to differentiate and here it may be necessary to use the hand without a rubber glove. The fingers pass through the tear and come in contact with a space filled with soft clots, strands of fibrous tissue, sometimes nerves and vessels span the space and care must be exercised to prevent breaking them. If the tear is complete the fingers pass directly into the peritoneal cavity which may be recognized by (1) the smooth, slippery surface of the adjacent uterus. (2) The presence of gut and omentum. (3) The fingers may lift up the abdominal wall from the inside. (4) An attempt is made to outline the edges of the wound and to determine if the peritonium has been lifted up off the fundus. And (5) bimanually examination to determine if there are any structures between the fingers.

It is sometimes necessary to determine if other organs besides the uterus have been involved. The bladder may be examined with a cystoscope and Xray picture may show pneumoperitoneum. The rectum may be explored but if any injury higher up is suggested the abdomen should be opened.

### VIII. Prognosis.

The prognosis is grave in all cases but, fortunately the improvement of modern obstretical practice with asepsis and early recognition and operative treatment of the accident has effected a substantial reduction of the previous high mortality. Lester (26) gave the following figures as evidence, early the mortality was 83% but surgery has reduced this to 26%. Rongy (23) cited Krukenbergg as the first to review (in 1886) the frequency of rupture following cesarean section, he collected 20 cases with a mortality of 50%. Rotton (13) included the following quotations on the mortality following rupture; Tranoff of Moscow Maternity 1877-1901 reported 124 cases with 79% mortality; Lobenstine reports 37 cases with 81% while Broadhead reports 15% in 16 cases which shows an improvement over the earlier dates. Dorland in 1901-1903 reported a mortality of 24% in 50 cases. Rotton (15) gave the death rate for the baby as 80%, while Williams (16) describes the chances for the baby as almost uniformly bad. Incomplete ruptures are a little less dangerous than complete ones, but the prognosis depends on so many conditions, the site, the extent, the presence of infection, the environment (hospital or home) and the kind of treatment. De Lee's 18 cases of complete rupture, 11 died of shock or sepsis; of 19 cases of incomplete tear, 3 died, 2 from hemorrhage and 1 from peritonitis. In 23 cases reported by Scipiades whose findings were given by Williams (16) at autopsy death was found to be due to infection in 52% and the remaining 48% to hemorrhage or shock.

Death from hemorrhage usually occurs within the first few hours though occasionally it may be deferred for forty-eight hours. In infection the fetal termination may not occur for some days. If the patient recovers, perfect health is never restored,

the uterus remains large (chronic metritis) the laceration scars distort and displace it, and the pelvis is permanently the seat of venous congestion. However these patients due often respond and a life can be saved by early skilled attention.

Gelpi (24) in 1928 reported a case of his who underwent cesarean section to terminate her second pregnancy; placenta praevia being the indication. Rupture occurred with the third gestation and the patient was saved by laporatomy. Her condition was too critical to allow removal of the uterus. A few days less than a year the patient entered with the same symptoms except less severe. Porro operation was performed; a normal living child was extracted; mother and child made an uneventful recovery. Fava (25) described a case of rupture following classical cesarean section with normal birth in the interval.

#### IX. The Frequency of Rupture.

Statistical figures are variable and hard to evaluate accurately, for the circumstances are not known. For instance frequency of spontaneous rupture of the uterus is conspicuously higher in localities where pelvic deformities predominate. Davis (6) believes rupture occurs only rarely during the early part of gestation, and if so the cause is most frequently the cesarean scar. De Lee (7) believes that where good obstetrics are practiced, ruptured uteri is almost unknown, but the widespread performance of the classic cesarean section serve to keep up a large mortality from this usually preventable accident.

Multiparae are oftener thus injured than primiparae, about eight times as often. The years of greatest frequency are from thirty to forty. Women with loose abdominal walls are more

endangered, and fat women seem to be especially predisposed.

Rongy (23) quotes finding from Louis Singers (Paris thesis written in 1908). The report is based on 253 cases who had 290 gestations. Rupture occurred in 21 cases. Following an improvement in technique a more recent study of his based on 98 cases with 113 gestations showed a complete absence of subsequent rupture. Bell reviewed the literature up to 1916 and found 78 cases of rupture, 16 of these occurred before 1900 and 26 since, considering the increase of cesarean he concluded this indication of improvement in technique. Beck (8) gives figures collected by Asa B. Davis, covering a period of 37 years of 147,625 cases, delivered at the New York Lying In Hospital, rupture occurred 184 times. In the Moscow Maternity clinic there were 124 ruptures in 118,581 confinements, a ratio of 1 to 956. Of these, rupture was known to be complete in 58 cases and incomplete in 43. In the Royal Maternity Charity of London from 1827-1856, Ramsbotham discovered records of only 8 complete ruptures among a total of 48,996, 1 case occurring in 6124. The Rotunda Hospital Dublin reported rupture in 1689 cases.

If the single report from the Royal Maternity of London, where the ratio was stated as 1 to 6124, is excluded and the various other figures grouped, rupture occurred once in 841 deliveries. This entire collection excluded all cases with previous cesarean section.

The following collections are various reports of the frequency of rupture following cesarean. Davis (14) quotes the following reports. Schaaning in the University clinic at Oslo observed 25 spontaneous births with one rupture in patients who had had previous cesarean section. Hollan records a 4% frequency of ruptured scar after fundal cesarean section. Odshausen saw one



scar rupture in 120 cesareans. I. W. Potter, 1750 abdominal and vaginal cesarean with 16 subsequent ruptures. Thus it would appear the frequency of rupture following the classical operation may be taken as from 1 to 4%.

Beuthner refers to cesarean section as one of the causes of rupture and states that according to some authors previous cesarean scar is responsible for about 20% of the cases of rupture from all causes. He further states that most authors place the frequency between 1 to 4% following the classical operation and 0.28% following lower cervical cesarean section, this last figure is important and is confirmed by numerous observers. Findley (29) reviewed the earliest cases on low cervical cesarean 1916 as reported by the following. Frank reported 8; Sellhein 5; Litichkuss 12; Allow 30 and Rohrbock 93 cases which had stood the test of labor, but he considered more cases should have to be reported to establish the criterion for the procedure. Phaneuf (30) 1927 found 10 ruptures recorded in the cicatrix of 3600 cesareans of the low cervical type. In Potter's (17) recently reported series of 1750 cases, 17 were known to have ruptured, 43 of these the previous operation had been the low cervical type, but rupture did not follow any of them.

#### X. Treatment.

Prevention: Antoine (31) refers to Stockel textbook on Obstetrics where he writes that rupture of the uterus is a good criterion for the obstetrical efficiency of the physicians and midwives. As intimated in the introduction of this writing the doctor, by the use of improved surgical technique, is able to do much for these patients. However surgery is employed as a way out of other obstetrical difficulties and as such often leaves a uterus predis-

posed to rupture. Any modifications of procedure to lessen this predisposition would be considered worthy effort. Probably the most lively subject in surgical obstetrics at present, is the question of the relative merits of low cervical cesarean section over the classical type of section. Rupture has followed this latter form of operation frequently enough as to develop the widespread dictum once a cesarean always a cesarean.

Fendley (29) in 1916 saw a case of rupture in the Charity Fravenklink clinic in Germany under the supervision of Prof. Franz which died although operated. Prof. Franz and later Prof. Jardine of Glasgow Maternity commented on the case concluded that the cesarean scar was indication for a second operation. Following these experiences Findley covered the literature on the subject, at onset he was prejudiced in favor of repeated cesarean section, but later modified his attitude.

In the section on frequency of rupture it was shown that rupture following fundusotomy occurs from 1 to 4% while cervical section is followed by rupture in 1% or less. This contrast is impressive and indicates the value of its choice in preventing the frequency of this distressing accident. Low section has been in use in Europe for twenty years. Those to advocate it first in this country were Hrist, Polad, Beck and De Lee. Northup (33) cited a series of cases by Reynolds, Routh and Bailey showing the mortality rate for the classical cesarean to be 3.8% if done before labor and 12% after a trial of labor and 34% following examination or manipulation. It has been definitely shown that bacteria have ascended to the fundus after about six hours following the onset of labor. De Lee reported 338 low cervical cesarean operations done in the Chicago

Lying In with two deaths, one ether pneumonia and the other uremia, 136 classical at the same time with 7 deaths. Opitz performed 443 low cesareans for contracted pelvises, there were no deaths following 103 low cervical. Northrup (33) concluded with his own 24 cases 8 of which had had trial of labor 24 to 36 hours. In 5 the bag of waters had ruptured at the beginning of labor. Daichman (34) reported a series of 933 cesarean sections with 25 fatalities to the mothers giving a mortality rate of 3.4%. Any case of temperature of over 100 degrees by mouth for a total of 72 hours was classified as a morbidity. With this standard 46.8% in this series had a morbidity. Low section was performed in 57 of this series and the mortality and morbidity was no higher than for the non elective classical cases, in spite of the much longer test of labor and greater period of rupture of the membranes. Lull (35) concluded after a survey of the 573 cases upon whom section was performed in Philadelphia during 1933, that his findings bore out the facts as had been found in other statistical studies, that mortality rate of the low operation is approximately one half that of the higher operation. Stevens (32) was convinced that in infected prolonged labors this type of operation was especially suitable as the lower uterine segment resists infection better than the fundus. Sutures in the passive lower segment are afforded more protection and less strain from muscular activity, providing for stronger scar and a lessened liability to uterine rupture in any subsequent labor. Transverse incision may be made adequately long for the area is thinner, avascular and the muscles and blood vessels run transversely as compared with the upper portion. Phaneuf (36) concludes cervical cesarean section protects against septic peritonitis, is responsible for better healing of the incision and permits an easy convalescence and may be repeated with ease. In his

series 14 women had repeated 23 pelvic deliveries following cervical cesarean sections resulting in 24 births. An efficient test of labor may safely precede the operation thus allowing a number of women to be delivered through the pelvis who otherwise might have been delivered abdominally. These numerous advantages demonstrate the prophylactic value of the cervical cesarean in providing for a trial of labor and possibly avoid section thus greatly reducing danger of subsequent rupture.

Williams (16) emphasizes the value of prophylactic measures. He drew attention to the fact that rupture occurs rarely in well-regulated hospitals and comparatively frequently in the homes of the poor. Merger Tetrault (37) teaches it is advisable to prescribe a rest during the last months of pregnancy for a woman who has undergone previous cesarean section. This preventive treatment can not always be sufficient, because it is impossible to suppress the uterine contractions of gestation, which are the principal factors in the determination of the ruptures. D. Acierno (38) also advises the necessity for carefully watching the patient following cesarean section especially during the latter months of pregnancy and if need be hospitalization. A subsequent pregnancy should be discouraged for at least two years after a cesarean section. Phaneuf (36) in his analysis of 53 cases of rupture following fundal section discovered the following relation between frequency of rupture and the interval elapsing between operations and the subsequent pregnancy.

9 between 1 and 2 years,  
22 between 2 and 3 years,  
6 between 3 and 4 years,  
4 between 5 and 6 years,

1, 8 years after operation.

1, 12 years after operation.

Bell (27) observed a similar frequency of liability. In every case of mechanical disproportion, contracted pelvis, malpresentations, hydrocephalus, or weak uteri, previous section or history of pelvic infection with or without curattage the accoucheur should scan the face of the labor for the first outward expression of threatened rupture. If a diagnosis of irritable rupture is made, the indication is to empty the uterus as quickly as possible and moreover this must be done with the least possible increase of the intra-uterine tension, with no further stretching of the already overstretched lower uterine segment, cervix and vagina. Findley (23) would not favor high forceps in any circumstance but emphatically not here. Version, pituitrin or hydrostatic bags only increase the dangers in presence of a scar which is an unknown factor and strain should be avoided. He concluded once a cesarean always a hospital case in subsequent pregnancies.

If the cervix is imprisoned in the pelvis, it must first be pushed up, because traction on it from below would stretch it still further in length and effect transverse tear which is impending. If all the conditions for forceps are fulfilled this is the operation of choice, but it may not be forced, since the dragging down of the child may pull the thin cervix apart, cranioclasia is preferable and more humane. In Breech presentation the after-coming head must be carefully led through the enlarged portion of the parturient canal. In shoulder presentations embryotomy, evisceration and rachiotomy, is the method of election. Since the child is nearly dead or dying and version carries so terrible a risk for the mother, cesarean

section must always be done where there is a disproportion or pelvic obstruction. In these cases, the early performance of operation is not the radical procedure that operation as a last resort would be.

To prevent a rupture while preparing for the operation the patient should be instructed to lie quiet. The uterus may be supported by a binder, but the best remedy is a deep ether narcosis to paralyze the uterus until aid is at hand. If the patient is to be transported, morphine  $1/3$  to  $1/2$  gr. is to be given before starting and the journey rendered as smooth as possible. To prevent the uterine tumor from swaying from side to side and thus putting the endangered lower segment on too great a strain, a well padded binder should be applied, and sand bags laid on both sides of the abdomen.

Treatment after rupture: If the child is alive and still within the ruptured uterus or if it has already escaped into the abdominal cavity, no attempt should be made to extract it per vaginam, but laparotomy should be immediately performed and followed, after removal of the child, by whatever operative procedure may be deemed necessary. Beuthner (28) concluded after his study of 10,800 labors with 8 ruptures that if symptoms suggestive of a rupture appear the condition must be immediately treated surgically.

Treatment after rupture as in prevention of rupture will depend on the circumstances under which the accident occurred and the ability of the one in attendance. If the rupture is complete and the catastrophe occurs in the home it is a sad plight. If the child is still in the uterus and readily accessible it should be delivered from below, the rent quickly tamponed, the patient given pituitrin, ergot and morphine and sent to the nearest hospital. If

the child is in the belly, no attempt to deliver it may be made but the tear and the vagina are to be tightly packed and the patient sent to the hospital immediately. Incomplete tears may often be repaired. Usually the bleeding is so profuse that clamping the broad ligament or tamponade is demanded at once. Whatever is needed must be decided instantly and done quickly, the seriousness of the situation usually brooks no delay.

The degree of success attained in handling many of these cases depends on the facilities for treating shock. Greenhalgh (39) 1869 in a case in which the treatment consisted of opium and brandy when the first symptoms of faintness occurred. Two days later she developed peritonitis, 12 ounces of blood was taken from the arm, she was given calomel, opium and salines. The next day venesection was again resorted to with further relief of pain. Boudelocque (39) 1893 advised the use of pure cold water or water mixed with vinegar injected into the uterine wound to stimulate contraction the same as was done by the lower orifice after a common labor in flowing cases. In modern practice physiological solutions and often times blood transfusions may speedily be arranged and the patients life saved. Several oxytocic drugs are readily accessible and may be injected into the vein for rapid and prolonged contractions, all of which aids in controlling hemorrhage and preserving the individuals energy.

Spontaneous rupture occurs less often in the hospital. Immediate laparotomy is the choice treatment and is imperative if injury to the pelvic viscera is suspected. If upon opening the belly, the rent is found to be smooth and the bleeding easily

stanching by suture, simple repair may be made, otherwise supra-vaginal or total hysterectomy is performed. Scheyer (40) emphasizes individual treatment and considers that total extirpation of the uterus is not always necessary although every case is infected. The end result depends on the individual especially on the resistance of the pelvic connective tissue and the reticulo-endothelial apparatus and peritoneum. The advantage of radical operation in removing all infective tissue is often counterbalanced by the opening of new extensive wound surfaces on which germs thrive. At laparotomy the surgeon should be able to form a fairly correct opinion regarding these factors and then decide on his future course. Total extirpation is the method of choice in any rupture involving the main branches of the uterine arteries. Also in cases where hemorrhage can not be stopped without tying these and in cases where the injury goes either straight or diagonally across the uterus as sutures give bad results. In injury in which the uterine artery is spared supra-vaginal amputation does as well as total extirpation.

The fetus and membranes along with blood clots are rapidly removed from the abdominal cavity, hematomata are evacuated the whole extent of the wound explored, perfect hemostasis effected, the wound packed with gauze leading into the vagina, the peritoneum closed over the stump and finally the abdomen closed. Hypodermoclysis and blood transfusion are continued. The condition of the patient and skill of the operator are factors to consider in deciding whether to merely amputate or to remove all of the uterus.

Incomplete ruptures are usually extensions of cervical tears, and may be repaired from below if not too deep. The wound is exposed by broad specula, the cervix is pulled down by forceps,



and deep sutures placed high in the fornices, each suture being drawn up to make higher portions of the lower uterine segment accessible. It is possible to throw a suture around the uterine artery by pulling down the cervix and holding the anterior wall of the vagina up. If hemorrhage an aorta compressor may be temporarily applied. It might be well to detach the bladder by an anterior colpotomy to get to the highest angle of the rupture, which must always be secured to prevent hematoma formation in the broad ligament which may extend up to the kidney. A firm uterovaginal tampon is placed after all suturing. If the tear extends high into the lower uterine segment, or if it is real rupture of the lower uterine segment, it becomes inaccessible to suture. A skillful operation might perform vaginal hysterectomy, but more often laparotomy is chosen. In practice, if we find suture impractical or unsuccessful, the rent is packed at once. Rarely a single tamponade suffices. If the first tampon is bled through, the vagina is to be filled with cotton while laparotomy preparations are being hurriedly made. When applying a tampon care is taken not to punch through the thin peritoneum, and to pack lightly, and to handle the patient gently afterward, as the thin veil may tear over the gauze. If the peritoneum is lifted off its attachments for a great extent, as occurs in multiple ruptures, if there is a suspicion of infection, if the wound is complicated, the case is to be treated like a complete rupture.

If a case is seen only after the bleeding stage has passed an infection with or without peritonitis has begun a bad prognosis is to be made, but hope is not abandoned. The usual method is to open the belly, amputate the uterus low, clean out the hematoma, pack their bed in the pelvic connective tissue, drain per vagina,

and close the peritoneum over the stump. If peritonitis is already general the shock may be fatal, drainage should be made from above and below.

After treatment should consist of ergot to keep the uterus contracted, a firm abdominal binder should be applied, though it is needed for counter pressure to aid a tampon in stopping hemorrhage not much may be expected. The gauze is removed on the third day. If the tear has been drained it is best not to let the wound close too rapidly. If signs of infection appear, a vaginal examination is required to determine the presence of an exudate.

The site of a healed rupture of the uterus is not strong. The patient is instructed as in cases who have had previous cesarean section to spend the last four weeks in a hospital. In these cases cesarean section should be performed before labor declares itself. If this advice is unheeded the labor should be terminated with forceps as soon as the conditions are present. Induced labor is slightly less dangerous than labor at term, but if pelvis obstruction is to be overcome it is not advisable and the abdominal delivery at term is imperative. The induction of abortion for a rupture scar alone is not allowable.

### Summary and Conclusions.

1. Spontaneous rupture of the uterus is a severe accident, but occurs rarely about once in 1000 pregnancies.
2. Rupture occurs more frequently in multipara than primipara speaking for degeneration of the uterine wall.
3. The incidence following previous operations on the uterus is higher than the nonoperative cases particularly if the post operative course was fibril.
4. The uterine scar is an unknown factor in all cases.
5. The low cervical scar ruptures less frequently in subsequent labors. Less than 1 per cent compared to from 1 to 4 per cent following classical section. This is due to the less frequent chance of the placenta being implanted over the scar and to the more favorable anatomical and phisiological character of the lower segment.
6. Trial of labor can safely be allowed if low section is anticipated.
7. The dictum once a cesarean always a cesarean is not true, but once a cesarean always special observation and prenatal care.
8. Finally, all of the factors general and particular to the case must be correlated with the facilities at hand and the ability of the attendant in charge, in concluding what is to be the deposition of the individual case.

## Bibliography.

1. De Sa, H. D. , Spontaneous rupture of the pregnant uterus with report of case; Journal of Obstetrics and Gynecology 41: 416 June;34.
2. Dewees, William P., An essay on rupture of the uterus; The Philadelphia Journal of Medical and Physiological Sciences 1: 73; 1820.
3. Barry, P. J., Notes of a case of ruptured uterus; Dublin Journal of Medical Sciences 94: 206; 1892.
4. Trask, James D., Rupture of the uterus; American Journal of Medical Science 15: April, 1848.
5. Baudelocques, Rupture of the uterus; Mr. Heaths translation of Baudelocques Midwifery; published by Thomas Desilver 253 Market St., Philadelphia; 553, April 1848.
6. Davis, Carl Henry, Gynecology and Obstetrics 1: Chapter 19, page 10.
7. De Lee, Joseph B., Principles and Practice of Obstetrics; W. B. Saunders Co., Philadelphia, 810: 1933.
8. Beck, Alford C., Rupture of the uterus; Nelsons Loose-leaf Surgery 17: 810.
9. Banks, Harry, A case of spontaneous rupture of the uterus at 6 1/2 months; Journal of Obstetrics and Gynecology of the British Empire 41: 82; February 1934.
10. Schenone, Alfred A., Spontaneous rupture of the uterus with a seven months pregnancy; American Journal of Obstetrics and Gynecology 26: 904; December 1933.

11. Rosenfield, Samuel S., Spontaneous rupture of the uterus following a wedge shaped resection of the fundal portion; American Journal of Obstetrics and Gynecology 22: 436; September 1931.
12. Stevens, I. H. K., A case of spontaneous rupture of the uterus; The British Medical Journal 3591: 806; November 2, 1929.
13. Weston, W. Reynolds, The factors concerned in spontaneous rupture of the uterus, with report of case; American Journal of Obstetrics and Gynecology: 25; January 1911.
14. Murray, F. J., Spontaneous rupture of the uterus; Nebraska State Medical Journal 18: 458; December 1933.
15. Rotton, C. S., Rupture of the uterus during pregnancy; Northwestern Medical Journal 27: 72; February 1928.
16. Williams, J. Whitridge, Obstetrics, a textbook for the use of students and practitioner, D. Appleton and Co., New York; 1027; 1931.
17. Jacobs, J. Bay, Rupture of the uterus; Medical Journal Record 132: 386; October 15, 1930.
18. Baudelocques, Rupture of the uterus; Mr Heaths translation of Baudelocques Midwifery; published by Thomas Desilver 253 Market St., Philadelphia; 610, April 1848.
19. Schenone, Alfred A., Spontaneous rupture of the uterus with a seven months pregnancy; American Journal of Obstetrics and Gynecology 26: 754; December 1933.
20. Warfield Jr., J. Ogle, Spontaneous rupture of the uterus; Journal of American Medical Association 90: 691; March 3, 1928.

30. Phaneuf, Louis E., Obstetrical future of women delivered by low cervical section; American Journal of Obstetrics and Gynecology: 446; April 1927.
31. Antoine, T., On spontaneous atypical rupture of the uterus; Wiener Klinische Wochenschrift 44: 168-170; February 6, 1931.
32. Stevens, Wm. J., Indications for abdominal section and the low cervical operation; The Canadian Medical Association Journal: 498; May 1934.
33. Northrup, L. C., Low cervical cesarean section; Oklahoma State Medical Journal: 143; May 1933.
34. Daichman, Isidore, A study of 733 cesarean sections; American Journal Obstetrics and Gynecology: 522; April 1933.
35. Lull, Cliffer K., A survey of cesarean section performed in Philadelphia during 1933; American Journal of Obstetrics and Gynecology: 426; March 1933.
36. Phaneuf, Louis E., The cervical cesarean section; New England Journal of Medicine: 245; February 1, 1934.
37. Merger and Tetrault, Spontaneous rupture, before the onset of labor, of a pregnant uterus, after a preceding cesarean section; Clinical and Therapeutic Observations. La Medecine 13: 310; April 1932.
38. D'Acerno, Pl., Spontaneous rupture of the uterus; The American Journal of Surgery 19: 315; February 1933.
39. Greenhalgh, Care of ruptured uterus; Transactions of the Obstetrical Society of London 11: 9; (1869) 1870.
40. Rongy, A. J., Rupture of cesarean scar; American Journal of Obstetrics and Gynecology: 710; December 1916.

21. Jacobs, J. Bay, Rupture of the uterus; Medical Journal Record 132: 201; October 15, 1930.
22. Smylie, Robert S., Spontaneous rupture of the uterus at 3 1/2 months gestation; American Journal of Obstetrics and Gynecology 23: 595; April 1932.
23. Rongy, A. J., Rupture of cesarean scar; American Journal of Obstetrics: 954; December 1916.
24. Gelpi, Maurice J., Rupture of the uterus in the scar of a previous cesarean section occurring twice in the same patient within one year; American Journal of Obstetrics and Gynecology 15: 85; January 1928.
25. Fava, V. Philip, Rupture of the uterus following classical cesarean section with normal birth in the interval; American Journal of Obstetrics and Gynecology 28: 284; August 34.
26. Lester, F. W., Rupture of the pregnant uterus at full term; New York Medical Journal: 1108; October 1, 1932.
27. Bell, John Norval, Rupture of the uterus in cesareanized women with review of the literature on the subject; American Journal of Obstetrics 74: 950; December 1916.
28. Beuthner, B., Symptomatology and etiology of spontaneous rupture of the uterus; Zeitschrift fuer Geburtshuelfe and Gynaekologie, 100: 115-130; 1931
29. Findley, Palmer, Rupture of the scar of a previous cesarean section; American Journal of Obstetrics and Gynecology 74: 411; September 1916.