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Appendicitis as a complication of pregnancy

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INTRODUCTION

For more than a century, the obstetrician and surgeon alike have been confronted with the perplexing problem of the safest course to follow, for both mother and infant, when appendicitis presents itself as a complication of pregnancy. Appendicitis gained recognition as a complication of pregnancy during much the same period in which appendicitis, per se, was recognized as a clinical entity. However, when pregnancy co-exists with this disease, the hazards are greatly increased due to anatomic and physiologic changes brought about by the pregnant state. These different relationships will be discussed later.

The need for quick, decisive action is mandatory in this condition. Early writings on the subject emphasize this point, and yet the problem has been complicated by two viewpoints, viz., that of the surgeon who, in essence, says, "A human life is at stake and operation must be performed immediately to save that life irregardless of the presence of the fetus", and the viewpoint of the obstetrician, who says, "If we operate we may save the life of the mother but in doing so we jeopardize the life of the infant. If we wait, Nature's defenses may halt the disease".

But one cannot adopt either of these policies without hazard, for the surgeon who operates to save the life of the mother, thus jeopardizing that of the infant, may find that his operative interference has started the process of labor and his patient may die because of a diffuse peritonitis brought about by the uterine activity. On the other hand, the obstetrician who chooses to "wait and watch" may find that his delay has allowed the process to go too far with a similar outcome.

HISTORY

The disease which we now know as appendicitis was first mentioned in the literature by Heister(1), in 1711, in his "Medical, Chirurgical and Anatomic Cases and Observations" in which he described an abscess of the appendix found at autopsy. Appendicitis in pregnancy was first recorded in 1759 by Mestivier(2), who described an appendiceal abscess found at autopsy in a woman eight months pregnant, the disease having been caused by a needle in the lumen of the organ.

Hancock(3), in 1848, reported the first case of appendiceal abscess with survival of the mother. Abortion occurred four days following onset of symptoms and the premature infant expired after twenty-four hours. Fourteen days after onset of symptoms, the abscess was incised and the mother recovered, although convalescence

was quite stormy.

Fitz(4), in 1886, defined appendicitis and analyzed 257 cases of perforative appendicitis. Kelly(5) states that "to Thomas G. Morton, of Philadelphia, belongs the credit for the first successful removal of the appendix, deliberately undertaken". This occurred on April 27, 1887.

Wiggin(6), 1892, was the first to report a case in which the diagnosis of appendicitis complicating pregnancy was made and operation advised. Friends of the patient refused operation and the patient died. Autopsy proved the diagnosis to have been correct.

Munde(7), 1894, reported a case of appendicitis complicating pregnancy at the eighth month. The patient aborted seven days after the onset of symptoms and was operated thirteen days later. The patient recovered, thus giving us the first recorded instance in which diagnosis was correctly made, operation performed and the patient recovered.

THE ALTERED RELATIONS IN THE PREGNANT ABDOMEN

As gestation progresses, the enlarging uterus greatly changes the relations of the abdominal viseera.

Baer, Reis and Arens(8), at Michael Reese Hospital, made an exhaustive study of seventy-eight patients.

This was a select group in that each was found clinically to have a normal appendix and normal pregnancy. There was no history of appendicitis nor was there roentgenographic evidence of pathosis of the appendix. The patients were examined at regular intervals from the second month of pregnancy until the tenth postpartum day. Barium meal was given eighteen hours before X-ray and flouroscopy was done. Examination was carried out in both the upright and the dorsal positions. The authors studied the relationships of the base of the appendix and the caput coli to fixed anatomical structures which are easily recognizable on X-ray. The base of the appendix was measured in relation to the iliac crests, the iliopectineal line at its sacral termination, or the symphysis pubis rather than to McBurney's point which varies as pregnancy progresses. The measurements were recorded in fingerbreadths.

The iliac crest averaged five fingers above, and the symphysis pubis five fingers below the iliopectineal line. Clinically, McBurney's point lies on a line from the right anterior superior iliac spine to the umbilicus, two inches medial to the spine. Roentgenographically, the base of the appendix will be found

one to two inches medial to McBurney's point. In summary, the authors found that the base of the appendix ascended from two fingerbreadths above the iliopectineal line (McBurney's point) at the end of the second month, to an average of two fingerbreadths above the iliac crest at the end of the eighth month, and that within ten days following delivery, the base of the appendix had returned to the same level from which it had started at the end of the second month. X-ray and flouroscopy also revealed that the appendiceal relationships further varied in that the organ was shown to undergo axial rotation in a counterclockwise direction so that by the end of the eighth month, it curved upward and ran vertically in 80% of the subjects studied. The appendix then, in the second trimester, is pushed out of the pelvis and becomes an abdominal organ(9).

In the nonpregnant abdomen, various barriers to the extension of the disease are present. These include loops of intestine which become involved by the disease process and become matted together by adhesions, thus walling-off the active inflammation. A further barrier to extension of the process is the omentum which, in the non-pregnant abdomen, hangs in apron-like fashion,

and, depending on the level to which it descends, helps to limit the extension of the pathosis by "wrapping" itself around the involved area. However, the enlarging uterus is gradually lifting the mass of intestines and the omentum out of the pelvis as gestation progresses until, by the end of the first trimester, these natural defense barriers are losing their effectiveness, and, as gestation progresses, the danger of diffuse, generalized peritonitis becomes greater(10).

With the loss of these natural barriers, the enlarging uterus becomes more and more exposed to the active disease and after the third month of pregnancy the uterine wall forms the medial wall of the abscess cavity in those cases which go on to suppuration(11). It can easily be imagined, then, that any movement of the uterus, whether it be due to changes in the position of the mother, fetal movements, or contractions of the uterus, could conceivably cause breaking-down of the protective adhesions and subsequent spread of infective material from the abscess cavity to the uninvolved portions of the peritoneum(9).

Lobhardt (30) felt that the congestion in the pelvis and in the abdominal viscera which was due to pregnancy relieved the chronic inflammation which so

often exists. Paddock states, "That this theory is erroneous is proved by the fact that most of our cases had previous attacks, and that the pregnancy, instead of decreasing such inflammation, increases it". Maes(9) also supports the latter view, adding that the vascularity and lymphatic dilatation caused by pregnancy predispose to phlebitis and thrombosis, and that morbidity and mortality are increased because of the lessened resistence to infections and toxemic processes in the pregnant woman.

Various authors(9)(12) feel that constipation, which is so commonly associated with pregnancy, also increases the liability for excitation of the latent disease in those who have had previous recurrent attacks.

Maes, in his previously mentioned paper, points out that recurrent appendicitis is unfavorably influenced by menstruation and feels that the menstrual cycle, even though suppressed during pregnancy, continues to exert its effect on the appendiceal disease.

It must be remembered, too, that an enlarging uterus can break up adhesions caused by a previously inflamed appendix(10), and that occasionally adhesions are present which bind the appendix to the uterus and/or its appendages(12).

INCIDENCE

Such varied reports as to the incidence of appendicitis in pregnancy have been given that the picture is obscure. Various factors influence the frequency with which the disease is met. Such things as eating habits, economic status, climatic conditions, etc., tend to control the incidence, at least to some extent.

Reported incidence ranges from 0.17% (Baer, et al.) to 2.5% as given by von Eiselberg, Schmid(9), and Paddock(11). In 1902, Rosner reported twenty-two cases of appendicitis found in 1500 pregnancies(13), While in 1903, von Oordt said that he had observed the complication in only 3 out of 10,000 cases studied at the Rotterdam Maternity Hospital(11). J. B. Murphy(31), in 1904, reported 2,000 cases of appendicitis but does not mention the complication of pregnancy. Treves(32), in 1905, reported 1,000 cases of operation for appendicitis. Three hundred and nineteen were women and six were pregnant. Mt. Sinai Hospital(11)(1898-1907) reported 2003 cases of appendicitis, 731 of which were females and nine of which were pregnant. Lobenstine(14) reports on 30,000 cases at New York Lying-in Hospital out of which he found five cases of acute gangrenous appendicitis. Norris(11) reports 445 females operated for appendicitis and six were pregnant, while Baldwin(11)

reports 1890 appendectomies with six pregnancies. Vineberg(11) found nine pregnant women out of 731 operated. Fraenkel(11) reports five pregnancies in 40,000 appendectomies, while von Eiselberg(11) found 13 pregnancies in 526 appendectomies. Crane and Mussey(15) found that approximately 2% of females with symptoms of appendicitis were pregnant.

Babler(13), in 1908, reviewed the literature and found 235 cases of appendicitis during pregnancy, labor and the puerperium, 207 of these having been during pregnancy. Of these, 103 were perforative or gangrenous and 104 of the non-perforative type. He does not feel that pregnancy predisposes to appendicitis and calls special attention to the fact that 75.7% of his reported cases occurred after the third month of pregnancy.

H. H. Schmid(14) collected 486 cases from the literature from 1892 to 1912, while Renvall(33), in 1908, reported 25 cases of his own and 253 collected from the literature.

Maes(9) reports the highest incidence between 20 and 30 years. In his series, the ages ranged from 16 to 43 years. Of his 50 reported cases, 40 were under thirty years of age and 15 were between 16 and 20

years of age.

Twyman, Mussey and Stalker(15) reviewed 75 cases of appendicitis in pregnancy at the Mayo Clinic from 1928 to 1939 inclusive. Of these, most of the patients were in the third decade of life, but the ages ranged from 17 to 40 years. The majority were in their first of second pregnancy. Twenty-eight of the cases yielded appendices with acute inflammatory changes, three of which were gangrenous and perforated with subsequent peritonitis. Forty-seven of the cases were not operated but the clinical course indicated acute appendicitis. These authors feel that "the incidence of appendicitis during pregnancy is no greater than at any other time". This view is held by most authors, who feel the pregnancy does not increase the incidence of appendicitis but that it does increase the the hazards once it is complicated by it.

Norton and Connell(16), in 1936, reviewed the literature and found 1110 cases of appendicitis complicating pregnancy and lobor. The results of this review will be found in TABLE I.

ETIOLOGY

It is generally agreed by most authorities that the etiology of appendicitis in pregnancy is no

different than in the non-pregnant state. Primary attacks are not incited by pregnancy, but there is a greater liability to recurrent attacks at this time(12). Paddock(11) further states, "Another factor---which may figure in the etiology, and which one would think should render the cases more frequent is the frequency of the association of diseased appendices with diseased ovaries and tubes".

Since a complete and detailed account of the etiology of this disease is not within the scope of this article, the reader is referred to the excellent presentation of this subject by Sloan(17).

DIAGNOSIS

The chief reason for delay in treatment is the failure to promptly diagnose the condition(19). The diagnosis of appendicitis in pregnancy is based on a careful history and physical examination just as in the non-pregnant. The most helpful point is always a history of previous attacks(18). In the early months of pregnancy, the patient frequently relates a classical sequence of events in the progress of the disease. It must be remembered, however, that the percentage of of atypical attacks of appendicitis is high at all times and is higher during pregnancy because of the

altered relationships in the abdomen(18).. Classically, the disease presents itself first as generalized abdominal pain which within a few hours localizes peri-umbilically or in the epigastrium and finally localizes in the right iliac fossa. Along with the development of pain, which is the most common symptom of the disease, the patient becomes nauseated and frequently vomits, the vomiting usually not being protracted and occurring possibly only once or twice. Within a few hours the temperature may rise to 100° or 101° F.(17). The rise in temperature is seldom marked and, if so, one must strongly consider other abdominal conditions as causative, e.g., pyelitis, salpingitis, etc. A pulse rate out of proportion to the fever is quite suggestive and helpful in the diagnosis(18).

Examination commonly reveals right rectus rigidity which early in the disease relases with each expiratory effort, but later remains constant. Deep tenderness in the RLQ is a very frequent finding as is also rebound tenderness. The finding of muscle rigidity of the whole lower abdomen, more marked on the right leads one to suspect that the appendix has ruptured and generalized peritonitis is present. Rupture rarely occurs before

twenty-four hours from the onset of pain int he adult and sudden cessation of pain may indicate that rupture has occurred(17).

The above conditions become altered to some extent with the progress of pregnancy. As mentioned previously, the appendix is pushed upward and laterally so that since the point will be located more cephalad and laterally, depending on the state of gestation(8). In the latter months of pregnancy, then, the pain will be more abdominal than pelvic in location. Localized tenderness may be difficult to elicit because of the size of the uterus. Pushing up of the cecum and appendix by the uterus may cause confusion with gallbladder disease and peptic ulcer. In the latter months of pregnancy, these symptoms, if of a mild nature, might be erroneously considered evidence of beginning lobor(19).

Leukocytosis is usually present but need not be since a relative leukopenia has been noted in cases in which acute purulent appendicitis has been found at operation(15). Among the patients studies by Baier, et al., the leukocyte count ranged from 8,400 to 19,500, with anc average of 13,400 cells/cubic mm.(8). Paddock(11) aptly states, however, that "one always has to remember that a normal pregnancy has an occasional

leukocytosis", while Zander(18) believes that any white cell count below 12,000 is not significant. Of significance, however, is an increase in the polymorphonuclear leukocyte percentage of the differential count. The erythrocyte sedimentation rate may be raised but cannot be relied upon

In the study of 78 patients by Baer, et al., 28 had right-sided abdominal pain; 17 had nausea and 16 had vomiting. Two had severe "indigestion". Twenty-four had fever; 28 had RLQ tenderness; 15 had muscle spasm or rigidity, and two were distended.

Diagnosis must not be delayed since rupture usually results in rapid spread of peritoneal infection due to decreased effectiveness of the natural defense mechanisms. Babler(13) states that "the mortality of appendicitis complicating pregnancy and the puerperium is the mortality of delay", while Munde(20) thinks "that the numerous instances of appendicitis with and without supperation, occurring during pregnancy and labor---should induce us to watch for this accident at those times quite as much as on other occasions, and to treat the disease entirely regardless of the existence of pregnancy".

Diagnosis is often made difficult, especially in

the latter months of pregnancy, by the enlarged uterus, and the change in organ relations. Muscle rigidity becomes more marked as the uterus enlarges and the abdominal muscles are more and more put on the stretch. The question often arises whether the pain is due to the onset of labor or to cuases outside of the uterus, but any tendency for referred pain to the RLQ, or eliciting of any pain or tenderness in this region must be given special weight(21). Mild attacks are often misdiagnosed and McGehee feels that "the history of previous attacks coupled with a careful analysis of the clinical signs and symptoms and laboratory data, as a total white and differential count, offers the best safeguard against diagnostic error"(19).

DIFFERENTIAL DIAGNOSIS

1. Pyelitis on the right side may be mistaken for appendicitis and this is one of the most important diseases to be differentiated since it is rather frequent in pregnancy and six times more frequent on the right side simply because the pregnant uterus normally rotates to the right and compresses the ureter at the point where it crosses the pelvic brim(18,19). This can usually be differentiated from appendicitis by the presence of lumbar pain, frequency, pyuria, daily chill

followed By fever, costovertebral angle tenderness and tenderness along the course of the ureter, and by the absence of right rectus rigidity and point tenderness(13). The temperature may be high (104-105°F.) while at the same time the pulse may be low(10). In typical cases of appendicitis the sequence of events is pain, fever and chills, while in pyelitis it typically is chills, fever and pain, but too much reliance must not be placed on cases since wide deviations are possible. In pyelitis, the urine is turbid and contains pus and micro-organisms. The colon bicillus is the most common arganism in both conditions and it must be remembered that the pregnant female with pyelitis can also develop appendicitis, while the converse is also true, but if in doubt, operate for appencicitis. However, the laboratory and/or cystoscopy can usually settle the question(18,19).

2. Ectopic gestation and rupture is characterized by pain which is more paroxysmal and severe in nature. Rigidity and tenderness over McBurney's point is not marked. The temperature may be high but may be sub-normal at the onset. There is usually an intermittent bloody flow from the vagina and bimanual examination generally reveals a mass in the adnexa(10). Moving of the cervix is usually very painful, this being a fairly

characteristic sign of irritation of the tubes. The shock-like picture which is commonly seen in ruptured ectopic gestation becomes "progressively more profound, the pulse becomes rapid and thready, the blood pressure falls alarmingly, the lips and mucous membranes show a striking pallor, and the blood count is characteristic of an acute and severe secondary anemia"(22).

3. Acute salpingitis may be mistaken for appendicitis. Crossen and Crossen state, "In appendicitis the pain is more likely to start as a general abdominal pain, the point of greatest tenderness and the inflammatory mass, if there is one, being in the appendix region instead of in the tubal region. In appendicitis also there is frequently a history of stomach or bowel disturbance preceding or associated with the attack of pain, while in salpingitis there is usually a history of uterine disturbance---dysmenorrhea, prolonged menstruation, vaginal discharge, and other indications of a previous or coincident uterine disease. In some patients both structures are involved". Frequently the patient will have pain radiating down the thigh and a history of gonorrheal infection may be obtained. Differentiation is often impossible if the appendix is adherent to the right adnexa(10). Bilateral or right-sided salpingitis

is sometimes difficult to exclude, especially later in pregnancy when bimanual examination is less conclusive because the adnexae cease tobe in reach of the examining fingers. The fever is usually higher in salpingitis and exacerbations of the pre-existent disease are more likely to occur after delivery than during gestation(18).

4. Ovarian cyst with a twisted pedicle must be considered as a possibility but here the pain is paroxysmal, severe and often out of proportion to the constitutional symptoms(10). It must be remembered that subserous fibroids can at times be attached to the uterus by only a thin pedicle and here again the tumor may undergo torsion with resultant twisting of the pedicle. Even the uterus itself may undergo torsion(18).

5. Cholelithiasis and cholecystitis and diseases of the liver and fallbladder must also be excluded. In the second half of pregnancy the points of tenderness in appendiceal and gallbladder disease become close together since the appendix is pushed upward. This may render diagnosis difficult at times. Paddock says, "Icterus is usually absent; however, we may have a septic icterus in severe cases of appendicitis"(11). Cholecystitis with or without stones can usually be

differentiated from appendicitis by the combination of the location of the pain and its tendency to radiate to the back and shoulder and a history of previous attacks. A patient with biliary tract disease is more likely to be a more seriously ill patient at the onset of the attack than a person with appendicitis would be(18).

6. Perforated peptic ulcer can usually be ruled out on the basis of a history of epigastric distress, food intoleraches, etc.

7. Intestinal obstruction.

8. Mesenteric thrombosis.

9. Renal pathology (other than infectious, which we previously discussed) can usually be differentiated easily on the basis of history, physical examination and laboratory findings. Renal colic may be related to obstruction, but this is not necessarily true. Typically, the attacks come on suddenly with severe pain in the "kidney region" and from there it radiates downward to the groin, vulva and the anterior surface of the thigh. Less often, the pain will follow the course of the ureter to the vulva. Sometimes the pain will travel down the leg, even as far as the ankle. The pain is usually severe and nausea without vomiting

is almost the rule. The patient may be constipated or distended with the attack. The duration of the attacks is usually 4 to 12 hours but may last only minutes or several days. Hematuria is present in 58.1% and sand, gravel or small stones are passed in 32.3%. Bladder symptoms of frequency, urgency and burning are frequently seen.

In hydronephrosis, the primary symptoms are pain and tumor. Pain is the most characteristic symptom but may be absent. It is usually colicky and recurrent, is usually in the loin, and may radiate along the course of the ureter.

10. Incarcerated inguinal hernia.
11. Threatened abortion.
12. Vomiting of pregnancy and gastro-enteritis.
13. Abdominal malignancy.

Most of the conditions such as intestinal obstruction mesenteric thrombosis, extra-uterine pregnancy, torsion of ovarian cysts, uterine fibroids or even the uterus are surgical states, mostof them very urgent, and if the abdomen is opened, so much the better, even if the original diagnosis did happen to be incorrect(18).

PROGNOSIS

Appendicitis is a dangerous disease, especially

in the pregnant woman, and the final outcome of the disease depends to no small degree upon the sagacity and clinical judgment of the physician and the haste with which he institutes treatment. The maternal mortality is directly proportional to the stage of gestation and the severity of the disease(10,19). McGehee believes that the high fetal mortality, which is due partly to prematurity and partly to toxemia may be discounted, for it is largely inevitable(19). McDonald(23) says, "It is the disease itself, the fever and toxemia that go with it, the gastro-intestinal disturbances, the reflex peritoneal irritation and the direct extension of the infection that are the factors responsible for for abotion and premature labor and not the operative act itself". Women abort because they are dying and do not die because they have aborted(9,19). McGehee feels that if operated early, the chances are good that the pregnancy will go on undisturbed but that the chances of a happy outcome are decreased if the surgeon delays until operation is not much more than a gesture of despair. Cosgrove(24) agrees with the above views and feels that the safety of the mother, in either the acute or chronic disease, is best assured by early and immediate removal of the appendix and non-interruption

of the pregnancy and believes that such action will eliminate many complications and sequellae. Although abortion is not the primary event responsible for maternal death, it is a frequent sequella and the mortality is highest among those who abort while the most common cause of death is diffuse peritonitis(25). Abortion or labor during, or immediately after, an acute attack tremendously increases the risks, for the raw uterine cavity and the gaping, thrombosed sinuses furnish ideal channels for the spread of micro-organisms so that post-abortal or post-partal infection is a very serious possibility(9). Babler(13), in his report on 207 cases, states that delay until perforation results in an infant mortality of 66% and a maternal mortality of 48.5%. Of the 207 cases, 103 were perforated. Of these103, operation was performed in 89. Thirty-three aborted before, and 37 after operation. Thirty-six mothers died. Of the 14 treated medically, all died (10 aborted and in 4 the infant died in utero--a parent mortality of 100% and an infant mortality of 75%). Of the 104 non-perforative cases, 50 patients were operated. Seven of these aborted and one mother died. Of the fifty-four not operated, 6 aborted and four mothers died.

Cooke states that the mortality to the mother is about 50% in abscess cases which occur in the latter months of pregnancy which are operated and nearly 100% in similar cases not operated. When generalized suppurative peritonitis already exists at the time of operation, the prognosis is almost hopeless. Abortion or premature delivery occurs in about 80% of the acute gangrenous, perforative, and abscess cases(10).

Fegtly(26) states that in general, only 50% will terminate with a living child, 10% will result fatally for the mother, 40% will result in interruption of the pregnancy sooner or later, and although to be avoided if possible, 30% will require drainage.

Goedecke(27) reports on 16 pregnant women who had had previous attacks of appendicitis. Of these, 5 went through pregnancy and the puerperium with no trouble, while 11 had recurrent attacks during pregnancy.

Findley(12) reports 15 cases. Of these, 14 had had previous attacks. Six patients, who had only mild attacks, recovered without interruption of the pregnancy. Ten patients had severe attacks and, of these, seven recovered and three died. In one of the fatal cases, the patient was not operated. Of the 15 cases, 9 were during pregnancy, one during labor, and 5 during the

puerperium. The 5 which occurred during the puerperium were unusually severe. Of the three deaths, two died of septic peritonitis and one of bronchopneumonia. The majority of the cases occurred in the early months of pregnancy.

Paddock(11) has compiled the following statistics of other investigators:

Maternal Mortality		Infant Mortality
Rosmer	59%	Abrahams--Close to 100%.
Heaton	50%	Occasional case goes
Abrahams	53%	full term.

Twyman, et al., in their report on 75 cases at the Mayo Clinic from 1928 to 1939, inclusive, give the following data:

1. The majority were in their first or second pregnancy.
2. Twenty-eight acute cases, three of these perforative and with peritonitis. In these three perforative cases, open drainage was employed. In two of these (one in the first and one in the third trimester), the course of pregnancy was uneventful and resulted in normal delivery at term. In the third case, abortion occurred on the 18th post-operative day and the patient recovered after a stormy convalescence.

3. In 47 the clinical course indicated acute appendicitis.

4. In all cases in which appendectomy was performed, the pregnancy was undisturbed.

Zander(18) states that in a surprising number of cases, labor is not precipitated by operation, even fairly near term.

Marbury(28) reports on 34 cases in which appendicitis occurred during the last trimester. The maternal mortality for this series was 26.4%.

McDonald(29) reports the mortality for the intra-appendiceal disease as 0.71%, for abscess 23.5%, and for peritonitis 30%.

The incidence of abortion and premature labor is higher after operation for acute appendicitis during pregnancy, but this is due to the disease and not to the operation. Jerlov(36) reported an incidence of 13.8% in the intrinsic disease, 55% in abscess, and 63% in peritonitis. McDonald's figures are 11.4%, 66%, and 72%, respectively.

In conclusion, the association of appendicitis with pregnancy is a potentially dangerous one, both for the mother and for the infant, but quick, decisive and judicious action can, and usually does, result in

a happy outcome in the majority of cases. A most important point to remember is that the abdominal relationships in the pregnant woman are changed: the uterine wall forms a convenient "drainboard" for the flow of purulent material into the pelvis; the intestines are pushed out of the pelvis and cannot aid in the limitation of the disease as would be the case in the non-pregnant abdomen; the omentum is also pushed up and is limeited in its walling-off action; spread of septic material to the uterus can cause reflex emptying of the uterine contents. For these reasons, one must not delay and it is far safer to operate and find no appendicitis than to fail to operate when the disease is present.

TREATMENT

John B. Murphy has said, "There is never an excuse for delaying surgery in pregnancy, on the ground that if there is one thing that the surgeon of experience has concluded, it is that he does not know what is going to happen in the ten, or the twenty, or the forty hours following the onset of acute appendicitis"(19). Many years ago W.W. Keen stated that "---it is impossible in any case in the beginning for any medical man, however gifted he may be, to foretell whether the acute process will subside promptly or whether it will progress

to the stage where no treatment is of avail"(19). McGehee says, "---some medical men in this day and age consider the pregnant state an additional excuse to procrastinate and practice what they are pleased to call 'watchful waiting.----I subscribe to the view that the pregnant woman with acute appendicitis is a surgical problem first and an obstetrical problem second. Once the diagnosis is made, or even strongly suspected, immediate operation should be the rule"(19).

Moynihan(19) says, "It is unreasonable to permit an individual to die of one disease simply because he happens to be afflicted with another".

John B. Deavers(19) has said that "a hair-splitting diagnosis seldom gets a patient anywhere except to the grave".

Maes(9) says, "In cases of suspected appendicitis do not wait for a positive diagnosis.---When in doubt you are amply justified in performing an exploratory laparatomy, exposing the appendix and removing it". If there is any doubt, treat it as appendicitis(16).

Pre-operative management of the patient does not differ from that of any other patient with appendicitis. Operation should be performed just as soon as possible after the diagnosis is made.

Either a McBurney or a right rectus incision may be used, but one must take into account the stage of gestation, for in the latter months of pregnancy the appendix lies higher and more laterally(18). Baer, et al., feel that the gridiron incision is best used during the first half of pregnancy and that in the latter half of pregnancy the right rectus incision gives better exposure and less trauma to the growing uterus(8).

Excess manipulation is to be avoided, especially in the later months(19,24). Handle the uterus as little as possible and any necessary manipulation of the organ should be as rapid and gentle as possible(18). "Under no circumstances should attempts be made to bring it (the uterus) out of the abdominal wound"(9).

Drainage should be omitted when possible, but when frank pus is present it must be used(19). If and when abortion or onset of labor supervenes, the relationship of the uterus with the other abdominal organs will again be changed so one must take this into consideration when placing drainage tubes(19). If possible, place the tubes so that they will be disturbed as little as possible by the activity of labor(18). If removal of the appendix entails tearing of protective adhesions and spread of

infective material to other areas, the operative procedure should be limited to drainage of the appendiceal and other infected regions(24). Vaginal drainage must not be used(19).

Over the years since appendectomies have been performed in the pregnant female, opinions have conflicted pertaining to the question of what to do about the pregnancy. Without doubt, there have been many bitter arguments on this subject. In the early days of this century it was generally felt that delivery should be forced in such cases, but here again the problem was whether to deliver the appendix before the baby or the baby before the appendix. Cocke(21), in 1920, felt that the pregnancy should be terminated first and then the appendix removed. His argument was that removal of the appendix in the presence of a full-term uterus is very difficult and also that, if drainage is necessary, labor contractions and diminution of the uterine size might so disturb the operative field as to cause spread of infection to all parts of the abdomen. Other authors have used this latter opinion as their basis for a diametrically opposite stand on the question. Cooke(10), for example, in 1909, felt that the uterus should not be emptied either before or after the operation

inasmuch as the uterus forms the inner wall of the abscess cavity, if present and there would be danger of setting up a diffuse suppurative peritonitis. McArthur(35), in 1895, stated that the uterus was best emptied after drainage of the abscess and before the abdomen is closed.

Present day knowledge of the disease, and a much more vast experience with abdominal procedures, has reversed our thinking on the subject. Cosgrove(24) sums up the thinking of the majority of present-day authorities by stating that interruption of gestation has no place in the treatment of appendicitis in pregnancy. As Zander(18) puts it, we should let Nature take care of the pregnancy while the surgeon takes care of the appendicitis. With the aid of previous experience and the courage to take firm, decisive action, there is very little excuse for allowing appendicitis to progress to the stage of abscess formation. As has been stated previously, it is the disease rather than the operation which causes abortion and premature labor, and if operation is performed early and with gentleness and care, there will be few instances of abortion and it will rarely be necessary to empty the uterus at the time of operation. There may be isolated instances in which

emptying of the uterus may be indicated, as in the case of apatient in the last few weeks of gestation in which vaginal delivery would be impossible due to an absolutely contracted pelvis. In such a case, and this would be a rare occurrence, it might be practical to perform appendectomy and Caesarian section at the same time(18), but all possible precautions should be taken to prevent contamination of the raw, denuded inner surface of the uterus, with its gaping sunuses, by infective material from the site of inflammation. Porro section in unfortunate in the young female, but there may rarely be instances in which the patient's best interests may be served by it. Closure near term should be done with special care and thoroughness(18).

Post-operative care differs very little from that in a non-pregnant patient. The main consideration is the prevention of onset of labor and, therefore, sedation is used liberally(15,18,19). Twyman, et al., recommend the use of morphine gr. 1/6 to 1/4--depending on the patient's size---on a regular four hour schedule for several days post-operatively(15). Lackner and Tulsky(34) suggest the use of progesterone to serve this same end, since it has been found to give beneficial results in the prevention of abortion by inhibition of

uterine activity.

Fluid balance should be maintained by the use of at least 2000 cc. of parenteral fluids every day(18). No oral nutrition should be given until flatus has been passed per rectum, at which time small amounts may be given and the amounts gradually increased(15). Proctoclysis, enemata and cathartics are to be avoided for at least four or five days post-operatively. Constant decompression of the bowel and transfusion of blood can be used if indicated(18).

Appropriate antibiotics and sulfonamide therapy should be used just as in the post-operative care of the non-pregnant appendectomy patient.

SUMMARY

An attempt has been made , in writing this article, to focus attention upon the similarities and differences of appendicitis in the pregnant and in the non-pregnant. The work of Baer, et al., has shown us that, as pregnancy progresses, abdominal relationships change and clinical data has shown that these anatomic changes are reflected in similarly changing clinical signs and symptoms. Not only are the signs and symptoms altered by the progressively enlarging uterus, but also the ability of the organism to combat the disease process is altered so

that, in the latter months of pregnancy, appendiceal disease becomes potentially a very dangerous situation. No longer can we relie, in such an instance, upon Nature's methods of limiting the onslaught of this process. It then falls into the domain of the surgeon to halt the disease.

It has been shown, in spite of varied reports, that the incidence of appendicitis in the pregnant woman is probably no higher than that in the non-pregnant, and that pregnancy does not predispose to appendicitis, even though it renders it more dangerous when present. Appendicitis has its highest incidence during the childbearing years and it behooves every physician who deals with obstetrical problems to remember this fact, and, if there is ever a suspicion that appendiceal disease may be present, operate for the disease, for the surgical mortality to both mother and infant is many times lower than that caused by appendiceal abscess and diffuse, suppurative peritonitis. One cannot "wait a little while", for as John B. Murphy has said, no physician can possibly know how long he dare wait. An actively diseased appendix and a pregnant uterus have no place in the same abdomen, and in this day and age, with our knowledge of abdominal procedures, anesthetic

agents, fluid and electrolyte balance, etc., it is inexcusable not to operate---to allow a patient to die of peritonitis---when she has been seen in plenty of time for surgery to have been performed.

CONCLUSIONS

1. As pregnancy progresses, the appendix is pushed more cephalad and laterally, the point of greatest tenderness moving with it if the organ is diseased.
2. The omentum and intestines are pushed out of the pelvis, the pelvis becomes more congested and the ability to resist infections and toxemic processes is lessened in the pregnant abdomen.
3. The incidence of appendicitis in the pregnant is probably no greater than in the non-pregnant.
4. Appendicitis in the pregnant is a much more severe disease than in the non-pregnant.
5. Diagnosis is usually not difficult if one takes into account the stage of gestation and the corresponding anatomic and physiologic changes.
6. It is generally felt that abortion, when it occurs, is caused by the disease process and not by the operation itself.
7. Immediate operation in cases of appendicitis in pregnancy is the safest course of action for the mother,

for the infant---and for the physician.

FINIS

Case 1.

Mrs. I.F., 31 year-old patient of Dr. Leon S. McGoogan, entered Immanuel Deaconess Hospital on 8-10-51 at 5:36 P.M. with complaints of (1) inability to stand erect, (2) pain around umbilicus and (3) feeling that she had to defecate. The patient was 37 weeks pregnant. She had arisen early on the day of admission and thought she had to move her bowels, but attempts to do so were without results. She returned to bed and awoke with the same feeling and also with pain around the umbilicus. This continued throughout the day without changing in intensity. She thought that her abdomen had been rigid most of the day. Pain prevented her from standing erect. Flexing of the right thigh on the abdomen provided some relief from the pain.

PHYSICAL EXAMINATION: The patient was a well-developed, well-nourished, white female who was seen by the intern two days following the surgery. There is no record of physical findings prior to surgery.

LABORATORY: 8011051 (1st post-operative day) Hgb. 12.9, RBC 4.93 million, WBC 16,200 Differential: Neut. 92, Lymph. 8. Urinalysis: pH 7.5, Sp. Gr. 1.025, Sug. 0, Alb. 0, Acetone 3 +, RBC 10-15/hpf, WBC 1-2/hpf, Casts 0, Crystals 0.

OPERATIVE: The patient was taken to surgery on 8-10-51, the day of admission, where the abdomen was opened per low right rectus incision. The tip of the appendix was markedly bulbous, red and edematous. An amputation of the appendix was performed in the usual manner andthe incision was closed. The patient left the operating room in excellent condition.

MICROSCOPIC DIAGNOSIS: Argentaffinoma (carcinoid) of the appendix, with acute inflammation.

POST-OPERATIVE COURSE: The patient became distended but passed flatus per rectum on the fourth post-operative day. She had slight cramps, presumably labor cramps, starting on 8-11-51 andagain on 8-16-51 but there was no cervical dilation. The patient was dismissed on 8-19-51, undelivered.

Case 2.

Mrs. C.M., a 25 year-old para ii gravidaiii patient of Dr. James R. Kovarik, was admitted to IDH on 7-31-53 at 3:00 A.M. with complaints of RLQ pain. Until the previous afternoon, the patient had felt well but at that time became nauseated. There was no vomiting. At about 8:30 P.M. she began having pain in the midepigastrium. She slept until 10:30 P.M. and awoke with sharp generalized abdominal pain which was most intense in the RLQ. She was tender to touch in this area. The pain increased in intensity until 2:30 A.M. at which time she notified her physician and was advised to enter the hospital. The patient's last menstrual period was May 29, 1953. Previous periods were regular, every 30 days and lasted 7 days, with heavy flow. She had had no dysmenorrhea. She had had difficulties with previous pregnancies. Her labors had been short. She was taking thyroid medication at the time of this admission.

Past history, family history, and history by systems were non-contributory.

Physical examination was negative except for tenderness to direct pressure and rebound tenderness in the RLQ.

A diagnosis of acute appendicitis with the possibility of missed abortion or salpingitis on the right side was made.

LABORATORY: Hgb. 11.5 Gm., RBC 4.13 millions, WBC 14, 900, Differential: Neut. 86%, lymph. 14. Urinalysis: Sp. gr. 1.028, Alb.-slight trace, Acetone positive, Wbc-few.

The patient was taken to surgery. The appendix was approached per right rectus incision. The cecum was located with relatively little difficulty and the appendix was found to be on the posterior lateral side beneath a veil of peritoneum, doubled upon itself and approximately 3 cm. in width(?). The appendix was removed in the usual manner. Exploration of the pelvis revealed no further pathosis. The abdomen was closed and the patient left the operating room in good condition.

Microscopic diagnosis was acute catarrhal and chronic appendicitis.

The temperature rose to 100°F. by 8:00 P.M. on the day of operation but returned to normal by the early hours of the following day. The patient had an uneventful recovery and was dismissed from the hospital on the fourth post-operative day.

Case 3.

Mrs. C.C., a 27 year-old patient of Dr. Leon S. McGoogan, entered IDH on 8-27-51 with compaints of generalized abdominal pain, more severe in the right lowere quadrant. The patient was six months pregnant. She had been well until 5:00 A.M. on the day of admission at which time the pain developed. The temperature at 3@30 P.M. had been 99°/. The pain was so severe that the patient could not get out of bed. The pain was intermittent in character. There was no nausea or vomiting. She had one normal bowel movement that morning.

Past History, Family History, and History by Systems were non-contributory.

At time of admission the patient did not seem to be in any acute distress. There was tenderness to moderate pressure in the right iliac fossa. Pulse 100/minute.

LABORATORY: 8-27 WBC 12,800, Diff: Neut 90, Ly 9, Mono 1, Urinalysis: pH 6, Sug 0, Alb 0, Acetone trace, RBC 0, WBC 2-3/hpf, Casts 0, Cry 0, Bact 0. On the day following surgery, Hgb 11.5, RBC 3.39 million, WBC 9,100, Diff: Neut 97, Ly 3.

At 12:15 A.M. on 8-29, the patient was taken to surgery where the appendix was removed through a McBurney incision placed higher than the usual site. The appendiceal seresa was injected. A routine amputation of the organ was done and the abdomen closed. The patient left the operating room in good condition.

Microscopic diagnosis was "recurrent appendicitis".

Convalescence was uneventful and the patient was dismissed, undelivered, on 9-3-51.

Case 4.

Mrs. A.P., a 23 year-old white female, 4 months pregnant, a patient of Dr. Leon S. McGoogan, entered IDH on 6@9-48 with complaints of right lowere quadrant pain which started eight hours prior to admission. The pain had been mild in character except for one or two severe pains which had doubled her over. There were no other gastro-intestinal symptoms..She had had 3 or 4 previous attacks, similar, but more mild in nature.

Physical exam revealed nothing except slight tenderness over McBurney's area.

LABORATORY: Urinalysis 6-9: pH 6, sp. gr. 1.015, otherwise negative. Blood 6@9: Hgb 11.5, RBC 3.44 million, Color Index 1.09, WBC 10,200, Diff: Neut 60, Staff 8, Ly 3, Eos 8, Bas 1.

The patient was operated on 6-9. The appendix was removed in the usual manner. There were old adhesions around the organ which in its midportion bound it to the cecum. Microscopic diagnosis: Oxyuriasis, appendix. Convalescence uneventful. Dismissed 6013-48.

TABLE I

Author	Source of Cases	No. of cases during pregnancy	No. of cases during labor
Schmid	Collected from lit. for 20 years prior to 1911 plus 28 of own cases	486	0
Heineck	All cases in English, French and German literature, 1916-1926	405	2
Jerlov	Scandinavian hospitals from 1900-1920 (inc. in Heineck series)	---	0
D'Errico	Various Boston Hospitals	65	0
Maes	Charity Hospital, New Orleans	50	0
McDonald	Western Surgical Ass'n	33	0
Baer, Reis and Arens	Michael Reese Hospital, Chicago	28	0
Wilson	Obst. and surg. services, Methodist Episcopal Hosp., Brooklyn, N.Y.	10	0
Royston & Fisher	Personal series	10	0
Findley	Personal series	9	0
Portes & Seguy	Personal series	7	0
Puppel	Personal series	6	1
Barber & Miller	Personal case	-	1
Gratton	Personal case	-	1
King	Personal case	-	1
Krauss	Personal case	-	1
Le Jemtel	Personal case	-	1
Marbury	Personal case	1	-
Rose	Personal case	-	1
	Totals	1110	9

Taken from Norton and Connell(38)

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