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Appendicitis complicating pregnancy

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Appendicitis Complicating Pregnancy

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Introduction

Pregnancy may be complicated by the various disease conditions found in women of the childbearing age. These conditions may result from the pregnancy itself, or be an accidental complication. The latter may have existed before the inception of the pregnancy or may have been acquired during its course.

It is permissible to say that diseases which subject the organism to a considerable strain are found to be more serious when occurring in the pregnant woman, and it follows that appendicitis, in itself a serious condition, is of serious import to both the maternal and fetal organism when found as a complication of Pregnancy. (42). The pregnant woman is subject, in addition to the usual complications and sequelae of appendicitis, to further risks produced by the growing uterus. (3).

In general, it may be said that pregnancy exerts a deleterious influence upon all chronic organic maladies, while its effect is usually less marked in acute infectious processes. (62). The latter, however, frequently leads to premature delivery and the additional physical strain attending the latter may render the course of the disease much less favorable.

Incidence

Since appendicitis is preeminently a disease of the childbearing years, and since gestation confers no immunity to it, it is not surprising that the pregnant woman should exhibit it with more or less frequency. (61).

Appendicitis is not uncommon in pregnancy. (6). McLean says that it is the most prevalent surgical disease receiving the attention of surgeons. (42). It is thought by Fairbairn to be the commonest of all the abdominal emergencies which complicate pregnancy. (16). Babler thinks that appendicitis is found as a complication of pregnancy with greater frequency than the tabulated cases would indicate. (2). It probably occurs as frequently during pregnancy as at other times but until recently it was usually overlooked. (62). Maes is undoubtedly correct in his statement that the association of the two conditions is usually purely accidental. (10).

D. Errico states that appendicitis is a comparatively uncommon complication of pregnancy, estimating its frequency to be one in seven hundred and sixty-six pregnancies. (12). Tedenant found that it was still less frequent in the Baudlocque clinic. He reported one case in eleven thousand four-hundred and

seventy-nine deliveries. (60). Lobenstine reported five cases in thirty thousand deliveries at the New York Lying-In Hospital. (37). Schmid, in his monograph, stated that it occurs in one per cent of all pregnancies. (56). Mussey and Crane report a two per cent incidence from the Mayo Clinic. (45). The twenty-eight instances of appendicitis reported in the report of Baer all occurred among 16,543 deliveries at Michael Reese Hospital. This incidence is one in five hundred and ninety-one, or 0.17 per cent. (3). The exact incidence is not a matter of moment; in the reported cases it varies from a fraction of one per cent, as in the report of Baer (3) from the Michael Reese Hospital, to 2.5 per cent, as in the series reported by von Eiselsberg (65), by Schmid (56) and by Paddock (48). The important consideration is that the disease can occur as a complication of pregnancy rather than how often. (38).

The frequency with which pregnancy complicates appendicitis has also been previously estimated in the literature. Sonneberg (59) reports two thousands appendectomies with four pregnancies, an incidence of 0.2 per cent; Baldwin (4) found six Pregnancies in eighteen hundred appendectomies, and incidence of 0.33 per cent. Vineberg (4) gives 1.2 per cent as the

incidence; Mussey and Crane, a two per cent incidence; Von Eiselsberg and Schmid (56) both found a 2.5 per cent. Baer's series of twenty-eight pregnancies occurred among seventeen hundred appendectomies performed at Michael Reese Hospital, an incidence of 1.6 per cent. (3). H. H. Schmid of Vienna (56) says that two and one-half per cent of all women having appendicitis are pregnant.

It would seem, from a study of these figures, that pregnancy cannot be considered a predisposing factor in the production of appendicitis. The marked displacement of the normal appendix during pregnancy apparently does not result in any additional tendency toward appendical inflammation or infection when such a pathologic condition is not preexistent. (3).

Primary acute appendicitis does not occur more frequently in the pregnant than in the non pregnant woman. (53). Attacks of primary acute inflammation are occasionally seen occurring in all periods of the childbearing age, being possible in any gestation, be it first or last, in single or twin pregnancies, and even with extrauterine gestation. (53). Rose (44) says that in practically all of the cases seen, a history is obtainable of previous attacks of appendicitis with

a resulting exacerbation if pregnancy supervenes. Findley, in 1912, reported fifteen cases of appendicitis complicating pregnancy in which fourteen had suffered from previous attacks. DeLee (14) says that primary appendicitis is rare, but recurrent disease is more common during gestation. Maes (38) believes that it is beyond question that the woman who has once had a ppendicitis of the so called chronic or recurrent type is very likely to develop it again during her pregnancy, often with much graver results. In his series over half gave stories of previous attacks. Findley (19) states that from fifty to sixty per cent of women who have had appendicitis prior to gestation will suffer more or less disturbance referable to the appendix during pregnancy. Felkner says that only one out of thirty-eight hundred known cases of appendicitis escaped a return of the trouble during pregnancy.

Maes (38), reporting fifty cases from the Charity Hospital in New Orleans, says that the majority of cases of appendicitis in pregnancy occur in the second trimester, within which period the appendix becomes an abdominal organ. He thinks parity plays no special part, the disease becoming increasingly infrequent and perilous as pregnancy advances; Royston (54) and

Fisher, presenting a series of ten cases, show none of the acute type later than the sixth month; Landry (35) says it is much more frequent in the third and fourth months and further adds that during the last two months the problem is a gigantic one.

Heineck (28) made an analytical study of all operated cases of appendicitis associated with gestation reported in English, French and German literature from 1916 to 1926. His statistics include those cases presented by Jerlov, in 1925, who has had an extensive experience and has written a very comprehensive monograph dealing with appendicitis and the puerperium gathered from Scandinavian sources from 1900 to 1920. From this vast amount of material Heineck (28) states that though complication is most frequently in the second, third and fourth months, it is rare in the last few weeks. Marbury says that eighty per cent are in the first six months.

(12), reporting sixty-five cases from various Boston Hospitals, shows four cases occurring during the last month. Wilson, presenting ten cases from the obstetrical and surgical services of the Methodist Episcopal Hospital in Brooklyn, had three cases in the last trimester. (63).

DeLee (13), reporting two cases which bring to four his total of cases observed in thirty years, says, "In the last few weeks of gestation and during labor it is very rare."

Schmid (56), whose series is one of the largest report in the literature, reports the majority of his four hundred and eighty-six cases as occurring between the third and sixth months of pregnancy and mentions only twenty-one cases occurring at the end of pregnancy.

LeJemel (36) finds appendicitis to be a complication found mostly in the first half of pregnancy.

Cook and Robin (8), reporting a case of acute appendicitis complicating pregnancy in a patient with a previous caesarian section, state that a survey of the literature reveals no such case having been reported before. They add that acute appendicitis complicating pregnancy in the third trimester is a comparatively infrequent occurrence.

Findley (18), reporting five cases of unusual severity occurring in the puerperium, says in the majority of cases the attacks recurred in the early months of pregnancy. About eighty per cent of the cases occur in the first six months of pregnancy, the disease being comparatively rare in the last trimester.(11).

Rose (53) indicates that this complication occurs most frequently between the third and sixth months, less frequently in the first three, and only rarely in the last trimester.

Baer (3) reports, from the Michael Reese Hospital in Chicago, twenty-eight cases of appendicitis occurring as a complication of pregnancy; fourteen patients of this group were operated during the second trimester of pregnancy, eight during the first trimester and six during the third trimester. They indicate a casual relationship between the first evidence of upward displacement of the appendix by the gravid uterus which is found after the third month and the increased incidence of appendicitis occurring during the second trimester. In this series fourteen, or fifty per cent, reported attacks antedating the pregnancy and ten additional patients, thirty-six per cent, reported repeated attacks during pregnancy. A total of eighty-six per cent, therefore, reported previous attacks either before or during pregnancy. This is in accord with the conclusions reached by Dworzak (15), Herman (29), DeLee (14), Royston (54) and Findley (19). Of all the writers on this subject only Schmid (56) concludes that the presence of pregnancy plays no role

in the course of appendicitis.

Table #1 shows a total of one thousand, one hundred and ten cases of appendicitis complicating pregnancy with only nine cases occurring in labor. The incidence is very difficult to estimate accurately from these series because one has no way of determining from how many cases of pregnancy these cases were drawn.

Table #1.

Author	Source of Cases	No. of cases during preg.	No. of cases during labor
Schmid	Collected from Lit. for 20 years prior to 1911, plus 28 cases of his own.	486	0
Heineck	All cases in English, French and German Lit., 1916-1926.	405	2
Jerlou.	Scandinavian Hosp., 1900-1920.	Inc. in 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 Hosp., Chicago	28	0
Wilson	Ob. & Surg. Methodist Hosp., Brooklyn.	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 Series	-	1
Grattan	Personal Series	.	1
King	Personal Series		1
Krauss	Personal Series		1
LeJemtel	Personal Series		1
Marbury	Personal Series	1	
Rose	Personal Series		1

From this table it is quite evident that there is no lack of statistical reports relating to appendicitis as a complication of pregnancy and further, that the complication is not unusual. But one must be impressed by these figures which indicate a total of one thousand, one hundred and ten cases of appendicitis during pregnancy and only nine during labor.

The largest series are those by Schmid (56), Heinreck (28) and Jerlov (32). In presenting his group Schmid, from a very detailed study of 486 cases, shows none as complicating labor. Heinreck indicates two cases during labor, and, while he discusses appendicitis as it occurs within several days of term, he does not go into any great detail concerning appendicitis as a complication of labor. Jerlov (32), in his report, does not indicate any of his cases occurring in labor.

Throughout the entire literature on this subject repeated reference is made to the statement by DeLee (14) that in thirty years, he has seen but four cases of appendicitis late in pregnancy.

The incidence of appendicitis with peritonitis complicating labor in Baer's series is as one in twenty thousand.

Appendicitis may occur at any time in the child-bearing age, but is more common in the young and only slightly more frequent in the primipara.(17). In practically all the reported series the highest incidence is between the ages of twenty and thirty.

Maes (38) reports that in his series the age limits were sixteen and forty-three years; forty of the fifty patients were under thirty years of age and fifteen were between sixteen and twenty years.

Etiology

It is not uncommon for pregnant women to complain of pain in the region of the appendix and this is possibly associated with the rising uterus drawing on complicating peritoneal adhesions. DeLee (14) supports this viewpoint by reporting that women who have had appendix operations almost always complain of dragging pains, especially from the fifth to the eighth months. This is the time during pregnancy when recurrences are most common, and so it seems that during this time there is more disturbance and anatomical alteration taking place.

Most of the authorities agree that pregnancy does not predispose to the development of an appendicitis but most all of them also agree that it is particularly likely to recur if there has been a history of previous attacks.

Wilson (63), reporting ten cases, says that in the six acute cases, only one of the attacks was primary. In all others a history of a pathological appendix was obtained.

Maes (38) agrees that pregnancy, which introduces altered abdominal relations and altered constitutional states, has an exciting effect upon latent appendicitis.

In all but one of the fifteen cases reported by Findley (18) there had been previous attacks of appendicitis. He says, "These experiences lead me to the conclusion that pregnancy probably has no influence in creating a primary attack of appendicitis but has a very great influence in creating renewed attacks."

Marbury (40) and Gare (24) also add their opinions that primary appendicitis occurs probably no more frequently in pregnant women than in non-pregnant ones, and that pregnancy is likely to cause an exacerbation of a previously pathological appendix.

D'Errico (12) alone believes that pregnancy does not tend to cause a recurrence of an old appendix.

In his textbook on Obstetrics, Williams (62) writes, "Pregnancy does not predispose to its occurrence, but in cases of chronic disease, in which the appendix has become adherent to the appendix or uterus, exacerbation may result from the traction exerted by the enlarging organ."

The reason for the recurrence of attacks of appendicitis during pregnancy is not explained in most of the reports in the literature. Landry (35) thinks, since gestation occupies a period of nine months, it is quite conceivable that an attack might occur as often

as once every six to nine months in anyone having chronic disorder in the appendix. He thinks that on the other hand there seems to be a definite relationship in many cases. For example, it is easy to visualize an adherent appendix being influenced by an enlarging uterus, the caecum being pushed up and consequently weakening of the structure or interference of circulation of such an appendix.

Probably constipation, so common to the pregnant woman, has something to do with recurrence.

Constipation is given as an etiological factor in the non-pregnant; doubly so, then, would it be accepted as one of the causes in the pregnant woman.

Maes (38) says constipation, which is usual during pregnancy and the engorgement of the pelvic and hemorrhoidal veins, which is physiologic, also play their part.

The appendix rotates counter clockwise as the uterus displaces the viscera upward. At about mid-term it is pointed medially, and by the eighth month occupies a vertical position. This fact, Sellers (58) thinks, is calculated to interfere with the normal blood supply, and hence, enter into the field as at least a contributing factor.

The radiologic studies of Baer (3), Reis and Arens, upon seventy-eight patients, show definitely that it undergoes a progressive displacement upward. At the end of the second month of pregnancy the base of the appendix is two fingerbreadths above the ileopectineal line, which corresponds to McBurney's point. After the third month the appendix is higher, being two fingerbreadths below the iliac crest. After the fourth month the appendix is still higher, averaging one finger breadth below the crest. The majority are found at the level of the crest after five months, and thirty-three and one-third per cent are above the crest. After the sixth month the average is one-half fingerbreadth above the crest and sixty-six and two-thirds per cent have been displaced upward above the crest level. One month later eighty-eight per cent have passed the crest level, the average being one and one-half fingerbreadths above the crest. The average is two fingerbreadths above the crest after the eighth month, and ninety-three per cent have been displaced upward above the iliac crest. The appendix has dropped again, on the tenth day post partum, to within two fingerbreadths above the iliopectineal line.

A gradual shifting in the position of the base

of the appendix from its normal low lying position in the iliac fossa to one somewhat above the iliac crest occurs near term; eighty-eight per cent are found above the crest after the seventh month of pregnancy. In addition, the long axis of the appendix changes from the normal downward and inward direction first to the horizontal, at which time it points medially, and finally to the vertical, often curving around the uterus fundus. The gradual outward and upward displacement of the appendix is well above the crest level and therefore far above McBurney's point.

It is obvious from these findings that anatomic and physiologic rest are alike impossible. Kelly (33) points out that the situation is even more aggravated if, as the result of previous inflammatory attacks, the appendix has become adherent to some one of the pelvic structures.

Fink (29) found no upward displacement of the appendix and caecum by flourescopic studies. Pankow (49) reported only slight upward displacement of the appendix. The appendix was below the iliac crest in thirty-two of the thirty-seven patients examined roentgenologically by Hoffman (31) and he concluded that upward displacement is rarely marked.

Füth und Abladen, on the other hand, agree with Baer's findings in that the appendix was found above the iliac crest in nineteen of the twenty patients examined after the seventh month of pregnancy. These results were also confirmed by Schumacher (57), who reported upward displacement increasing as pregnancy progressed. The appendix was found lying above the iliac crest in half the patients when examined in the prone position, and was always below the iliac crest in the upright position.

Position and Axis of the Appendix Throughout Pregnancy

Month of Preg.	Average Level	Highest Level	Lowest Level	Per cent above crest	Per cent Horiz.	Per cent Vert.	Comb. change in Axis
2	fingers 3 below crest	3 above I.P.L.	fingers 2 below I.P.L.	0	2	2	4
3	2 below crest	1 below crest	1 above I.P.L.	0	5	4	9
4	1 below crest	at crest	1 above I.P.L.	0	11	4	15
5	at crest	1 above crest	2 above I.P.L.	33	13	6	19
6.	$\frac{1}{2}$ above crest	3 above crest	2 below crest	66	20	10	30
7.	$1\frac{1}{2}$ above crest	4 above crest	1 below crest	88	20	40	60
8.	2 above crest	4 above crest	1 below crest	93	20	60	60

The rapid decrease in the size of the uterus following delivery may readily bring about rupture of the abscess wall when the process has eventuated in abscess formation before delivery.

The uterus, adnexa and uterine contents may readily become infected during pregnancy from an appendiceal abscess. Anatomical relations between the appendix and ovaries and tubes may have some bearing. (48). Myers (46) lays stress upon the ligament of clado as a means to carry this infection. He claims that the ligament serves as a direct lymphatic communication between the right ovary and the appendix.

Kelly (33) says that in all his experiments in injecting the lymphatics of the appendix from the periphery to the center, it was demonstrated that the lymph channels of the appendix pass inside of the mesoappendix toward the ileocolic group of glands, or through the caecum in the same direction, ultimately reaching the same group. Not a single lymph channel was seen to pass in or toward the ovary.

Paddock (48) thinks that there is probably no direct or special communication between the appendix and the pelvic structures, and if such a communication does exist, it is purely accidental and due to contiguity of the organs, which bring about the disease.

The organisms encountered in the infection are the same as those which occur in appendicitis at any other time, such as streptococcus, staphylococcus, colon bacillus and sometimes the welch bacillus. (53).

Fullerton (22) believes that the streptococci is usually the primary bacterial agent and that the colon bacillus is a secondary invader. Tonsils, teeth and sinuses in the chronic form may supply the streptococci which are carried in the blood stream to the appendix and if this organ is susceptible through physical defect, anatomical displacement, deficient blood supply, all contributing to a lowered resistance, a local inflammatory reaction is apt to occur.

Pathology

The appendix presents variations in size, length, mobility and location as are found in the non-gravid uterus. Also different pathological types are found as in the non-gravid state. (53).

The pathology is probably not inherently more serious than the pathology of appendicitis at other times, however, because it is so often enhanced and aggravated by delay, it seems to be more serious, especially in the later months.

DeLee (14) states that gangrenous and ruptured appendix occur more rapidly during pregnancy, and both Findley and Wilson (63) agree with him. The gangrenous and ruptured types, in comparative series studied by Baer (3) were respectively five and one-half and three and one-half times as frequent in the pregnant as in the non-pregnant state. McDonald (41), Jerlov (32) and Quain (57) reached the same conclusion.

Type of Pathologic Involvement	Pathologic Involvement		
	No.	Per cent	Per cent at the Michael Reese Hosp., Series of 3468 consecutive appendectomies
Acute Catarrhal	5	18	18
Acute Suppurative	5	18	14
Gangrenous	3	11	2
Ruptured	2	7	2
Subacute	2	7	19
Chronic	11	39	45

It is difficult to conceive of the passive congestion in the pelvic veins as a responsible agent in circulatory disturbances of the mesenteric veins and lymphatics. The correct explanation of this apparent marked increase in the more severe types of appendicitis occurring during pregnancy lies in the tendency of the patient and physician to regard abdominal pain, with or without nausea and vomiting, as inherent to the pregnancy. This results in delayed diagnosis and, therefore, delayed surgical intervention.

The appendix may be found adherent to the uterus, to the anterior or posterior abdominal wall, to the ascending colon, to the right tube and ovary, or it may be found buried in the undersurface of the liver. In diffuse peritonitis the death of the fetus in the uterus may be found caused probably by transplacental diffusions of bacteria. (63).

It should be remembered that in many patients the appendix is often in close proximity to the right adnexa and therefore, easily involved if pelvic pathology exists. The appendeculo-ovarian ligament contains lymphatic draining from the right adnexa and also in many cases, a small branch of the ovarian artery (appendiculo-ovarian). A decided reaction in the appendix has been observed, and recently certain

writers have reported the presence of endometrial implants. One can thus readily see that it can be damaged by pelvic pathology or itself involve the pelvic organs. (53).

DeLee (14) is convinced that tubal infections cause appendicitis. He sites that the frequency of appendicitis in newly married women is striking, and that the gonococcus was found by J. H. Hess in the pus from an appendix.

Diagnosis

DeLee (14) says that the diagnosis of appendicitis should present no special difficulties if only the possibility of its occurrence be kept in mind. The symptoms are the same as in non-pregnant individuals but frequently the condition is overlooked or not even suspected until peritonitis has set in. (26). The pregnancy, itself, is often blamed for the pain, while distention of the abdominal walls by the enlarging uterus makes difficult the appreciation of the rigidity and muscle spasm, which are usually valuable diagnostic aids. (62).

When a pregnant woman complains of pain in the right side of the abdomen, associated with an elevation of temperature and pulse, the possibility of appendicitis should always be considered provided some more satisfactory explanation for the condition cannot be found. (62).

Rose (53) says that in typical cases, the first symptom is a vague abdominal pain felt in the region of the umbilicus and later radiating to the right iliac fossa. The pain is felt and tenderness elicited wherever the appendix is situated, whether towards the

median line or in the pelvic, retroceally, towards the lateral gutter, or lying towards the gallbladder. Nausea and vomiting ensue. At first there may be no temperature or pulse elevation. There is usually an increase of symptoms later.

Zweifel (66) claims that the pain is more often referred to the region of the liver and perhaps to the left side than to the region of the appendix in early pregnancy and the puerperium.

A false sense of security is often felt when there is a lack of muscular rigidity, a slight degree of temperature or a low count. Culpepper points out that this is exceedingly dangerous and must be guarded against. (15).

In all twenty-eight patients reported by Baer (3) there were complaints of right sided abdominal pain. Seventeen complained of nausea, sixteen of vomiting and two of severe "Indigestion".

Early in pregnancy the pain is low, and, as the pregnancy progresses and the appendiceal displacement becomes more pronounced, the pain is located higher than in the non-pregnant patient, and the point of tenderness also follows the upward displacement of the appendix. (6).

Maes (38) remarks that prompt diagnosis is not as simple as it sounds. Even in the non-pregnant individual appendicitis is very frequently an atypical disease. In two hundred and thirty-nine fatal cases of acute appendicitis studied by C. Jefferson Miller (43), less than half of the patients exhibited the so called cardinal triad of symptoms--pain, nausea and vomiting, and localized tenderness.

The history of previous attacks is perhaps the most valuable single point in making a diagnosis and, where this is lacking, the clinical signs and symptoms must be analyzed with more than unusual care. In the majority of cases seen a definite past history of repeated attacks is obtainable. (53).

Acute appendicitis developing at, or very near, the end of pregnancy or with the onset or in the course of labor is rare, and the difficulties of diagnosis may be great. (7).

The laboratory is not very helpful. Leukosytosis is physiologic during pregnancy. Maes (38) found that the sedimentation test was of little help in his series of cases.

As pregnancy advances it introduces still further complications.

Abdominal discomforts that amount to actual pain are often caused by movements of the child after quickening. Maes (38) points out that one of the patients in his series of fifty cases complained that her pain was aggravated by fetal movements. Marbury (39) and Jerlov (32) also reported this symptom. It was, however, not mentioned by Baer (3).

Bimanual examination is seldom satisfactory except early in pregnancy, for in the late months the adnexa are out of reach of the examining fingers. (38). Frankels (21) suggestion that the patient be examined while lying on her left side, in which position the heavy uterus is at least partially removed from the field of investigation, is a very practical one, though, as Marbury points out, the attenuation and thinning of the abdominal muscles which are constant in late pregnancy tend to minimize muscle spasm.

In arriving at a diagnosis of acute appendicitis during pregnancy the following are some of the conditions to be considered and ruled out:

1. Right sided ectopic pregnancy.
2. Ovarian cyst with twisted pedicle.
3. Pyosalpenx.
4. Eclampsia.

5. Pyelitis on the right side.

Ectopic pregnancy, whether aborted, ruptured or in progress, abdominal or intraligamentary, ovarian, tubal or tuboovarian, must be removed immediately. The age of pregnancy or the mother's general condition can make no difference, for this is a life saving indication. The life of the fetus is to be disregarded in an ectopic pregnancy. Appendicitis also calls for immediate surgical intervention, irrespective of the type, so differential diagnosis between these two conditions is not necessary. Immediate exploring is necessary in both conditions. (28).

The pain is usually lower in the case of an ovarian cyst with a twisted pedicle than that found in appendicitis. It is of a more continuous character and followed early by a mass that increases in size quite rapidly. (58). Careful bimanual examination is suggested by Baer (3) to be the best method of diagnosing this condition. As in Ectopic pregnancy, and acute appendicitis, early operation is indicated. Maes (62) suggests that the confusion with these conditions is not of great moment and that it may be rather fortunate, since early operation is indicated in all these conditions and the mistake in diagnosis may save a life.

Sellers (58) says pyosalpinx should not be confusing in that a negative history plus negative findings at the usual examination in early pregnancy would eliminate this complication.

The confusion with eclampsia, which is sometimes ushered in by epigastric pain, nausea and vomiting, is seldom lasting, according to Maes (38), for the proper investigations promptly clear the field.

Pyelitis is the most important disease to be differentiated from acute appendicitis. It is reported by Maes (38) to be found six times more frequent on the right side than on the left. This is due to purely anatomic reasons, because the uterus rotates to the right and so may compress the ureter where it crosses the pelvic brim. Repeated urinalyses usually differentiate these conditions. It is dangerous to rely entirely on urinary findings, however. McDonald (41) points out that pyuria or bacilluria do not necessarily clinch the diagnosis of the pyelitis. He reports that in the literature several of the worst cases had been treated for some time as pyelitis and the true condition was recognized only after diffuse peritonitis was present.

Laboratory tests, including cystoscopy, in con-

junction with other findings in their correct sequence, usually settle the diagnosis. Polack (50) points out that the difference in the sequence of events in appendicitis and pyelitis is important in differentiating them. In appendicitis the findings are: first pain, later fever and rarely chills. In pyelitis chills come first, then fever and pain.

Since most of these conditions are treated surgically, Maes (38) suggests that the safest rule is to eliminate non surgical complications and then to operate, even without a definite diagnosis. He points out that Deaver's Aphorism is applicable, that a hair splitting diagnosis seldom gets a patient anywhere except to the grave. Most of the writers agree with Maes in that an operation on the mistaken diagnosis of appendicitis is far better than abstinence from operation on the mistaken diagnosis of pyelitis.

Management

The diseases which occur concomitantly with pregnancy should, in general, be thought of and managed just as though the pregnancy did not exist. (10). All writers agree that acute appendicitis is an operative indication, so in the presence of acute symptoms suggesting appendicitis, the complication of pregnancy should be disregarded and early operative interference is even more urgent, if it is possible, than in the ordinary case. (53).

Maes (38) says that appendicitis in its acute manifestations is exceedingly serious, and that there is even less justification for temporizing with it here than in the non-pregnant state. He says the patient with appendicitis is a surgical problem first and an obstetrical problem second.

In his textbook on obstetrics, Greenhill (26) agrees that the appendix should be removed as quickly as possible and nothing else done except perhaps drain if pus is present in the peritoneal cavity. He adds that the incision must be made higher than usual.

Williams (62), in his textbook on obstetrics, points out that in all cases in the early months, operation

is indicated, since abortion is not likely to occur unless the uterus is subjected to much manipulation. In the early months of pregnancy, operation is seldom difficult or complicated, but the difficulties increase the nearer term approaches.

McDonald (41) believes, as most of the writers do, that in early uncomplicated cases promptly treated, the danger of abortion or labor is slight and requires no special consideration.

Ficklin (17) utters a word of caution against the furor operandi in apparently mild cases, where there is only mild pain and nausea, low leukocyte count, and especially where symptoms begin to abate within three or four hours of the onset.

It is evident that there is complete agreement as to the wisdom of noninterference with pregnancy in the presence of early acute appendicitis and its sequelae. But where the appendicitis complicates the last two months of gestation and, especially where labor is eminent or actually in progress, there is sharp divergence of practice.

The authors of recent obstetrics texts are quite unanimously of the opinion that there should be no interference with the uterus during operation for

acute appendicitis.

DeLee (14) suggests that the rule, "get in and get out quickly", should be observed, and the uterus be manipulated as little as possible. Should abortion occur, however, it should be allowed to run as natural a course as possible, the tampon and prolonged expectancy being employed. Instrumental curettage is employed should the uterus not empty itself. This is to keep from breaking any protective adhesions present around the area, which condition might result with manual curettage.

DeLee (14) however, implies the occasional advisability of Porro section, in relation to appendicitis in late pregnancy in the interests of the two individuals where suppurative peritonitis threatens. He suggests that cesarean section is contraindicated, and believes, in cases where the uterus is opened in the presence of pelvic infection, as from ruptured appendix, it is best to amputate the bulky organ and drain the whole pelvis freely from below.

Beck (6) agrees that it is imperative to remove an acute appendix before rupture, a laparotomy being indicated whenever the diagnosis is in doubt. He adds, "Following operation, the patient should be thoroughly

morphinized for several days to prevent abortion or premature labor." If the appendix has ruptured, he says that a successful outcome depends upon drainage and prevention of interruption of pregnancy. "Handling of the uterus is to be avoided as much as possible during the operation."

"Performance of cesarean section at the same time as operating for appendicitis will generally increase gravity of the situation." (Williams 62).

In the literature conservatism is not found to be unaminously endorsed with reference to those cases occurring late in pregnancy, or in labor. Norton and Connell (47) feel that when peritonitis complicates labor, the condition should be managed surgically as it is at any other time, and the labor allowed to continue with delivery through the birth canal, in the absence of an indication requiring a different obstetrical procedure.

Maes (38) stresses the importance of prompt surgical intervention, saying that association of the appendicitis with pregnancy cannot alter the situation in any degree. He insists, however, that the gravid uterus be handled as little as possible, and emphatically denounces, as pernicious and unwarranted, any operative

interference with the pregnancy at the same time. If frank pus is present, and if the appendix is not readily accessible, drainage alone should be done.

McDonald (41) says that an acute abdomen with probable peritonitis is an unfavorable field for hysterotomy. Radical termination of pregnancy will not at all relieve the load of sepsis and impending labor. He believes hysterotomy a desperate procedure for a condition already nearly hopeless. His contraindications for abdominal section are:

1. There is great danger of directly infecting the uterus.
2. The uterus may not heal well and may rupture in subsequent pregnancies.
3. It is obstetrically objectionable in young women with no permanent distocia.

Heinreck (28) takes a somewhat modified stand, representative of the attitude of many writers, in that it might be necessary to resort to vaginal or abdominal cesarean section where coexistence of obstetrical complications, such as definite pelvic contractures or placenta previa requires unusual methods.

Some writers are so obsessed with the danger of labor activity on the course and the outcome of con-

current appendicitis, that they do not hesitate to advise termination by various procedures.

King (34) thinks the uterus should be emptied before operation to reduce its size and get away from its bulky interference. He feels that otherwise, premature labor will usually follow operation, breaking down protective adhesions and causing widespread infection.

Marbury (39) says, "...it may be wiser to make a paramedian incision and empty the uterus by cesarean section first, and deal with the appendix secondarily. This permits the operator to determine the degree of soiling after the uterus has contracted, and make a more definite and permanent toilet of the abdomen."

In the presence of peritonitis, Hirst (30) is in favor of doing a hysterectomy.

With reference to appendiceal abscess late in pregnancy, Wilson (63) says that labor follows operation within a few days with disastrous results. He believes that the uterus should be emptied at the time of operation, and a rapid Porro operation be done if marked peritonitis is present. According to him, the two flap, low section or classical section may be used in some cases with excellent results.

Rose (52) says the concensus of opinion is that in the presence of rupture and localized or spreading pus infection late in pregnancy, it is best to remove the appendix and do a porro section.

Cosgrove (10) does not think it tenable that emptying of the uterus can in any way be "in the interest of" the mother. He believes the fear of tearing the appendix or adhesions would appear to overlook the extreme mobility of all the abdominal viscera, and the possibility thereby of mutual accommodation to shifting relationships in spite of extensive inflammatory adhesions.

Babler (2) says that in the case of general peritonitis, abdominal section is indicated.

Even though there is divergence of opinion as to whether the uterus should be emptied, no one quarrels with the fact that the appendix must be dealt with surgically.

During pregnancy the removal of the appendix is more difficult than at other times, for the enlarging uterus is in the way, and, as the uterus grows larger, the head of the caecum is displaced upward. This must be kept in mind when making the incision. (26). The incision is made higher than ordinarily. (14)

Both the right rectus and McBurney incision have their advantage, since most of the abdominal cavity is obscured by the uterus. Also, when drainage is necessary a stab incision must be made. The McBurney incision has none of these disadvantages, but does not give adequate exposure in case the diagnosis is incorrect, and an exploratory is necessary. During the latter part of pregnancy the incision must be higher and more lateral than it usually is. Royston and Fisher (54) recommend opening the abdominal cavity through an incision which does not split or tear the rectus muscle in order to avoid any weakening of the abdominal wall.

Liberal use of morphine for the first few days postoperative helps prevent abortion and premature labor, and allows the acute abdomen to protect itself by forming adhesions.

Prophylaxis

It is agreed by all authorities that a married woman, who has a diseased appendix, should have it removed before becoming pregnant.

Wilson (63) says that a pregnant woman with a history of previous trouble in the appendix should have an appendectomy performed at the first appearance of symptomatology. The obstetrician attending the woman through the period of observation should ever be on his guard in expectation of an acute attack.

Tracy (64) suggests that any woman who has had an attack of appendicitis, and has not taken the precaution to have her appendix removed before conception, should have it done as soon as she knows she is pregnant.

During laparotomies the routine removal of the appendix should be done even when it appears normal.(63).

It is suggested by Gore (24) that the mortality can be reduced from thirty per cent to less than two per cent by removal of all diseased appendices before the occurrence of pregnancy.

Prognosis and Increased Hazards

That the seriousness and frequent dire outcome of this combination need no emphasis is agreed to by all.

Landry (35) says that the condition is always potentially lethal and that pregnancy and appendicitis might be thought of as being incompatible.

Tracy (61) insists that an acute attack of appendicitis, followed by a necrosis, as abscess or a spreading peritonitis, is one of the most serious complications which may befall a pregnant woman. He believes that there will be a high maternal mortality no matter what line of treatment is followed, and should the mother survive, the child will be lost in a large percentage of cases.

In his textbook of obstetrics, Williams (62) regards appendicitis as a very serious complication. He sites that many women die if not operated upon, and frequently when they are operated, premature labor follows.

Rose (53) points out that there is a greater morbidity and mortality when appendicitis is complicated by pregnancy than at any other time. The prognosis depends largely upon the rapidity with which diagnosis is made and treatment performed.

Baer (3) agrees with the rest that the fetus is endangered by a marked increase in the frequency of abortion and premature labor. As in the now pregnant, he believes that the prognosis, from a maternal standpoint, is dependent upon the duration of the disease and the time elapsed between the onset and operation.

Greenhill (26) is in accord with the rest in that early attacks afford a better prognosis because the diagnosis can be made more readily. He adds, however, that operation performed for this condition often leads to interruption of pregnancy.

Maes (38) goes further to add that the disease becomes increasingly infrequent and increasingly severe as pregnancy advances.

Every writer on this subject is in accord with Babler (2) in his statement that " the mortality of appendicitis complicating pregnancy is the mortality of delay".

Myers (46) says that prognosis improves with the amount of time which elapses between operation and the abortion or labor so, when operating, every care should be taken not to disturb the pregnant uterus.

Baer (3) believes that when the appendix is lifted out of the pelvic cavity into the general peritoneum by the enlarging uterus, the peritoneal cavity is notor-

iously less able to take care of acute infectious processes, and walling off and localization occur less frequently than if the appendix is in its normal position.

This condition shows a more marked tendency toward general peritonitis.

McDonald (41) is in accord with this. He has formulated a table showing that serious complications are more frequent as pregnancy advances.

	Confined to appendix	With Abscess	General Periton.
Quain, 1000 cases nonpreg.	55%	28.9%	16%
Jerlov, 204 cases preg.	45%	20%	25%
Western surgical group and literature, 70 cases preg.	50%	12%	39%

These figures show a comparative increase in frequency of general peritonitis and decrease of local abscess as complications.

In his textbook "Obstetrical Practice", Beck (6) says that after the appendix has ruptured, the problem is much more difficult and a successful outcome is dependent upon drainage and the prevention of the interruption of pregnancy.

In regard to perforation and suppuration periton-

itis, DeLee (14) says appendicitis with pregnancy is more serious than outside of pregnancy because:

1. Protective adhesions are less likely to be formed, the omentum and gut being pushed away by the enlarging uterus.

2. The inflammation is more stormy, owing to the intense vascularity of the parts.

3. Thrombosis and phlebitis are commoner.

4. Suppuration takes place higher in the abdomen (true of late pregnancy), which portion is recognized to be less resistant.

5. Drainage is less free, owing to the large uterus nearby and the abscesses burrow deeply in all direction.

6. Tympany compromises the respiration sooner, also pneumonia and pleurisy.

7. Obstructive symptoms arise earlier.

8. The bacteris floating in the blood may accumulate in the placenta, and even the fetus, causing abortion and sepsis.

In many cases perforation of the appendix, with peritonitis resulting, stimulates labor pains, thus causing premature labor and abortion, with death of the fetus.

Wilson (63) says that the uterus will empty itself

in at least fifty per cent of cases where perforation is present, and that the more advanced the pregnancy, the greater is the danger to mother and child.

Salter (55) believes that abortion occurs due to the disease and not because of surgical interference.

Maes (38) thinks that the part which abortion plays in the final maternal result is overestimated.

The ever present possibility of labor setting in jeopardizes the maternal prognosis.

Per Cent Aborted

	Confined to appendix	Local abscess	General Peritonitis
Jerlov, 204 cases	13.8%	55%	63%
Western surgical group and literature 70 cases	11.4%	66%	72%

It can be seen from the above figures that the liability to abortion increases directly with the duration and severity of the appendicitis.

Proof that abortion is due to the disease rather than to the operation is found in the fact that termination of pregnancy occurred before operation in some of the most serious cases.

McDonald (41) mentions five factors predisposing to bring on interruption of pregnancy:

1. Fever and toxemia as in pneumonia or influenza.

2. Gastrointestinal disturbances of themselves are not important.

3. Reflex irritation from peritonitis causes hypertonic contraction of the uterus, This results in painful uterine spasm. While this contracture may go on to active expulsive contractions, the hypertonus often persists as such for several days.

4. Extension of infection through communicating lymphatics to the right fallopian tube and endometrium may cause death of the fetus and abortion. In fifty-seven cases of appendicitis complicated by abortion Jerlov found twelve with salpingitis of the right tube.

5. Operative manipulation adds little if anything to the danger of abortion provided the stability of the pregnancy is not already disturbed. Spinal anesthesia is contra indicated. It causes undue relaxation of the cervix.

Mortality

It is difficult to accurately gage the mortality of appendicitis in pregnancy because the figures reported in the literature are based largely on acute cases.

Maes (38) reporting a few cases of recurrent and subacute types of disease before they progressed to the acute stage, shows that the mortality is minimal.

Once the disease becomes acute, the mortality becomes high, regardless of whether or not labor follows. The death rate is especially high in suppurative cases. (26).

There is a mortality of approximately one hundred per cent in non surgical treatment of the acute disease, just as it would be in the non pregnant state. (38).

The fetal mortality is also high. (55). This is partly due to toxemia. Maes (38) thinks this is largely inevitable. Anderson (1) reports the fetal mortality to be forty per cent.

Marbury (39) gives the maternal mortality as thirty to fifty per cent, and where peritonitis is present, eighty per cent. Dworzak (15) states that the mortality varies between 18.1 per cent and 76.9 per cent depending upon the stage in which the patients are referred for operation and the method used, and adds that the

infant mortality approaches one hundred per cent. Schmid (56) found the mortality to be 36.2 per cent in a series of 486 cases. This rate was reduced to 23.7 per cent by the inclusion of chronic cases amounting to approximately twenty per cent.

DeLee (14) reports that a worse prognosis than usual is to be made in puerperium sepsis, because nearly forty per cent of perforated appendix peritonitis cases die.

McDonald (41) has formulated a table comparing the mortality of appendicitis in pregnant and non-pregnant cases.

	Confined to Appendix % Mortality	Local Abscess % Mort.	General Peritonitis % Mortality
Jerlov, 204 cases preg.	0	20	31
Western surgical group and literature-70 cases pregnant.	3	50	27
Total, 274 cases preg.	0.71	23.5	30
Quain, 1000 cases non-pregnant	0.36	2.4	11

* The mortality is higher in cases which aborted.

It can be seen that the mortality was much higher in cases where the appendicitis was complicated by both pregnancy and peritonitis or abscess.

Conclusions

1. Pregnancy and appendicitis may be found together.
2. The incidence of appendicitis occurring as a complication of pregnancy varies from a fraction of one per cent to two and one-half per cent.
3. The incidence of pregnancy complicating appendicitis ranges from a fraction of one per cent to two and one-half per cent.
4. Primary acute appendicitis does not occur more frequently in pregnant than non-pregnant women.
5. The woman who has once had appendicitis of the recurrent type is very likely to develop it again during pregnancy.
6. The majority of the cases of appendicitis occur in the second trimester of pregnancy.
7. Appendicitis is very rare in the last few weeks of pregnancy and labor.
8. Forty to fifty per cent of cases of appendicitis in pregnancy report previous attacks antedating the pregnancy.
9. Constipation probably plays a part in the etiology of appendicitis complicating pregnancy.
10. Anatomic and physiologic rest are disturbed by the upward displacement and rotation of the appendix

upon its base because of the interference with its normal blood supply.

11. Gangrenous and ruptured appendicities in pregnancy are five and one-half and three and one-half times respectively more common than found in the non-pregnant state.
12. Pregnancy may somewhat confuse the diagnostic picture of appendicitis.
13. The laboratory is not very helpful in diagnosis.
14. Appendicitis in pregnancy should be handled as though the pregnancy did not exist, except that the uterus should be manipulated as little as possible.
15. The married woman who has a diseased appendix should have it removed before becoming pregnant or as soon as she knows that she is pregnant.
16. The prognosis depends largely upon the rapidity with which diagnosis is made and treatment performed.
17. Serious complications are more frequent as pregnancy advances.
18. At least fifty per cent of cases where perforation is present abort.
19. Abortion is due to the disease and not the surgical interference.
20. Liability to abortion increases directly with the duration and severity of the appendicitis.

21. The mortality is approximately one hundred per cent in non-surgical treatment of the acute disease.
22. The maternal mortality is between twenty and eighty per cent.
23. The fetal mortality is approximately forty percent.

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