5-1-1934

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April 1934

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Introduction

Diverticulitis today occupies an important place in medical literature and it is recognized as a distinct clinical entity by every operating surgeon of large practice. It is only within the past twelve to fifteen years that the profession has had an intelligent appreciation of this important condition.

Diverticulitis of the colon deserves repeated consideration because of the frequency with which it is encountered and the severity of the symptoms manifested in some of the cases. The treatment for the condition has not been definitely standardized, and it may be difficult to decide between operative and less radical measures.

Diverticulosis as well as diverticulitis is no longer a pathological curiosity, but appears in about twelve per cent of all of the x-rays of the lower gastrointestinal tract. Although not all of these give symptoms, they must be given due consideration in making a diagnosis of pathology in the lower abdomen.

The fact that diverticula often are symptomless does not rule out the fact that they might give rise to numerous complications that might terminate fatally.

Terminology

R. I. Rizer (42) defines diverticulum as a circumscribed dilatation of a part of the wall of any hollow viscus. Diverticulosis means the presence of diverticula usually not giving symptoms and the seat of no other pathology. Diverticulitis is a condition in which there is an inflammation of a diverticulum and usually means that the condition is located in the lower third of the large intestines.

History

Virchow (20) in 1853 described certain pathologic changes involving the descending colon and the sigmoid characterized by isolated circumscribed, adhesive, peritonitis. He even described some of the possible complications, adhesions, constrictions and perforation. He did not, however, note the presence of diverticula as the original cause, considering constipation as the etiologic factor, neither did he attempt to describe the clinical picture.

Graser, in 1898, presented a fairly accurate clinical and pathological description of diverticulum formation in the large bowel and showed that such cases were not uncommon.

Previous to 1898 the late Dr. C. A. Wheaton (38) J. T. Rodgers occasionally encountered cases of dense

infiltration and inflammatory changes in the ascending and descending colon. In these cases encountered by Dr. Wheaton and Dr. Rodgers, there would occasionally be an abscess, but, in several instances, nothing was discovered except a densely infiltrated bowel. Without exception they were all drained.

From 1900 on (20), many important contributions were offered particularly by American observers. Fisher in 1901 and Beer in 1904 did experimental work on the etiology of the intestinal diverticula. In 1907 the Mayos, Wilson and Fiffin reported several operated cases of diverticulitis, contributing particularly to the clinical aspects of the disease. In the same year Brewer offered a paper also describing the clinical manifestations of diverticulitis.

In 1907 Ashhurst reported a case of "Sigmoid Diverticulitis in a Child". This patient is the youngest case on record.

Telling in 1908, for the first time, collected and analyzed the recorded cases, classifying the pathologic changes and the clinical results. This classification has furnished the basis for most articles of importance written since that date.

Telling and Gruner amplified this classification basing the conclusions on a large number of cases.

During the last seven to eight years, there have been many contributions to both the clinical and pathologic features of multiple diverticulitis among whom are: Mayo, Wilson, Giffin, Hartwell and Cecil, Graves, Erdmann and particularly McGrath.

The x-ray as a means of diagnosis of multiple diverticuli was first brought to our attention by Dr L. T. LeWald who made a roentgen diagnosis of sigmoid diverticulitis in a case reported by Abbe in August 1914.

Carman in November 1914 and Case in 1915 described the radiographic appearance of multiple diverticuli of the colon. Since then a few contributions on this subject have been made by roentgenologists to periodicals and textbooks.

Anatomy and Classification

Erdmann classifies diverticula as acquired or congenital and false or true, the false in which one or two coats are absent, the true in which all coats are present.

Dr. Chas. Mayo (20) classifies diverticula as Erdmann has, and says that the various viscera and tubular structures of the body are subject to acquired diverticula. Even the large blood vessels are prone to this condition in the form of sacculated aneurysms.

A complete (20) diverticulum presents in its walls the same tissues and the same arrangement of lining mem-

branes as the normal intestinal wall. The incomplete or false diverticula consist of but part of the elements found in the normal intestinal wall. Diverticula of the large bowel may be found in any division of the large intestine, but are most commonly found in the descending colon and sigmoid.

Observations of George and Leonard (20) lead us to believe that diverticula occur in the ascending and transverse colon more frequently than has generally been believed. These diverticula are less likely to give symptoms than in the descending colon and sigmoid.

The number of diverticula vary from one to one hundred or more. Hanseman found four hundred at autopsy in a man of eighty five.

They vary in size from a small fraction to two or more inches in diameter. The tendency is to gradually increase in diameter. The average size is about that of a pea.

They are variable in shape being usually round or oval. Some are pedunculated, with a minute opening into the lumen of the intestines.

The contents of these pockets are almost entirely fecal material of variable consistency. Occasionally they are fecoliths.

The diverticula project from the exterior of the gut, usually close to the mesenteries' attachments.

They may be found between two layers of the mesentery.

On microscopic section, the diverticula are seen to consist of mucosa, usually submucosa and serosa. There is complete absence of smooth muscle fibers. In some of the larger diverticula the lining of epithelium is more or less obliterated, due to the continued pressure of the fecal contents.

Etiology and Incidence

F. DeQuervan (8) states that he believes that the outstanding etiological factor in diverticulitis is a weakened intestinal wall with constipation.

Keith (42) feels that diverticula are evaginations of the mucosa through the muscle coat at weak points in the intestinal wall, caused by increased intra-intestinal pressure.

Klebs (13) also offers the suggestion that traction upon the mesenteric border might be a possible productive cause through weakening of the walls.

S. G. Gant (19) says that in some, the etiology of acquired diverticulitis is obvious, but in other cases the causation of intestinal pouchings cannot be explained.

I. Age, through accompanying disturbed metabolism, weakening of the intestinal musculature and chronic constipation complicated by gas and fecal accumulation is an important factor, and sex is evidently a predisposing

cause, since the disease accurs more than twice as often in men as in women.

II. Wasting diseases, cancer, tuberculosis, colitis etc. with intestinal atrophy favor the formation of diverticula by impairing longitudinal and circular muscle fibers so that they stretch, break or separate allowing the mucosa to herniate through them when pressure is exerted within, in such cases normal colonic sacculations sometimes become exaggerated and are mistaken for diverticula.

III. Hemorrhagic infarcts, worms, foreign bodies, obesity (with fat intestinal wall) ulcerative colitis, dilated intestinal glands and other conditions have led to the formation of pouches by perforating, destroying or indenting the mucosa or impairing intestinal musculature.

IV. New growths, constipation and various chronic obstructive lesions responsible for obstipation, coprostasis and gas retention.

V. Intestinal pouchings occur more frequently at the site of appendices epiploicae, which undoubtedly are a factor in their production since such points are vulnerable because appendicies are continuous with the subperitoneal fat.

R. O'Callaghan (34) states that he has seen diverticula develope following a contusion to the abdomen combined with weakness of intestinal musculature.

E. S. Judd (26) says that the fact that diverticula rarely occur in young persons would indicate that they are not congenital although this point has been widely discussed. There is believed to be a congenital predisposition.

Erdmann (14) states that the arguments of Klebs (close relation to points of exit and entry of blood vessels in the intestine along the mesenteric attachment) are fallacious. He states that in his series of patients operated upon and those patients in whom these protrusions are found inactive, while operating for other causes, the most frequent site is that of the convex and lateral aspects of the colon, chiefly in the fat lobules or epiploons and rarely found in the mesenteric folds. Further, Klebs view of mesenteric traction acting as a tendency to weaken the wall, thereby being a productive factor appears to Erdmann to be of little weight.

It appeared (27) very significant that no case has occured in a child, the lowest reported age being twenty-two years. This has been disproven, however, by Ashhurst who reports a case of age seven.

The physiological role of the sigmoid with its retention of foecal matter and gas is stated to be important as is muscular deficiency of the gut wall associated with constipation and flatulence.

Lockhart - Mummery (28) also concludes that since cases have been watched with x-rays over long periods it has become quite obvious that the condition is often, if not always, progressive and that in course of time diverticula can be seen to develope in areas of the colon which were previously free.

Dr. E. I. Spriggs was one of the first men to describe the condition of "pallisading" in a roentgenogram. He and his associates concluded that the appearances were due to a chronic inflammatory condition of the colon wall, and they further argued that this inflammatory condition gave rise to the formation of diverticula.

H. Drummond (9) states it seems most probable to him that diverticula start as true pulsion of the herniae of the mucous membrane through the ridges in the circular muscle coat at the weak points where the blood vessels enter and that often their formation is followed by a retained fecal content setting up inflammation which spreads to the neighboring tissues.

Diverticulosis (41) associated with septic foci elsewhere, such as septic teeth, arthritis of the spine, or cholecystitis which would provide a focus of infection.

A. E. M. Woolf (45) says it seems permissable to suggest that the essential fault in diverticulosis was

a disturbance of the neuromuscular system of the intestines.

Keith demonstrated in the note that in diverticulitis there seemed to be a neuromuscular dysfunction of the rhythmical contraction of the segments of the large intestine. Eventually a little piece of mucous membrane was caught up or even intusscepted into the widened gap between the muscular bundles.

Constipation (7) and flatulence have long been held as prime agents in the production of diverticula.

Graser (18) gave us the theory of periodic mesenteric congestion as a possible cause of diverticula of the intestine. Sudsukis says that diverticula are due to loss of perivascular fat.

C. D. Enfield (12) states that most of his patients have been past forty years of age with an antecedant history of chronic constipation.

Hartwell and Cecil (40) sum up their opinion as to the etiology of the disease often considering the various theories as follows:

We, therefore, are drawn to the conclusion that no complete explanation of the primary cause of intestinal diverticula has been offered. The most that can be said is that for some cause a weakness exists in the intestinal coats and by reason of weakness a pouching of the coats takes place when undue pressure arises.

Incidence

In 13,069 necropsies (27) performed at Dresden City Hospital, Boston City Hospital and the Bender Hygienic Laboratories, there were found 39 cases of congenital diverticula, 16 instances of acquired diverticula of the small intestines and 28 cases in the large gut.

W. J. Mayo (10) states that diverticula occur in 5.71 per cent of cases of gastrointestinal conditions. He is of the opinion that about 12 per cent of the cases of diverticulosis, acute diverticulitis will develop.

Spriggs and Morxner found that 10 per cent of their patients examined with the barium meal showed definite evidence of this condition. W. J. Mayo states also that .5 per cent of all persons over forty years of age have diverticulitis.

Pathology

The pathological (15) conditions found may be of the same varieties as there are types of appendicitis from a simple catarrhal, better called acute type, to the types of exudative and occlusive changes and of ulcerative to gangrenous and perforative evidence. These may or may not all be accomplished by, or rather followed by, exudate to true abscess formation, and finally the acute processes may recur or never resolve and malignant changes are reported frequently enough to give some

weight to the possibility of an implantation of a malignant nature on a former simple inflammatory process.

The pathologic (7) features of a majority of cases of diverticulitis are those of a chronic inflammation of the bowel wall, arising at first from one or more diverticula, but later involving all the coats of the intestine including sooner or later, the peritoneal coat and later spreading to the surrounding structures.

Grossly the pouches look like pea-shaped projections from the bowel. These may be contained in the appendices epiploicae, they are most difficult to distinguish in situ and all that one sees is a tuberous like appearance of the bowel. When, however, the fat is stripped off, the diverticula are seen as typically bottle-shaped outpocketings, dark blue in color. The characteristic dark blue color is due to the fact that the mucosa and submucosa have herniated through the muscle wall and the contained fecoliths are seen through this wall. Usually a thin strip, whitish in color, can be made out about the neck of the diverticulum, marking the limit of the muscle covering.

Microscopically, there is a rarefying of the bowel muscle in the diverticulous area, the mucosa and submucosa may be seen penetrating the coats of the intestinal wall. Following the development of the pericoli-

tis, as the process continues, abscesses and fistulae are formed. The sites of spread are commonly to the bladder, small intestines, and abdominal wall in the male while in the female, in addition to these, the adnexa and uterus are frequently involved as the chronic inflammation continues, it leads to a fibrous thickening of the gut wall with resultant stenosis of the bowel with a wall from one half to one inch in thickness. Accordingly, it may be seen that the attack of diverticulitis with threatened obstruction may occur as the result of two conditions which differ widely in their ultimate gravity. The first type is where there is an attack of acute diverticulitis with the mucosal folds of the intestine inflamed and edematous, but without any implication of the other coats of the bowel. The second type is that in which there is a fibrous constriction of the bowel wall. In this type the mucosal swelling is at a minimum with the bowel rigid and the danger from obstruction is greater.

Continued (10) impaction will lead to ulceration and infection and may result in perisigmoiditis.

Although the infection will usually empty through the lumen of the diverticulum into the gut, it may also perforate externally and lead to abscess formation.

There (5) may be a retention of fecal material in the diverticula causing a spastic condition of the colon.

C. D. Enfield (32) says that the fecal matter in the diverticula does not cause symptoms unless the diverticula become inflamed.

The question (35) is brought up from time to time in patients in whom search is being made to find a focus of infection to explain remote constitutional disturbances, e.g. joint symptoms, as to whether an infected diverticula may act as such a focus.

Adain and Nicholls (38) call attention to the frequent association of chronic pulmonary affections in old people showing diverticulitis. Ulceration of an infected diverticulum may cause hemorrhage of the bowel.

C. H. Mayo has called attention to the fact that a diverticulitis low in the sigmoid or in the rectum is the cause of huge rectal fistulae.

J. I. Case (6) gives us the following pathological classification:

(1) Enterospasm type - including that type of case in which the diverticula even though numerous are scattered and where the symptoms are apparently only those of enterospasm kept up by continuous renewal of intestinal irritation from retained contents of the diverticular sacs.

(2) Hyperplastic type - in which the diverticula are situated fairly close together especially in the

region of the pelvic colon where an account of their grouping, the peridiverticular inflammatory reaction and the consequent production of connective tissue tends to produce a tumor with resulting organic obstruction.

(3) Pseudoappendicitis type - where one or more of the diverticula even where the saccules are not generally characterized by peridiverticular inflammation undergoes an acute inflammatory process analogous to that occurring with acute appendicitis. We may include in this group inflammations of an epiploic type.

The (1) induration of the wall of the sigmoid in the neighborhood of the inflammed diverticulum gives to the palpating hand of the surgeon and to the eye the impression of cancer.

No diagnosis of cancer of the colon, if inflammation exists, should be made without a microscopical biopsy of the tissue.

Otherwise, in a case of so-called cancer of the sigmoid, pronounced by the surgeon inoperable, the period of life alloted to the patient by the surgeon may prove far too short because he had only diverticulitis.

Diverticulitis seems to predispose to cancer. Only a thin bottle-neck communication exists between

the diverticulum and the bowel proper, through this there is insufficient drainage. Consequently there is apt to ensue slow, attenuated chronic inflammation persistent irritation with continuous epithelial and connective tissue hyperplasia. Diverticula in the sigmoid may account for the large per centage of cancer of the colon as compared with the rest of the bowel.

Cancer starting from the diverticulum has two characteristics. (1) The cancer often does not encroach upon the lumen, which, therefore, gives no filling defects in the roentgenogram. The starting from a diverticulum will not cause partial obstruction as in most intestinal cancers, but its early symptoms will be slow perforation and abscess formation outside of the bowel, appearing retroperitoneally in the lumbar or inguinal region.

Dr. Wm. Mayo (42) writes the only known fact of importance in the etiology of carcinoma is its relation to chronic irritation. The term precancerous is used to denote certain cell changes taking place in the area of chronic irritation which if found in connection with invasion of the tissues would be typical of carcinoma.

Carcinoma occuring so infrequently in association with diverticulosis makes on wonder whether or not the association with it is not one of coincidence. The fact that both conditions have a predelection for the lower half of the colon makes the idea of coincidence more probable, a similar relative relationship exist-

ing as between peptic ulcer and carcinoma of the stomach.

Symptomatology

There is usually (44) abdominal pain after generalized and crampy at the onset, moderate fever, leukocytosis and soon localized abdominal pain, tenderness low in the left side with muscle rigidity. Often the attacks will pass of in a few days, only to recur months or years later. The more severe attacks may go on to an abdominal abscess which has to be drained externally and often is associated with fecal fistulae.

Lynch (30) says that all people with diverticulosis have symptoms, but the symptoms are overlooked and are considered as being due to dietary indiscretion and the like. There is always a dull aching pain. The average practitioner unfamiliar with diverticulosis would not associate with that disease a dull aching pain accompanied by occasional attacks of diarrhea alternating with constipation and gaseous distention.

Where a (4) peridiverticulitis has occured obstructive symptoms not infrequently supervene.

Onset (31) of symptoms usually brought on or precipitated by some form of purge or by injection of rough or irritating foods occasionally it follows straining at stool. J. R. Morrison (33) gives evidence of a case of self medication with a resulting diver-

ticuli, bran caused an irritation of the diverticuli and resulted in a diverticulitis. There is sometimes an initial chill and then the temperature rises to 100° F. or higher. An acute attack may last from a few hours to two or three days. Defication usually gives marked relief.

Some (11) patients have vague and intermittent pains, perhaps occasionally cramp-like in character in the left lower abdomen associated with a tender palpable rope-like sigmoid. Accompanying the pain may be bladder symptoms.

W. W. Bailey (3) states that abdominal uneasiness, discomfort, sinking sensation, digestive disturbances moderate constipation and gas accumulate are the chief symptoms.

In subacute (17) variety of diverticulitis there is often a state of subsidence which enables the x-ray diagnostician to help us out. In the very low grade type with marked infiltration, the patient presents the occasional evidence of obstruction in mild or incomplete form with no evidence of blood or mucous as in carcinoma.

E. S. Judd (26) and J. W. Pollock say that the majority show no symptoms. Principal symptom was pain, constipation, abdominal tenderness, gas in the bowels and palpable tumor.

J. T. Rogers (38) points out that multiple diverticuli of the large intestines are not infrequently found at autopsy with no history of symptoms produced by their presence. Oftentimes, a tumor mass if first noted in the left lower quadrant. The tumor disappears only to reappear in a few days.

Masson of the Mayo Clinic states that 79 per cent of his cases had attacks of pain and that 34 per cent had recurrent attacks of pain, tenderness and rigidity with tumor in the left side.

Later (19) in diverticulitis when inflammation has extended deeply into or through the diverticulum, peridiverticulitis localized tenderness and cramps obstinate constipation alone or alternating with diarrhea, the sensation of blocking, fecal impaction and pain in the sigmoid region when the bowel is almost occluded there is marked gas and fecal retention, severe pain, muscular rigidity, nausea, vomiting, increased diarrhea and leukocytosis.

Perforation takes place there is the usual signs of spreading peritonitis when an abscess is formed continued localized pain and swelling are in evidence until it is drained.

Muscular (23) rigidity of the lower abdominal wall, pain in the region of the umbilicus radiating into the pelvis or left lumbar region with frequency,

a variable increase in temperature pulse rate are usual findings in acute diverticulitis.

J. D. Saner (39) in his series of cases points out that vague abdominal uneasiness with constipation and occasional attacks of pain are characteristic of diverticultis with no history of macroscopic blood.

In a series of cases studied by A. E. M. Woolf (45) the initial symptoms were those of early dyspepsia, irregular dyspepsia, flatulence and obesity. A common symptom was pain when the bladder was full due to adhesions to the bladder. Fistulae might be the first symptom.

A. E. Benjamin (4) from his study gives the symptoms of diverticulitis in order of frequency of occurrence:

I. Increasing disturbance from gas in the intestine.
II. General abdominal distress and pain.
III. Constipation.
IV. Pain in the left iliac region.
V. Bladder discomfort and frequency.
VI. Occasional diarrhea.
VII. Nausea and vomiting.
VIII. Pain in the rectum.
IX. Passage of blood.
X. Gradual loss of weight.
XI. Acute attacks of pain with fever and chills.

XII. Acute obstructive symptoms.

XIII. Acute perforative symptoms.

J. D. Gorham (21) contends that diverticulitis is found in the sthenic individual and it is especially noteworthy that in both, one often finds an automatic unbalance as denoted by vagus hyperirritability and a segmental spasticity of the intestines.

In all cases (38) of abscure abdominal pain, especially in the left side whether in patients past middle life, fat or thin, unless the cause is definitely determined, diverticulitis should be suspected.

Diagnosis

Ordinarily (24) the patient will complain of vague, intermittent pain, occasionally cramp-like in severity, in the lower left abdominal quadrant. Ocasionally the pain is most pronounced in the lower mid-abdominal region. Many patients will complain of bladder symptoms, notably frequency and tenseness. If the abdominal wall is thin it is usually possible to palpate a tender rope-like, hard, nodular sigmoid. The sacculation usually becomes filled with fecal material which becomes inspissated and often impregnated with calcium salts forming rock-like fecoliths.

The development of large inflammatory masses with or without perforation may produce angulation and obstruction.

Acute diverticulitis usually produces the symptoms of a left-sided appendicitis. The severe sudden abdominal pain is usually generalized at the abrupt onset of illness, but becomes localized in the region of the suppurative diverticulitis. These symptoms are accompanied by localized tenderness, muscle spasm, fever and leukocytosis, nausea and vomiting may occur. While the suppurative process remains restricted to the diverticulum, the fever and leukocytosis are usually of the mild degree. Extensive ulceration of the mucosa of the diverticulum is rare, so that it is unusual to find blood in the stool.

Unless the symptoms indicate that immediate operation is advisable, roentgen studies should be made. The roentgenographic appearance of diverticula of the large bowel is usually characteristic and diagnostic. If the saccules are filled with fecal matter, it is often impossible to outline the diverticuli with the barium mixture. A ragged spastic "saw-tooth like" appearance of the large bowel is highly suggestive and should invite further roentgen studies. If roentgenograms are taken from 24 to 72 hours after the opaque meal is given, the residue of barium will frequently outline the pockets after the lumen of the bowel has been emptied.

Age (15) of the patient is of importance. The majority are short, stocky males, well nourished and overweight, 40 to 45 years of age, giving history of dietetic indiscretion, as is also so often noted in taking a careful history of appendicitis.

Onset characterized by pain in the abdomen, which is more definitely located, early, in the left lower quadrant than is the localization in appendicitis.

Graedel (22) states that only the mucosal and submucosal type of diverticuli are difficult to diagnose, the other true protrusions of the intestinal wall appear usually quite distinct especially after a portion of the barium enema has left the rectum.

Benjamin (4) believes the x-ray most valuable in diagnosing, diverticuli may retain barium many days, demonstrating how long enteroliths may remain in some diverticuli.

Cystitis has led many clinicians astray. They have not always recognized the cause as arising from an abscess of a diverticulum and bladder infection therefrom. Likewise, prostatic symptoms in the male, as well as bladder pressure and discomfort in both sexes, can originate in a diverticulum of the sigmoid.

Blood occurs in stools in about 3 to 8 per cent of cases usually in association with a malignant condition according to the findings of D. F. Jones (25).

J. I. Case (6) believes that in some cases sigmoidoscopic examination offers some help and should always be made. It is occasionally possible by this means to visualize the orifice of one or more of the diverticuli and often one may draw conclusions regarding the regidity or fixation of the pelvic colon. Being careful of a possible rupture of diverticuli during examination.

If one definitely (6) suspects a diverticulitis but finds no signs of the diverticuli with the opaque meal, it may be helpful to give the maximum physiologic dose of belladonna or atropine during 24 to 48 hours. Then prepare the colon with cleansing enemas. The antispasmodics will differentiate between spastic colon and stricture.

Diverticulitis may also be added to lesions of the right side of the abdomen, sometimes associated with an acute appendicitis.

L. T. Lewald (29) has brought to light the fact that one of the most striking evidences of diverticulitis is the presence of a localized narrow lumen with spasticity, indicative of surrounding pressure, such as might be caused by an inflammation with exudate. If the opaque injection be given prior to the meal, this narrowing may be the only indication of diverticulitis, for in his experience diverticuli have been more fre-

quently observed after an opaque meal than after an injection.

Filling defects often noted in some cases in the exact region where the patient complains of pain and where tender mass may be palpable.

The lack of filling associated with irritability differs from a filling defect due to new growth in that the former is not constant and is not obstructive. It resembles more the roentgen appearance of an ulcerative lesion of the colon such as tuberculosis where the most characteristic finding is a spasmodic filling defect due to irritability of the inflamed mucosa.

The greatest (14) difficulty in making a positive diagnosis prevails in cases of perforated malignancies as in these patients, owing to the perforation, we have an absorption or infection, temperature and a tumor mass in both the malignancy and the infection. Carcinoma brings to light an occasional pain, colic, constipation, loss of weight, blood or mucous in the stool, and secondary anemia.

Differential Diagnosis

Erdmann (16) says the differential diagnosis rests between a possible but rare left-sided appendix and carcinoma. A normal appendix may be so long as to extend to the opposite side. Abscesses have been opened

in the left that subsequent operation proved to be of appendicular origin in the right side.

Adenocarcinoma is a disease of late years, diverticulitis usually occurs earlier in life. Ulcerative perforations in carcinoma without previous distinct symptoms for some time are exceedingly rare. Mucous and blood in carcinomatous conditions, alternation of constipation and diarrhea, loss of weight with secondary anemia is the usual finding.

Pain (20) is not a constant symptom in carcinoma until obstruction has arisen. Blood on the other hand may be an early finding in carcinoma and when a tumor is present it is a permanent tumor, and this is not always the case in diverticulitis.

Left-sided appendix (26) can be ruled out by the x-ray. X-ray of a case of diverticulitis shows evidence of definite diverticuli with a spasticity and inflammatory thickening of the intestinal wall and partial obstruction.

Sigmoiditis (6) is an older disease which may have a special dysenteric or local bacterial origin and usually ends in spontaneous recovery.

Syphilis is rare in the sigmoid and colon, but there are other evidences of lues which can be brought out in any suspected case.

Actinomycosis usually occurs in the cecum and the clinical and pathological developments are very much different than in diverticulitis.

Pelvic lesions are usually left-sided, but the bemanual examination and the history usually permit a differentiation.

H. E. Potter (36) reports a case of gall stones confused with colon diverticuli. The faceted appearance of the gall stone is often of a great deal of value in differentiating diverticuli from gall stones. Another point is the rarity of diverticuli in the gall stone region. Visualization of the gall bladder by dye and visualization of the hollow organ by barium will, of course, serve to orient such shadows and prevent an error in what might otherwise be considered a rather clear cut demonstration of gall stones.

The proctoscope (25) is of value in differential diagnosis and in case of a bleeding carcinomatous mass, the objective findings upon observation are of great value in making a differential diagnosis between carcinoma and diverticulitis.

Prognosis

S. G. Gant (19) states the mortality is nil, and recovery promptly follows the removal or infolding of small or large uninflamed inactive pouches; there is some danger from operation for chronic diverticulitis and the mortality is rather high in cases in which

operation is performed during an acute crisis complicated by marked obstruction peritonitis or abscess formation.

C. D. Enfield (12) in following his series of cases found that in the acute cases with early operation, prognosis is good, while in chronic cases with resection, it is equal to that of all ordinary large intestinal surgery of relative intensity.

Treatment

C. W. Barrett (2) contends that the most important step in the treatment of diverticulitis is prophylaxis. When diverticulosis has once developed, great care should be exercised to avoid excess food and especially irritating foods; foods containing small sharp seeds. The bowels should be kept empty and harmful bacteria reduced to a minimum. Enemas and careful manipulation should be used to free the diverticuli of stereoliths, foreign bodies and bacteria.

J. W. Rankin (37) and P. H. Brown are of the opinion that medical treatment of diverticulitis is preferable and usually only when complications occur, is operation to be undertaken. The prescribed treatment medically is as follows: Rest in bed, residue of free diet at onset, icebags to the lower portion of the abdomen, and rectal irrigations with hot physiological

solution of sodium chloride. As the condition subsides in the course of a few days, a bland anticonstipation diet is instituted and mineral oil is given orally, administer 4 - 8 c.c. T.I.D. Hot irrigations discontinued as soon as the inflammatory reaction subsides and the bowel begins to empty naturally. Patient is also given Tincture Belladonna 5 - 15 min. T.I.D.

Careful education of the colon and the practice of hygienic measures tending to improve intestinal flora are prophylactic means of undoubted value in combating the development of diverticuli and the mutation from a diverticulosis to a diverticulitis.

Medical treatment as outlined by J. I. Case (6) is as follows: malt sugar or glucose enemas employed under low pressure, warm olive oil 4 - 5 injected after enema. All purges should be abandoned and antispasmodics indicated. Bismuth subcarbonate is of value in subsiding infections.

L. T. LeWold (29) has had success in the treatment of a large number of his cases by the use of colonic irrigation some form of catharsis and the patient being confined to bed during the attack.

Judd and Pollock (26) are convinced that a case of diverticulosis is not progressive and unless there are symptoms from the diverticuli, no treatment other than palliative, such as regulation of the bowel move-

ment is indicated. Conservative measure rather than an operation should be seriously considered in all these cases.

If the discomfort (8) is of a mild nature, of the type of a spastic colitis which does not affect the general condition, then one will refrain from operative interference and confine oneself to regulating the diet and controlling the patient on regular medicinal lines. If the disturbance be marked, if there be much hemorrhage, or if attacks of obstruction have already occurred, operation is the only treatment.

R. I. Rizer (42) puts the patient on a diet of puree vegetables, encouraged them to drink fluids, eat cooked fruits, coarse bread and butter, cooked cereals, also the patient is put to bed and given tepid sponge baths. Locally one ounce of 1 per cent aqueous solution of mercurochrome is injected into the rectum to be retained as long as possible. Heat is applied externally.

Dudley Roberts (38) stresses the importance of medical treatment and claims that it is extremely satisfactory. He advises daily doses of agar and mineral oil, small injections of warm water, large doses of bismuth weekly by enema or mouth, injection of hot gelatine 8 3/4 10 per cent solution introduced into the sigmoid at a temperature of 120° F., antispasmodics, lu-

minal and atropine three times a day. He claims surgery is only indicated for a sequellae.

Acute diverticulitis is a surgical problem since there is no way of destroying the sac except by operation is the opinion of S. G. Gant. Numerous small pouches and those of moderate size that have not undergone secondary changes may be buried by coloplication or ligated, excised and the stump inverted with a purse string suture or the wound closed, if long, with through and through reinforced by Lembert stitches.

Removal of the sacs and resection of the involved bowel is impractical when diverticuli are numerous and widely scattered, and the intestine should be short circuited. In case of an abscess, incise, irrigate and drain, only partially closing the wound after destroying binding adhesions. When there is a fistulous opening between the bowel or bladder and diverticulum after the sac has been dissected free and the edges cauterized, the aperature is closed by infolding sutures.

In case of acutely inflammed diverticuli, Rogers would operate as soon as diagnosis was sufficiently certain to justify operation. In the hyperplastic inflammatory forms of multiple diverticuli and small abscesses, drainage is all that is necessary. Where a vesicle fistula is formed the operation is more form-

idable and will require a possible resection of the sigmoid as well as excision of a portion of the bladder wall.

In cases of obstruction, if the condition found justifies the attempt, excision and end to end anastomosis will be the proper procedure. If conditions are such that the danger of primary resection is too great, a colostomy above the diseased area is advisable and a resection may be made later when the infection has subsided.

If the disease is so located that a Mikuliez three-stage operation can be performed, it may seem advisable as the mortality from this operation is much lower than operations as primary resection.

A. Primrose finds the Mikuliez operation most satisfactory in cases of diverticulitis of the sigmoid with obstruction. In such cases it is possible to bring out the loop and to excise the affected portion of the bowel with subsequent closure of the fecal fistulae. This, no doubt, is the ideal treatment in suitable cases, particularly in view of the fact that cancer is sometimes engrafted upon a diverticulitis.

J. F. Erdmann (17) treats some of the chronic cases of diverticulitis with partial obstruction by establishing an artificial anus proximal to the obstruction. This operation allows obsorption to take

place in the thickened portion so that eventually the channel has almost reached normalcy, whereas in other instances resection of a portion will be necessary.

End to end suture has a greater life hazard than the former operation, while the side to side anastomosis type of operation is practical only in certain cases.

In the cases in which mass formation has not occurred, attempts at repair of the perforation are in order and meet with great success in the acute cases, where abscess exists liberal drainage and attempt at repair are indicated when feasible, otherwise liberal drainage only.

In the acute variety, which is situated between the plates of the peritoneum in the mesentery, it has been Erdmann's custom to split the peritoneum on both sides parallel to the vessels so that free drainage will occur from the fat of the mesentery and that most vicious type of absorption, a retroperitoneal lymphatic is diminished.

P. H. Miller (32) often does an appendicostomy or cecostomy as useful adjuncts in the surgical treatment of chronic diverticulitis since they provide for through and through colonic irrigation, which heals inflamed and ulcerated areas, frees the bowel of irritants and facilitates convalescence from autointoxication.

R. Warren (43) contends that it is an unreasonable risk to remove such a large amount of colon as would be necessary to eradicate entirely all diverticuli and it will be wiser to adopt medical measures especially in older individuals.

J. W. Rankin (37) and P. H. Brown also believe it more essential to confine surgical operation in this ailment, to chronic complicated cases or to cases of the acute type in which the condition has progressed to perforation. The complications which arise and necessitate surgical intervention are: (1) acute perforation, (2) abscess, (3) fistulae, (4) inflammatory obstruction, and (5) malignancy.

Acute perforation of a mobile segment of the colon, where diverticulitis more frequently occurs is unusual. Usually perforations from diverticulitis are not into the free peritoneal cavity because the inflammatory reaction most commonly draws to the sigmoid either loops of the small bowel or fixes the sigmoid to the lateral parietal peritoneum, bladder or anterior abdominal wall. Consequently, penetration and abscess more commonly results. In acute perforation, the ideal type of procedure is to remove the offending diverticulum, close the opening and drain the peritoneal cavity.

Abscess may form and perforate through the abdominal wall or it may perforate into a viscus.

If the diverticulum (24) should rupture through the following, its withdrawal from the abdominal cavity, little or no harm results. Hot boric acid dressings should be applied to the exposed loop of infected bowel until the infection has become inactive. After the inflammatory process has entirely subsided, it is possible to release the loop of bowel and place it beneath the abdominal muscles external to the peritoneum.

W. D. Haines (23) in his handling of cases of perforation says that attempt at closing these perforations at the primary operation are futile. The bowel wall is edematous, the suture yields, and it fails to heal. There is, however, a favorable tendency to spontaneous closure after drainage.

Summary

1. The actual method of the production of diverticulae is unknown. The most widely accepted theory is that of a weakened intestinal wall with increased intraintestinal pressure.

2. Diverticulosis of the colon being a precursor of diverticulitis is not to be regarded lightly, and vague gastro-intestinal upsets and attacks of flatulence in adults between the ages of forty and sixty warrant further investigation which should include a barium series.

3. Various stages of the disease have been noted all of which may be present at the same time in the same segments, or in different parts of the bowel.

4. Diverticulitis in the minds of the majority of clinicians and surgeons is essentially a non-surgical entity, surgery being employed mainly in the treatment of complications.

5. It is true that the chief diagnostic difficulty of chronic diverticulitis lies in the multiplicity of subjective symptoms that may occur none of which is pathognomonic or major in character, and that it is only by finding the typical shadow on the x-ray plate or by inspection of the diverticulum at operation or on the post-mortem table that we can be sure. The x-ray is not infallible. If there exists much inflammation about the neck of the diverticulum due to obstruction it

cannot be visualized.

6. The proctoscopic examination is usually only of negative value.

7. In the differential diagnosis carcinoma is most important. It is most probable that malignancy occurs independently of diverticulosis.

8. The differential diagnosis between carcinoma and diverticulosis of the sigmoid may at times be impossible except by biopsy. Blood may occur in the stools in both conditions.

9. It is probable that all acquired diverticuli, especially of the colon, show, at some time, inflammatory changes and are potentially a source of infection and irritation and are thereby directly or indirectly accountable for symptoms.

10. It may be surmised that acute and chronic diverticulitis of the colon is a comparatively common disorder. If this be so, then the role of this disease appears to be important if we are to continue to accept focal infection as possible etiological factors in certain systemic conditions. The lymphatics of the intestines serve as conveyors par excellence of toxins and infections.

Case Reports

Case I (1) J. M., aged 48, fleshy workingman, admitted to Harper Hospital Sept. 26, 1922.

For the past month he had slight attacks of abdominal pain, and at times diarrhea and constipation. The day before entering the hospital there was intense pain in the abdomen, tenderness and vomiting. At first the pain was general, then it became localized in the lower left abdomen. He was a very sick man, the skin cold and clammy with sweat, abdomen rigid in both lower quadrants, slight elevation of temperature, pulse 120, leucocytes 17,150, 86% polys.

He was immediately operated upon with a diagnosis of acute appendicitis. Right-sided incision showed the appendix only reddened like the intestine elsewhere. A large inflammatory mass was felt in the lower sigmoid, which was covered with inflamed fat tabs. No gross perforation could be seen. The fibrin covered part of the sigmoid was walled off with iodoform gauze and the man made a slow recovery. On Oct. 14, 1922, the piece of inflamed bowel was resected, on account of the condition being a possible malignancy. The patient made a good recovery from the resection and anastomosis. Microscopical report showed the tissue to be entirely inflammatory.

Case II (1) F. I. male, aged forty-three, very fleshy, referred to Dr. Ballin Sept. 17, 1919.

His illness began six days previously with acute abdominal pain in the appendix region, and he came home from the west with all the signs of a progressive case of appendicitis. Examination showed tenderness over the appendix, leucocytes 18,000, 76% polys.

At operation the appendix was not inflammed. In the middle of the ascending colon, toward its lateral side lay an inflammed fat tab tightly adherent to the colon, covering over some dark, nearly hemorrhage infiltrate in the colon. Drainage was established at this point, the appendix was incidently removed and the man made a complete recovery. The described is a case of a perforating diverticulum in the ascending colon.

Chronic Diverticulitis

Diverticuli of the colon without symptoms have been found in a great number of autopsies; still there is no doubt that certain intestinal complaints should be referred to diverticuli. Such complaints are constipation, feeling of fullness, mucous in the stools and aching in the left side relieved by defecation. Constipation may contribute to the formation of diverticuli.

Case III (1) E. H. male, aged sixty-eight, for twenty years complained of "gas" and that he had to have three or four bowel movements every morning and use an enema before being relieved. Four years ago a very large prostate causing dysuria was removed. While the urinary symptoms were relieved, the somewhat expected relief from gas did not result. Three or four days after an opaque meal, roentgenograph showed multiple diverticuli all along the transverse colon and sigmoid. Waste free diet and an irrigation of the colon gave this man more relief from his gas and tenseness than any previous measures.

Case IV (1) Mrs. O., aged forty-eight, complained for years of intestinal symptoms mainly "gas" and desire to go to stool several times every evening and some passing of mucous, but no diarrhea. Appendectomy and several pelvic operations gave no relief. At the last operation by a very prominent surgeon, diverticuli of the upper and lower sigmoid were discovered in such position and extent that resection was not deemed advisable. Waste free diet and colon irrigation every morning also made this patient fairly comfortable.

These and similar cases should suggest looking for diverticuli whenever chronic intestinal stasis is encountered with complaints of gas and frequent desire to stool in the morning.

Case V. Mrs. M. P., sixty-eight years old, had been under observation for a long time on account of nausea, vomiting loss of weight, and constipation associated with pain in the lower bowel. An x-ray diagnosis of multiple diverticuli of the sigmoid with obstruction had been made. She had apparently a very marked reversed peristalsis with fecal vomiting. The first stage of a Mikuliez operation was done under pernocton anaesthesia and a small opening immediately made in the gut to favor drainage. There was no improvement. The involved area was then resected, but vomiting continued. Transfusion and feeding into the colon did not improve the general condition. She died eight days after operation from general asthenia. The specimen presented numerous diverticuli filled with hard concretions. At one place the lumen was completely obliterated by a semi-gelatinous translucent tissue which was later reported gelatinous carcinoma.

Case VI. Mr. M. O., forty-six years, admitted four days after an acute onset of abdominal pain and vomiting for years had attacks of indigestion, was troubled with gas, and at times had colicky pain in the left lower abdomen. Little blood in stool for many years. On admission chief complaints were pain and incessant vomiting. He looked very sick, eyes sunken, temperature

100° to 102°, pulse 90 to 120. A tender mass was palpable in the left lower abdomen with signs of peritonitis. White blood cells 16,000, polymorphonuclears 86%. Barium clysma, given carefully, showed deformity of sigmoid 6 to 8 inches in length. Barium passed through slowly and filled the upper descending colon and part of the transverse. Operation was done within a few hours after admission. Suppurative peritonitis was found, pus removed by suction. A large inflamed sigmoid was exposed, partly covered with fibrin. Loops of small gut were adherent on the mesial side. Upon separating them there was a gush of foul-smelling pus from a large abscess. In contact with this the wall of the sigmoid over an area the size of a silver dollar, was gangrenous and flaccid. Pus had extended upward between the loops of intestines along the posterior abdominal wall and in the left lumbar gutter. To prevent further leakage and later be able to resect the affected gut, a first stage Mikulicz operation was done. The arteries of the mesentery were found normal but several veins throughout were thrombosed. Ample drainage was established. In spite of this the condition did not improve. Temperature rose to 107° F. and the patient died on the fourth day. Pathological diagnosis--chronic sigmoiditis, acute suppurative perisigmoiditis with diverticulitis.

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