APPENDICITIS OBLITERANS.

Read before the Chicago Academy of Medicine, March 16, 1894.

BY N. SENN, M.D., Ph. D., L.L.D.

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PROFESSOR PRACTICE OF SURGERY AND CLINICAL SURGERY RUSH MEDICAL COLLEGE; PROFESSOR OF SURGERY CHICAGO POLICLINIC; ATTENDING SURGEON PRESBYTERIAN HOSPITAL; SURGEON-IN-CHIEF ST. JOSEPH'S HOSPITAL.

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The successful surgical treatment of peritonitis caused by infective lesions of the appendix vermiformis constitutes the most brilliant chapter of modern aggressive surgery. The surgeons have taught physicians by scientific research, as well as by lessons learned from clinical experience, that peritonitis, in the majority of cases, is a secondary affection, and that its successful treatment depends largely upon the detection and removal of the primary cause. The present large amount of knowledge concerning appendicitis and its complications is largely the result of the work of American surgeons. The European surgeons are slow in accepting the teachings and practice, as developed and promulgated in this country, but in the near future they will have to submit to the most convincing proof—the results of clinical experience. During the last five years so much literature on the surgical treatment of inflammatory affections of the appendix has accumulated that this subject has become somewhat threadbare and confusing. For a number of years it was customary for a certain class of abdominal surgeons to report the result of their annual work on ovariotomy; then it became the fashion to give the statistics of tubal surgery, but at the present time the appendix vermiformis is the favorite topic of discussion, and to it is assigned a liberal space of the medical press and the programs of medical societies, both large and small.

It appears to me that it would be more profitable in the future for this department of abdominal surgery to write less concerning individual experience, and elaborate more thoroughly upon a pathologic basis the conditions which demand surgical interference. The surgeon must bring more convincing proof than the simple recovery from the operation, viz.: The reasons for the necessity of operative intervention, in order to convince the mass of the profession of the correctness of the ground taken by a number of surgeons, that the appendix should invariably be removed when it is the seat of an infective lesion. There are exceptions to nearly all rules, and the surgery of the appendix vermiformis has not advanced sufficiently to enable us to lay down cast iron rules when and when not to operate. Pelvic surgery has been degraded by the modern *furor operativus*, and the same fate threatens the surgery of the appendix. The conscientious surgeon must bring his work in consonance with the pathologic conditions which he is expected to correct or remove. If it were my intention to report the result of my own work in the surgery of the appendix, I should certainly feel inclined to offer an apology in view of what has been presented by the medical journals, especially those of our country during the last five years, but as I propose to limit myself to the description of a special pathologic form of appendicitis, I am confident that I have opened up a field that will afford ample space for future investigations of a similar character and which will, in the course of time, furnish a foundation for accurate diagnosis and an improved technique.

I have, for a long time, been convinced that appendicitis is an infective disease, caused by pathogenic microbes which reside in the normal intestinal canal and exercise their specific pathologic properties in the appendix whenever the essential *locus minoris resistentiæ* is produced by other conditions. The anatomic location of the appendix is such that retention of its secretions is liable to occur, particularly in cases in which the lumen at the proximal end has become narrowed by congenital stenosis or antecedent affections of the cecal wall. From a bacteriologic aspect the appendix may be regarded as an open test tube, and the retained secretions a culture medium. I have but little doubt that future research will demonstrate that the most frequent microbic cause of appendicitis is the bacillus coli communis. Pus microbes undoubtedly enter largely into the etiology of mixed infections here as elsewhere. Intensity of the inflammation is determined more by the quantity than by the pathogenic quality of the microbes. The same cause which in one case produces a mild form of inflammation may in others determine speedy death from gangrene or perforation and acute sepsis.

I have performed at least 150 operations for lesions of the appendix, but instead of giving a detailed account of these it is my intention, in writing this paper, to call the attention of the profession to a pathologically and anatomically well-defined form of appendicitis that has heretofore not been separately described. For a number of years I have noticed in the examination of specimens removed from cases of recurring appendicitis, varying degrees of contraction of the lumen of the appendix, differing in extent from slight stenosis to complete obliteration. In recent cases I have invariably found the wall of the appendix more or less thickened at the seat of constriction. Similar observations have been made by other surgeons, but I have not seen anywhere special mention of this particular form of appendicitis. The *Medical Record*, July 15, 1893, alludes to a specimen described by Dr. Biggs, which had been removed from a man dying of chronic alcoholism. The appendix consisted of a small pouch

about 3.1 ctm. in length, and beyond this a fibrous cord 2 mm. in diameter, which, apparently as a result of an old inflammation, had been united by adhesions to the neighboring tissues. The effect of this appendicitis had been to cause a complete obliteration of more than one-half of the lumen of the appendix. Sections of the fibrous cord showed, under the microscope, unstriped muscular tissue, fibrous tissue and many small round cells. Fenger ("Remarks on Appendicitis," *American Journal of Obstetrics*, No. 2, 1893), has described a similar specimen. Nearly one-half of the appendix on the distal side was found obliterated. (Fig. 1. "Obliteration of Appendix on Distal Side." Fenger's case.) T. G. Morton ("Two Recent Cases of Excision of the Vermiform Appendix for Chronic Relapsing Appendicitis in the Interval," *Medical and Surgical Reporter*, Dec. 23, 1893) has recently removed an appendix for recurring inflammation in which obliteration had taken place on both sides. "It measured rather more than three inches in length; it was greatly distended near its middle, and the proximal and distal ends were thickened and swollen; a section showed total obstruction of the organ except its middle or distended portion, which was filled with about two drachms of very offensive pus." Lange, of New York, has also described several similar cases.

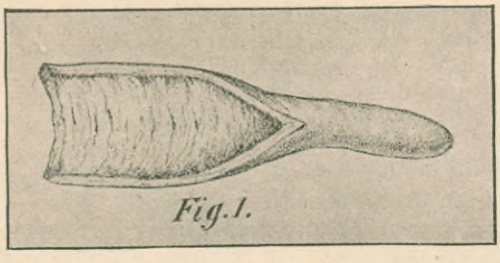


Fig. 1.

My attention has recently been called forcibly to this form of appendicitis, as within the short space of two months four cases have come under my observation. I have designated this form of appendicitis as appendicitis obliterans, because the most conspicuous pathologic condition presented by the specimens is an obliteration of the lumen by cicatricial contraction. The pathologic processes resemble very closely a similar condition in the terminal arteries designated here as arteritis obliterans. The patients presented before the operations a complexus of clinical symptoms which, when grouped together, will enable the surgeon to at least suspect, if not positively predict, this condition. I will briefly report the four cases of appendicitis obliterans which have recently come under my observation, and later utilize them as a text upon which to base some general remarks on the pathology of this form of appendicitis.

Case 1.—H. M. Stewart, aged 26; business, book-keeper; residence, Lyons, Kansas. Admitted into St. Joseph's Hospital, Sept. 30, 1893.

The patient states that his health had been fairly good until three years ago, when he suffered from an attack of "cramps in the stomach," and pain and tenderness in the ileo-cecal region. This attack lasted about eight hours. Similar attacks followed at intervals of two or three months, becoming more frequent until during last year they occurred every four to six weeks. The acute symptoms would, as a rule, subside in from six to fourteen hours, to be followed by a dull aching pain in the right iliac fossa accompanied by tenderness on pressure which would continue for ten days to two weeks when he would be able to resume his occupation, but more or less soreness and tenderness remained. The last attack which was unusually severe occurred in June. Operation was performed Oct. 2, 1893. The appendix was found behind the cecum directed inward and upward. It was adherent to the cecum and a loop of the ileum, mesenteriolum shortened and much thicker than normal. The organ when removed measured about three inches in length and presented a peculiar club-shaped appearance, the constricted portion being on the proximal side while the free end was bulbous. (I am indebted to Dr. Mellish for the illustrations in this paper). The wall of the free bulbous portion was much thickened. About one-third of the lumen on the proximal side was completely obliterated. The excluded part contained a viscid fluid, of a brownish color. The temperature ranged between 99 and 100 degrees F., for four days when it reached 101½ degrees F., on the fifth day, after which it became normal. The patient left the Hospital at the end of the fourth week.

Case 2.—J. Barzhof, aged 25; German-American; dentist; residence, Manitowoc, Wis. He entered St. Joseph's Hospital at the request of his attending physician, Dr. Pritchard, Nov. 4, 1893. Operation on the following day. General health fair. In the summer of 1888 he was taken with the first attack in the form of severe vomiting, diarrhea and intense pain in the abdomen, radiating upward and downward to the right of the median line. The first seizure lasted about four days. Similar attacks occurred about four times every year. In the spring of the present year it appeared that the attacks were provoked by change in diet. Pain often more severe when stomach was empty. Dietetic treatment had no effect in preventing recurrence of the difficulty. No constipation. Last and most severe

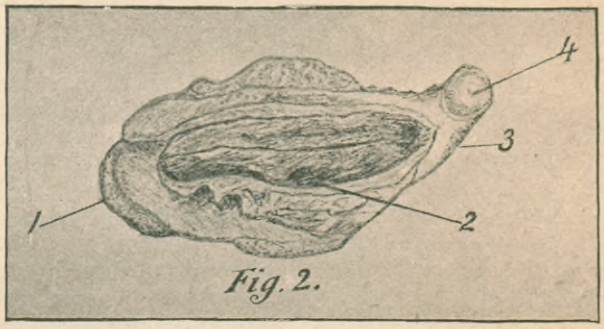


Fig. 2.

Appendix laid open from tip to near proximal end; Mrs. W.; Nov. 13, 1893. 1. Bulbous extremity. 2. Everted exceedingly vascular mucous membrane. 3. Obliterated portion. 4. Central part showing location of obliterated lumen.

attack about September 20. This was preceded by a somewhat hard swelling extending from umbilicus to the right inguinal region which was followed by a severe chill, vomiting, diarrhea and the characteristic sharp lancinating pain more severe in the ileo-cecal region. Highest temperature 102 degrees F. The pain and tenderness in the ileo-cecal region never disappeared completely after this and were relieved only by rest in the recumbent position. On opening the abdominal cavity the appendix was seen at once. It measured at least five inches in length and was firmly attached to the caput coli and extended behind the colon. The distal bulbous end was small. A similar bulbous expansion was found near its attachment to the cecum. Between these bulbous expansions the organ was not larger than a small lead pencil, anemic and very dense. Owing to the length of the mesenteriolum it had to be tied in four sections. The glands in the vicinity were found much enlarged, some of them had attained the size of an almond but none of them presented any evidences of caseation. Examination of the specimen after its removal showed that nearly the entire lumen had been obliterated, only a small portion on the distal and proximal side remaining patent. The open spaces contained a catarrhal viscid secretion of a brownish color. The temperature in this case never reached 100 degrees F., and the patient left the Hospital at the expiration of four weeks.

Case 3.—Mrs. E. A. West, aged 28, American, housewife; residence, Decatur, Ill. Entered St. Joseph's Hospital at the suggestion of the family physician, for the purpose of having the appendix removed for a recurrent inflammatory affection in the right iliac region of long standing. Her mother died of pulmonary tuberculosis when patient

was only six months old, and the latter has always been in delicate health. Married two years; no children. Six years ago was taken suddenly ill with symptoms indicating peritonitis. The pain was diffuse and of a grinding character. The acute symptoms subsided in five or six hours, but she was confined to the bed for four days. The tenderness in the right iliac region remained for a number of days. Later, in the same year, had a similar attack and during each of the succeeding four years the same experience was repeated from two to four times. Beginning with September, 1892, she had an attack each month until February, 1893, six in all. The attack in February was so severe that a physician was called for the first time. As in all previous attacks, pain passed off in a few hours but patient was confined to bed for four or five days, and tenderness persisted for as many more days. She was never aware of the exact location of tenderness until she was examined by her physician. The last and most severe attack occurred in July of the present year, which lasted twelve days. She was attended by Dr. Bumstead, who recognized the difficulty and advised a radical operation. During the last attack the temperature reached 103 degrees F. Vomiting and nausea were not conspicuous symptoms during any of the attacks. In the beginning of the acute exacerbations the pain was generally diffuse; later, localized in the ileocecal region. Hot applications always afforded prompt relief, was no nausea or vomiting; a little tympanites and constipation. He attributed the difficulty to a strain produced by lifting. The second attack in April, the following year, commenced with a sudden, sharp, intense pain confined to the right side in the region of the appendix. The acute symptoms continued for one month, during which time he was confined most of the time to bed, but at any time, if assisted to his feet he could walk with the aid of a cane. During the second month he improved sufficiently to resume his work. A sense of soreness and tenderness in the ileocecal region remained. Vomiting occurred on the evening of the second day. Tympanites absent. Diagnosis of appendicitis was made on the fourth day by the attending physician. Third attack February, 1893, resembled the second in every respect. There remained not so much tenderness on pressure, as a soreness or pain from a slight jar, as would happen when riding in a buggy when the wheel struck a stone. Could not stand perfectly erect, but would incline the body slightly forward and to the right with feet about twelve inches apart. Examination before operation revealed tenderness in the region of the appendix on deep pressure. Operation Dec. 8, 1893. The appendix was readily found as it was directed forward and to the right, occupying a groove in the caput coli. During its separation from the cecum I expected every moment to make a rent in the bowel as the peritoneal coat of the latter appeared to be absent and the

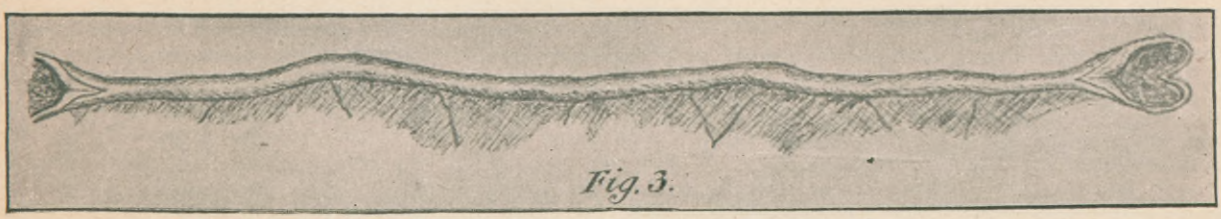


Fig. 3.

Obliterated appendix showing small pervious spaces at each end, the intervening part converted into a solid cord.

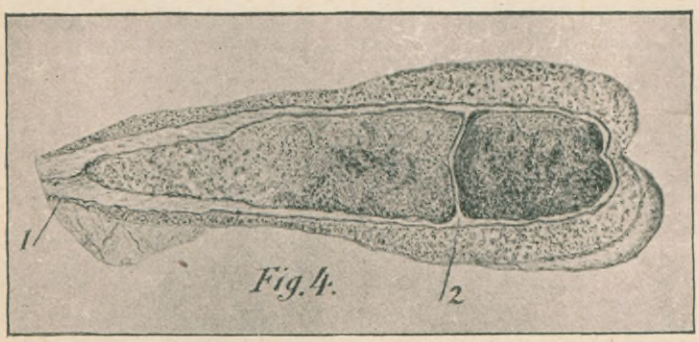


Fig. 4.

1. Proximal end completely obliterated. 2. Narrow stricture dividing completely the remaining lumen into two unequal portions; great thickening of wall near distal end.

and she believes that they were the means of cutting short several of the attacks. When examined after her admission into the Hospital the appendix could be felt as a firm cord, and tenderness was limited to this structure. Operation November 14. In this case the appendix was directed downward and inward toward the pelvis; adhesions old and firm. Mesenteriolum very short and adherent to appendix. It was tied in several sections. About one-fourth of the lumen on the proximal side was obliterated and the corresponding portion of the appendix transformed into a firm fibrous cord. (Fig. 4.) Beyond this obliterated part the lumen was much dilated, and subdivided into two unequal portions by a thin partition composed of cicatricial tissue. Wall of appendix much thickened and dense. Both compartments contained inspissated pus which resembled liquefied caseous material. Lymphatic glands in the vicinity of the appendix much enlarged and exceedingly vascular. Patient recovered without an untoward symptom. A small stitch abscess at the end of a week gave rise to a slight elevation of temperature, and slightly retarded the healing of the wound.

Case 4.—J. H. Croskey, aged 33, American; farmer by occupation; residence Farmer City, Ill. Entered St. Joseph's Hospital Dec. 5, 1893. Family history good. Patient was never sick until November, 1891, when after a hard day's work, he experienced a dull pain in right side and lower part of abdomen. He was able to sit up but could do no work for three days, when all symptoms passed away. There muscular coat very much attenuated. The dissection was made slowly and carefully and mainly with the aid of blunt instruments. The mesenteriolum was incorporated so firmly in the adhesions that ligation was rendered superfluous. A number of bleeding points were ligated. The appendix when removed measured three inches in length, and on slitting it open it was found that about one-third of its lumen on the distal side was completely obliterated. (Fig. 5.) The distal end tapered into a sharp point. Wall of remaining portion only slightly thickened. Mucous membrane intensely congested. At a point about half an inch distant from obliterated part, both the wall of the appendix and its lumen showed changes which indicated the first stages of the formation of a circular stricture. Mucous membrane much thickened.

In this case the second attack of appendicitis produced an intense localized plastic peritonitis which gave rise to the extensive and firm adhesions of the appendix to the cecum, rendering the operation one of great difficulty. During the dissection I feared that a perforation at the tip of the appendix had taken place, followed by rupture of a small abscess into the cecum, and on this account anticipated injuring the wall of the bowel. Examination of the

specimen, however, proved conclusively that this had not occurred and that the adhesions were caused by a plastic peritonitis without perforation.

Since writing this paper the following interesting case of appendicitis obliterans has come under my observation in the clinic of Rush Medical College:

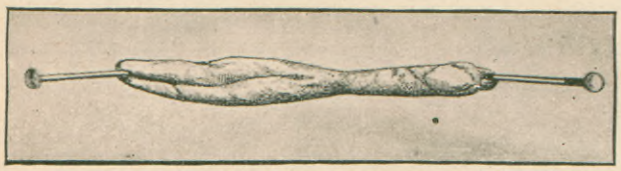
Case 5.—Jas. McChane, occupation, farmer, aged 35 years, married; mother died of phthisis. Personal history: Never a very robust man. Had "ague" eight years ago lasting three months. Regular in habits; no venereal history.

In August, 1893, the patient, while threshing wheat, was attacked with a severe paroxysm of pain in the right lumbar region. He had to stop work but did not go to bed. He has not been able to do a day's work since, although he has not been confined to his bed. The pain is always present, a dull aching pain, and the least exertion aggravates the difficulty and tenderness. The pains are always referred to the same point, a few inches to the right and below the umbilicus.

The bowels have been constipated and the patient resorts to the use of enema to relieve them. The appetite is very poor and he has been steadily losing flesh. When admitted the patient's temperature is normal in the morning with a slight evening rise.

On physical examination, a point of tenderness found corresponding to McBurney's point, with some induration and fixation of head of cecum.

From the clinical history and existing symptoms I was able to make the diagnosis of appendicitis obliterans before the operation. The operation was performed in the clinic. Photograph of specimen herewith shown. The distal end was patulous and is slit open, showing interior view with the obliterated portion at the proximal end.



Appendix, about one-third natural size.

GENERAL REMARKS.

The cases just reported present many clinical features in common. The age of the patients varied from 25 to 38. Four were males and one female. In all of them the acute exacerbations were characterized by symptoms of peritonitis of varying intensity. Swelling does not appear to have been a constant feature, either during or after the acute attack. In most instances the pain was at first diffuse or referred to epigastric region; later, localized in the ileo-cecal region. In most of the cases, tenderness in the region of the appendix remained a long time after the subsidence of the acute symptoms, or remained as a permanent condition. In all of the cases I was able to produce pain on making deep pressure directly over the appendix. The point of tenderness therefore varied according to the location of the appendix. The febrile disturbance during the acute attack appears to have been moderate and of short duration. Nausea and vomiting were not constant symptoms. Tympanites depended on the extent of the peritoneal involvement. The most constant and characteristic feature was recurrence of the acute exacerbations which set in from once a year to every few weeks. As a rule, the attacks became gradually more frequent. In two out of the four cases, some of the most important symptoms remained in a masked form during the intermissions. This was noted particularly in the cases in which the appendix was obliterated on the proximal side. I should suspect, very strongly, appendicitis obliterans in cases of recurrent appendicitis in which no complete intermission takes place during the interval between the acute attacks, and no appreciable swelling can be found in the region of the appendix. From what has been said it will be seen that the most conspicuous symptoms of this form of appendicitis are: 1, short duration and moderate intensity of the acute exacerbations; 2, slight or no swelling in the region of the appendix; 3, recurrence of acute attacks varying in frequency from a year to several weeks; 4, persistence of some soreness and tenderness in the part affected during the intermissions.

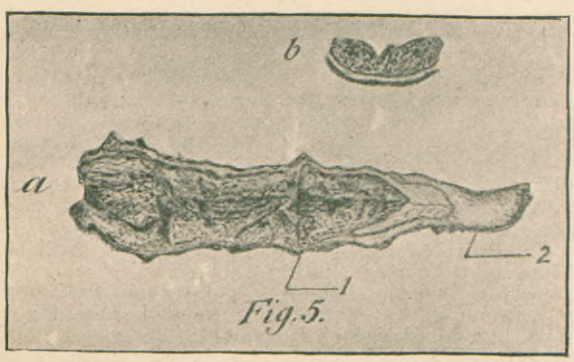
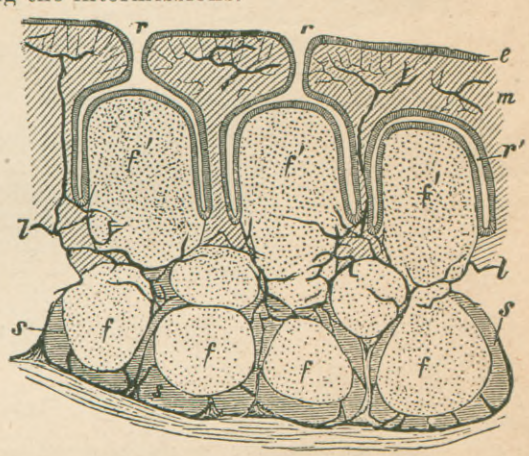


Fig. 5.

a—Appendix laid open from proximal end as far towards distal end as it is pervious, and a little farther. *b*—Transverse section of same, showing bulging of the mucous membrane.

1. Narrow circular strip of appendix much thickened, lumen much contracted; early stages of circular stricture. 2. Distal obliterated end tapering into a sharp point.



Appendix of rabbit, lymphatics injected. *f f*—Outer follicles with lymphsinus, *s s*. *f' f'*—Inner follicles. *l l*—Lymph vessels which leave the lymph follicles. *m*—Mucous membrane with dilated glands; *e*—their epithelial cells; *r r*—their recesses. *r'*—Recess; point of entrance does not correspond with level of section (Orth).

Etiology.—I have already made the statement, in the introductory remarks, that this as well as other forms of appendicitis is caused by pathogenic microbes, and therefore regard all acute inflammatory affections of the appendix as infective lesions. A glance at the anatomy of the appendix, as well as an examination of the most constant pathologic conditions, will corroborate the correctness of this assertion. The appendix is richly supplied with lymphatic vessels, and it is through these that infection most frequently takes place. Orth (*Cursus der Normalen Histologie*, etc., Berlin, 1878,) has fully described the lymphatic structures in the appendix of the rabbit, and Morris has recently alluded to the lymphatic channels of this structure as a route of infection in man.

It is not difficult to understand that an ordinary

catarrhal inflammation would render the mucous membrane permeable to the passage of pathogenic microbes, rendering it possible for them to pass from the lumen of the appendix into the lymphatics, the essential cause of the inflammation thus coming in direct contact with every anatomic constituent of the wall of the appendix, its serous investment and even the free peritoneal cavity without any ulceration or perforation. The distribution of the microbic cause through the lymphatic route has been demonstrated by many postmortem examinations and appendices removed by operative treatment. Minute miliary abscesses have often been found in the wall of the appendix and underneath the peritoneal coat, and usually in locations formerly occupied by lymphatic channels. There can be no question that the exciting cause can often be traced to a trauma, indiscretion in diet and exposure to cold. In none of the cases of appendicitis obliterans did I find a foreign body or an enterolith. In Fenger's case in which the obliteration was on the distal side, two grape seeds, one fecal concretion the

examinations. He found partial or complete obliteration in 25 per cent. of these cases. He believes that this change is due to involutionary changes in the majority of cases. One reason for entertaining this idea is that this condition of the appendix is met with more frequently in persons advanced in years. The influence of age is shown in the following table:

1 decennium	. . . . .	4 per cent.
2 "	. . . . .	17 "
4 "	. . . . .	27 "
5 "	. . . . .	36 "
6 "	. . . . .	53 "
7 "	. . . . .	58 "

In favor of the inflammatory origin of appendicitis obliterans it can be said that appendicitis is a comparatively rare affection in children, and that the longer the person lives the greater the liability to suffer from an attack. I have no doubt that obliteration of the appendix occasionally occurs as a congenital condition. Atresia of the lumen of this organ is probably more liable to occur during intra-

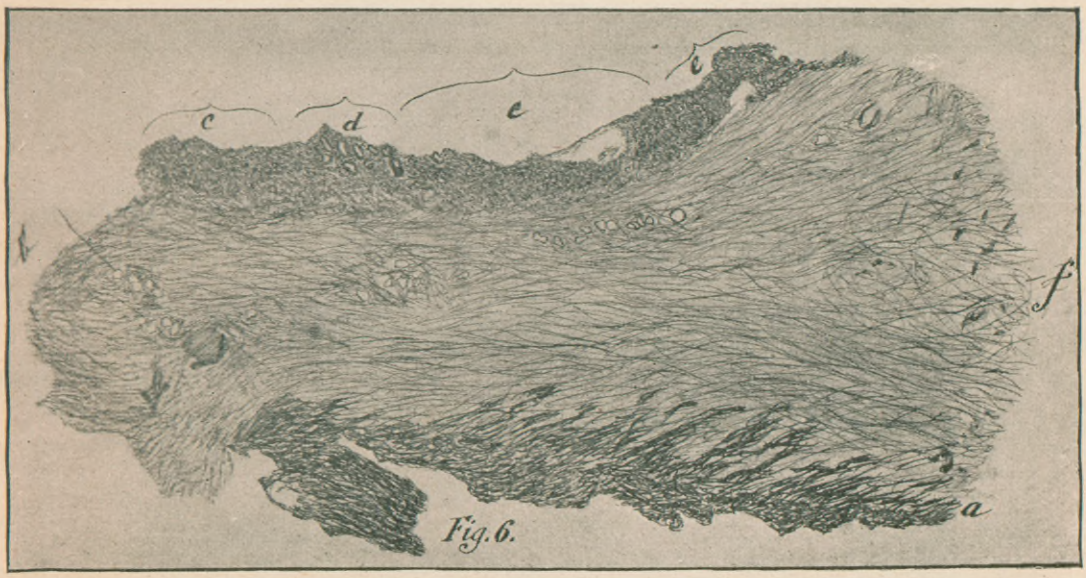


Fig. 6.

Appendix (Stewart). + section through cicatrix, one-half circumference. The upper border of drawing represents the mucous surface— × 25 diameters. *a*—Muscular tissue. *b*—Empty glandular spaces. *c*—Granulation tissue. *d*—Remnants of mucous membrane. *e*—Fibrous and granulation tissue. *f*—Cicatricial tissue.

size of a split pea, and the husk of an oat were found in the appendix. In the event of incarceration of a foreign substance or fecal concretion on the distal side of the obliteration, I should expect more pronounced symptoms during the intervals between the acute attacks, and apprehend great danger of perforation with all its immediate disastrous consequences. In only one case did the inflammation result in suppuration on the distal side of the obstruction, and in this case the pus had become inspissated. In all the other cases the excluded part of the lumen of the appendix contained from one to a few drops of viscid fluid stained a brownish color. It is evident that a plastic peritonitis in the vicinity of the appendix can be produced by pyogenic microbes without visible pus within the appendix or its wall.

Ribbert (*Virchow's Archiv*, 1893,) wished to ascertain the frequency with which the appendix vermiformis undergoes obliteration, and for this purpose noted the condition of this organ in 400 postmortem

uterine life than the same condition in other parts of the gastro-intestinal canal.

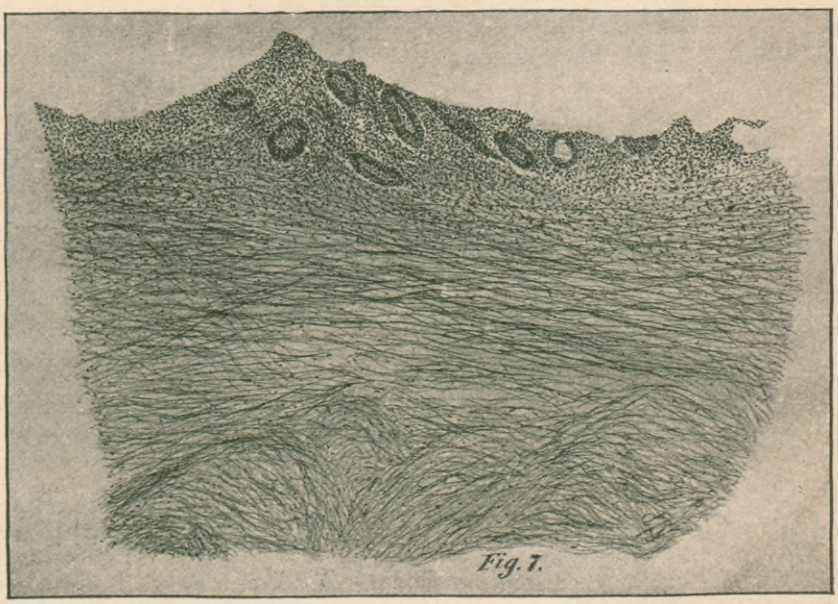
Pathology and Morbid Anatomy.—Ranvers (*Zur Pathologie and Therapie der Perityphlitis Deutsche Med. Wochenschrift*, 1891, No. 5,) found the appendix completely obliterated in thirteen postmortem examinations. All of the specimens showed evidences of circumscribed plastic peritonitis. He believed that in some of these cases perforation had taken place, and that the disease ultimately cured itself. In one specimen he found a small fecal concretion, surrounded by a capsule of cicatrical tissue. The most striking morbid changes in obliterating appendicitis are found in the different tissues of the organ, and these are directly concerned in the gradual and progressive obliteration of its lumen. A stricture of the appendix, like that of any other hollow organ, may be brought about by: 1, destruction of the mucous membrane by ulceration; 2, infiltration, thickening and contraction of the muscular coat; 3, prolonged cica-

tricial contraction of exudates upon its serous covering; 4, or, in consequence of a combination of two or more of these causes. In a former communication on relapsing appendicitis, ("A Plea in Favor of Early Laparotomy for Catarrhal and Ulcerative Appendicitis, with the Report of Two Cases," JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, Nov. 2, 1889.) I described an appendix in which the mucous membrane was extensively ulcerated. " . . . . On inspection of the mucous membrane lining it, an oblong ulcer was discovered near the middle and opposite mesenteric attachment. The ulcer measured about half an inch in length, and a quarter of an inch in width. Its greater diameter corresponding to the long axis of the appendix. The margins of the ulcer were regular in outline and not undermined. It presented no evidences of repair. Its greatest depth corresponded to its center. The whole mucous membrane was exceedingly vascular and much thickened, the submucous infiltration being uniform over its entire area. A transverse section of the appendix through the center of the ulcer, examined under the microscope, showed that the entire thickness of the mucous membrane and part of the muscular coat were destroyed by the ulcerative process, and that the remaining thickness of the wall, as far as the peritoneum, was infiltrated with embryonal cells and leucocytes which were closely grouped together in the connective tissue reticulum. The submucous tissue and part of the muscular coat were similarly infiltrated throughout." The healing of such an ulcer would naturally produce stenosis and eventually complete obliteration of the lumen of the appendix. Such an event would presuppose subsidence of the infective inflammation, the lining of the floor of the ulcer with active granulations and the transformation of embryonal into cicatrical tissue endowed with the characteristic intrinsic tendency to progressive contraction. Such a mode of obliteration is shown by illustrations, Figs. 6, 7 and 8. The sections were taken from near and under the obliterated part of the appendix removed from Mr. Stewart.

Fig. 6 represents a section through a portion of the circumference of the appendix near the occluded part. Most of the spaces shown in the scar tissue were evidently formerly occupied by submucous glands. A few of them represent lumina of blood vessels.

The mucous membrane is almost completely destroyed, only a few remnants at *d* remaining. The place formerly occupied by the mucous membrane is now the seat of active cell production from the submucous connective tissue. The numerous vacant spaces in the fibrous tissue are empty glandular and lymph spaces, in which the parenchyma of gland tissue was destroyed, either by the infective inflammation or later by pressure from cicatricial contraction. The inflammation started in this case either in the mucous or submucous tissue, and extended towards the periphery of the organ, as indicated by the pathologic changes. The peritoneum, with the exception of the adhesions, had undergone but slight textural changes, while the tissues underneath were not much affected.

Fig. 7 represents the same section under higher power. It shows the remnants of glandular tissue and the almost complete destruction of the epithelial cells lining the interior of the appendix, and an abundance of scar tissue taking largely the place of muscular tissue. (Fig. 8). This section was taken from near the distal extremity of the excised appendix where the mucous membrane was least affected, and demonstrates that the primary lesion commenced some distance from the terminal end of the lumen, and that the process of obliterating cicatrization extended from here in both directions. It also illustrates that the fibrous thickening of the wall takes place largely by proliferation of the submucous connective tissue. It appears from these illustrations that while the primary microbic cause in such cases acts with sufficient intensity to destroy the mucous membrane, producing more or less suppuration, the destruction of tissue is limited to the epithelial lining and perhaps the submucous glandular and lymphoid tissue; when it comes in contact with the connective tissue its pyogenic function is limited and an abundance of



Same section as represented in drawing No. 6, showing remains of mucous membrane mingled with granulation tissue—× 75 diameters

granulation tissue is formed, which not only limits infection but likewise brings about obliteration of the lumen which in many instances assumes a progressive character. The adjacent mucous membrane not only suffers from continual exposure to the primary infective cause, but also from impairment of nutrition from gradually increasing cicatricial contraction. It is probable that in this way obliteration of the entire lumen would be finally accomplished, and that this termination is most likely to occur if the obliterating process begins in the distal part of the appendix.

I am, however, inclined to believe that in the majority of cases the obliterating appendicitis has a deeper and more serious origin in the direction of the lymphatic glands and channels. In such instances the mucous membrane at some point furnishes the necessary infection-atrium through which the microbes enter the lymphatic channels resulting finally in an interstitial inflammation, with more or less involvement of the peritoneal coat. The acute exacerbations in this variety of appendicitis obliterans are more intense, because the primary seat of infection is nearer the peritoneal coat, and the route of infection towards it more direct. The interstitial inflammation may result in the formation of small intermural abscesses which are more likely to reach the mucous than the serous surface. The mucous lining of the lumen of the appendix becomes implicated by the inflammation extending from glandular structures and connective tissue underneath it, and later from cicatricial contraction. Case 4 furnishes a good illustration of this type of obliterating appendicitis. The clinical symptoms in this case pointed to severe circumscribed plastic peritonitis, and the pathologic conditions revealed at the time of operation extensive and very firm adhesions. The appendix removed was occluded for about an inch at the distal extremity. The non-occluded portion showed the presence of catarrhal inflammation with the characteristic bulging of the mucous membrane after the appendix was laid open.

Fig. 9 represents a section through one-third to one-half of the entire circumference of the obliterated portion of the appendix. The section includes only a small part of the peritoneum which was very much thickened and the subserous vessels dilated.

As compared with the other illustrations the section through the obliterated part shows fewer empty glandular spaces and more blood vessels. The glandular structure was destroyed by the inflammation at an early date and not starved out, as was the case in the former instance. The former lumen of the appendix is here indicated by a mass of embryonal tissue in various stages of transformation into connective tissue. Reduction in the size of the obliterated part of the appendix was brought about in part, at least, by constriction of the peritoneal adhesions.

Fig. 10 represents the appearance of the tissues in a section near the obliterated part. At *a*, the superficial glands remain while in close proximity to it at *b*, the epithelial lining and glands are destroyed and their places are occupied by granulation tissue. The submucous tissue is again the seat

Fig. 8.

Showing remnants of mucous membrane with granulation tissue. At lower edge is shown a few muscle fibers. × 75 diameters; + section. Peritoneal surface not shown.

of active tissue changes, especially under the mucous membrane at *a*. The continuance of inflammation at the proximal end of the obliterating process, is indicated further by the presence of an extravasation of blood at *f*, and the masses of embryonal cells near the muscular coat at *g*. The thickening of the wall of the appendix is most marked during the acute exacerbations and in the excluded part. In the obliterated part the diameter of the organ is gradually diminished until it is transformed into a firm solid cord while its length, owing to adhesions, is often elongated instead of undergoing shortening (Case 2).

Among the cases which I have reported there is no instance of obliteration from cicatricial contractions of peritoneal adhesions alone, nor have I been able to find such a case in literature; but that such an occurrence is possible we know from analogy. In Case 4, we have reason to assume that the extensive and firm peritoneal adhesions aided the obliterating process. In reference to the contents of the excluded portion of the appendix we find that in two cases it consisted of a small quantity of viscid fluid devoid of odor and stained a brownish color, while in one case the cavity contained inspissated pus. In Morton's case it contained two drachms of fetid viscid material. In distal obliteration the proximal patent lumen usually contains the characteristic catarrhal secretion. One of the interesting pathologic conditions attending proximal obliteration which attracted my attention is the implication of the lymphatic glands in proximity to the vermiform appendix. In such cases the escape of septic material into the intestinal canal is prevented by the occlusion, and indefinite accumulation is prevented only by the passage of the products of the septic inflammation through the lymphatic channels. In this way lymphangitis and lymphadenitis, usually of a non-suppurative type, are produced. I found more or less enlargement of the lymphatic glands in all cases in which the product of the inflammation was thus imprisoned. In Cases 2 and 5 a number of lymphatic glands the size of almonds were found. The operative removal of such glands is superfluous as the removal of the depot of infection will be promptly followed by resolution. The great thickening of the wall of the appendix in the part excluded must be attributed, in part at least, to the vain attempts of the organ to evacuate its contents.

Operative Technique.—The operation performed in these cases for the removal of the appendix, as in other forms of relapsing appendicitis, was in all essential points the same as described in my paper referred to above. The abdominal incision was made from a point half way between the anterior superior spinous process of the ilium and the umbilicus in a vertical direction down to near Poupart's ligament. The cecum was used as a guide to the appendix. The free abdominal cavity was protected by sterilized gauze during the isolation and removal of the appendix. The mucous membrane of the stump was cauterized with pure liquid carbolic acid, the surplus acid carefully removed with a gauze sponge, the stump dusted with iodoform and buried by three or more Lembert sutures of fine silk, which included the serous and muscular coats of the cecum on each side. The line of suturing was made in accordance with the conformation of the cecum, in a direction which would cause the least tension, and without causing any unnecessary encroachment upon its lumen. I look upon this method as the ideal one in disposing of the stump, as it most efficiently guards against the two most serious after complications in such cases—infection and formation of a fecal fistula. I appreciate more and more the difficulties which so

Fig. 9.

Appendix (J. H. Croskey). Distal end, occluded, + section through about one-third of its circumference—× 25 diameters. *a*—Non-striped muscle fibers. *b*—Blood vessels. *c*—Collections of round or oval cells. *d*—Peritoneum. *b c*—Granulation tissue partially converted into connective tissue.

often confront the surgeon in performing this operation. Although I have had but one death in about thirty-five operations, for recurring appendicitis, I am always prepared to meet unexpected complications and inform the patient of the possible risks which he assumes in subjecting himself to the operation. As in none of the cases of obliterating appendicitis pus was found outside of the appendix, flushing and drainage were dispensed with. The external incision was invariably closed by four rows of sutures, the first of catgut including the peritoneum only, the second of the same material embracing the fascia of the external oblique, the third of silkworm gut including all of the tissues, and, finally, the fourth of very fine catgut in the form of a continued suture, to bring the skin in accurate contact. As I have observed a number of cases of ventral hernia following operations upon the appendix in my own, as well as in the practice of other surgeons, I am exceedingly anxious to prevent this occurrence by bringing the most important tissues in accurate contact by separate rows of the buried suture. I never permit patients to leave the bed in less than four weeks, and I advise them to wear a well-fitting bandage for six months as an additional safeguard against this exceedingly undesirable remote complication.

Fig. 10.

Appendix (J. H. Croskey). Proximal end; + section through about one-sixth of its circumference—× 25 diameters. *a*—Glands. *b*—Granulation tissue, the deeper portion more or less fibrous. *c*—Connective tissue. *d*—Non-striped muscle fibers. *e*—Blood vessels. *f*—Extravasated blood. *g*—A collection of cells like granulation tissue cells. The peritoneum is not shown.

CONCLUSIONS.

1. Appendicitis obliterans is a comparatively frequent form of relapsing inflammation of the appendix vermiformis.

2. It is characterized by progressive obliteration of the lumen of the appendix, by the gradual disappearance of the epithelial lining and glandular tissue, and the production of granulation tissue from the submucous connective tissue which by transformation into connective tissue and cicatrical contractions starves out remnants of glandular tissue, and finally results in obliteration.

3. The obliterating process manifests a progressive tendency, and may finally result in complete destruction of all glandular tissue and obliteration of the entire lumen.

4. The incipient pathologic changes occur either in the mucous membrane of the appendix, in the form of superficial ulceration, or as an interstitial process following lymphatic infection.

5. The most constant symptoms which attend this form of appendicitis are relapsing acute exacerbations, of short duration, moderate or no appreciable swelling at the seat of disease, and persistence of soreness and tenderness in the region of the appendix during the intermissions.

6. The process of obliteration may begin at the distal or proximal end, or at any place between, or it may commence simultaneously, or in succession at different points.

7. Obliteration on the proximal side gives rise to retention of septic material which finds an outlet through the lymphatics giving rise to non-suppurative lymphangitis and lymphadenitis.

8. Circumscribed plastic peritonitis is an almost constant concomitant of appendicitis obliterans, and hastens the process of obliteration.

9. Complete obliteration of the lumen of the appendix results in a spontaneous and permanent cure.

10. In view of the prolonged suffering incident to a spontaneous cure by progressive obliteration, and the possible dangers attending it a radical operation is indicated, and should be resorted to as soon as a positive diagnosis can be made.