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Diverticulosis and diverticulitis of the large bowel

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DIVERTICULOSIS and DIVERTICULITIS of the LARGE BOWEL

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INTRODUCTION

Diverticulosis and diverticulitis are fairly common among people over forty years of age, and it may be fairly accurately diagnosed, if previous note has been made of its several clinical pictures.

The following pages contain a sketch of some of the more important literature written about diverticulosis and diverticulitis. An attempt has been made to group similar phases of the literature into sections, and these sections are in turn, organized, mor or less in a chronological order. The latter arrangement was adopted to indicate the general trend in thought, except in certain instances in which contradictory statements were made at nearly the same time. These contradictory views when expressed at about the same time, were grouped together to denote that the last word has not as yet been conceived concerning various phases of diverticulosis and diverticulitis.

DEFINITION

Diverticula are blind tubes or sacs branching from cavities or canals. (9) When diverticula are present in the large bowel, the condition is termed, "Diverticulosis". If these diverticula become inflamed, the condition is termed, "Diverticulitis".

Diverticula may be of two types, those in which all the layers of the gut are present and those in which all the layers of the gut are present, except the muscular layer. The latter is the more common form. The former has been referred to as the congenital or true diverticula while the latter has been referred to as the acquired or false diverticula. (10), (23), (37), (46) At the present time there is some disagreement on the accuracy of this method of classification. (9)

These diverticula assume a flask-shape in which the neck is constricted by the wall of the bowel and the body is dilated beyond the bowel wall. The average diameter of the aperture is from one to three millimeters and the average diameter of the body is four to eight millimeters. (9)

They occur through-out the large bowel, and they vary in number, sometimes occurring singly but they usually are multiple, in rows or clusters. (36), (52)

HISTORY

Until the beginning of the present century very little had been written about diverticula of the colon and, with the exception of Cruveilhier (1849), Virchow (1853), Sidney Jones (1858) and Graser (1889), no one had attempted to clarify the problem. (9)

Virchow (73) 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, constriction 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.

Sidney Jones (27) in 1858 reported a fistulous communication between bladder and bowel, secondary to an inflamed and ulcerated diverticulum of the sigmoid flexure.

Graser (26) in 1898 stated that diverticula of the large bowel are not so uncommon and are of great importance. He emphasized the importance of, and described the hyperplastic stenosing type known as peridiverticulitis, and its simulation of carcinoma of the sigmoid flexure.

Shortly after this the subject was extensively studied in America, where Beer, Fischer, and others made contributions to the etiology, and the Mayos,

Wilson, Brewer, Giffin, and others to the clinical aspects. (68)

Moynihan (51) in 1907 was the first English observer to publish a case of peridiverticulitis causing a "mimicry of carcinoma". He also stressed vesico-sigmoid fistulae.

Telling in 1908 reviewed the subject of diverticulitis, and, after an analysis of one hundred five cases he outlined its pathology and clinical manifestations. Lastly in 1917, Telling and Gruner from a study of three hundred twenty-four cases, added to the knowledge of both its pathologic and clinical sides. (21)

CLASSIFICATIONS

Diverticula were classed as true, in which the muscular layer was present or false in which the muscular layer was absent. Another classification was also used, congenital and acquired and some writers used congenital interchangeably with true, and acquired interchangeably with false diverticula, then someone questioned the accuracy of this terminology and suggested a new and clearer classification.

Biue (9) states that all outpocketings are diverticula, hence they are all true diverticula and he also states that congenital or acquired diverticula may either have the muscular coat or not have it, hence he suggests the following classification:

- Prenatal diverticula (two types)
  - First type in which all the layers of the colon wall are present.
  - Second type, same as first, except the muscular layer is absent.
- Postnatal diverticula (two types)
  - First type in which all the layers of the colon wall are present.
  - Second type, same as first, except the muscular layer is absent.

Mayo (46) divides diverticulitis into four groups: (1) Self-limiting diverticulitis with peridiverticulitis, only inflammation of the walls of the sac. (2) The above with abscess resulting in enteroenteral, entero-

vesical, enterocutaneous and other fistula. (3) Diverticulitis complicated by obstruction due to infection and edema or hyperplasia, the acute, or adhesions and angulation, the chronic. (4) Carcinoma developing in diverticulitis.

Spriggs and Marxer (66) in 1927 pointed out four stages of diverticulosis: (1) Prediverticular stage--normal segmentation of bowel is absent, being replaced by a ragged outline of little convex irregularities. This stage precedes the formation of pouches, and it is apparently associated with some weakening of the submucosa and mucosa layers. (2) A stage of irritation often follows stage (1), here the bowel is more irritable. (3) Developed diverticula of various shapes and sizes. (4) Diverticulitis--inflammatory process about the necks especially of those containing stercolitha, and spread to wall of bowel, giving rise to a local colitis or pericolitis.

Spriggs and Marxer (65) in 1925, pointed out three stages in which they had not recognized the second stage of the preceding classification.

ETIOLOGY

McGrath, 1912, as the result of a combined anatomical and experimental investigation, came to the following conclusions: No single factor explains the origin of the ordinary form of diverticula. As in the case of an aneurysm or an ordinary hernia the fundamental factors are insufficient resistance of the wall and increased pressure from within. The weakening of the wall may be congenital in origin, it may be due to general degenerative changes, debilitating disease, and senility, or it may arise in local conditions such as chronic constipation.

Telling and Gruner in 1917 suggested that diverticula of the colon where due to a congenital defect in the wall of the colon or pressure due to constipation or that both factors entered into the formation of diverticula. (68)

Drummond in the same year expressed his belief that the etiological factor is a general deficiency of the non-striated muscle tissue. (16)

Roberts in 1918 pointed out that constipation of long standing is usually present. (59)

Chronic constipation which results in increased gas pressure in the large bowel, associated with a weakness of the muscular or elastic walls, along with late life and degeneration of the bowel wall were suggested by Lockhart-Mummery as causes of diverticula. (34)

Mackoy in 1926, suggested that heredity plays a part

in diverticula formation and he sites a family in which eight members in three generations had chronic intestinal trouble, with similar clinical pictures. Two of the eight were diagnosed by x-ray as having diverticulitis, the others were not examined by x-ray.

It is suggested that diverticulosis is the result either of a degenerative or an inflammatory process. Its association with spondylitis of the lumbar spine, which was found in seventy per cent of the diverticulosis patients as compared with twenty per cent in a control series, might favor either view, but the inflammatory appearance of the prediverticular state and the association, nearly as frequently as that of spondylitis, with abscesses at the apices of the teeth, also with septic foci, favor an infective origin. The demonstration of the prediverticular state particularly, which has now been observed in thirty-five patients, makes it improbable that diverticulosis is due to mere passive extrusion in a weak but otherwise healthy gut. (65)

Spriggs and Marxer (66) in 1927 stated that the etiology of diverticulosis is not understood as yet. In the prediverticular state there is irritation of the bowel wall with tenderness in that area and there may or may not be pain. Evidence points toward the association of early diverticulosis with septic foci in the body, indicating an inflammatory change, probably bacterial, and not degenerative and passive. Location of small herniae where the blood-vessels and lymphatics

penetrate the bowel indicates that they are passive extrusions from the beginning through weakness in the bowel. How much constipation plays a part is unknown. Flatulent distension of the bowel would be expected to aid in formation of pouches and to cause enlargement of those already formed. In later stages, when diverticulitis threatens, fatty tissue around the bowel is probably less resistant to infection than the more vascular non-fatty peritoneum. There is no special association between spasm of the bowel and diverticulosis.

Woolf (72) suggests a disturbance of the neuromuscular system of the intestine as an etiological factor.

Benjamin (3) states that the location and direction of the lateral vessels of the colon and sclerosis of these may predispose to herniation. Congenital weakness or defects in the wall are recognized possibilities. Age, obesity, and sedentary habits may favor diverticulosis. Improper habits and unsuitable food may account for their unusual frequency in humans as compared with animals.

Morley (50) believes that diverticula are due to normal mass peristalsis of the colon, forcing small herniae of mucosa through the vascular gaps in the muscle coat.

Oldham (54) suggests that spasm might be a contributory factor. He states that as an enthusiastic user of spinal anesthesia, he had frequently noted that when

segments of pelvic colon were in spasm the mucosa bulged through the muscular coat as a string of tiny blebs in the lines in which diverticula occurred.

Ochsner and Bargen (53) in discussing etiologic factors of diverticulosis, state that constipation and flatulence are not more often found in these individuals than in the general population. Obesity is not a factor inasmuch as most of these patients are of normal weight. Inherent weakness of muscular layers of intestinal wall, inherited or acquired. Diverticula occurred during the years of degenerative changes in the body. Possibility of formation of diverticula as a senile change in an inherently weak muscular wall of the colon suggests itself. The weakness occurs in disseminated places and affects patients who have been subjected to colonic strain.

Jones (28) mentions the fact that where diverticulitis most often occurs, in the sigmoid colon, that the bowel is of smaller caliber and the stool is firmer.

Niles (52) agrees with most of the recent observations but he emphasizes the point that feces collects in the sacs and becomes subject to bacterial action which inflames the walls. They may then become serious foci of infection and intoxication.

INCIDENCE

McGrath (38) in 1912 stated that diverticula of the large bowel is comparatively frequent in middle and late life.

Drummond (16) in 1917 reported twenty-two cases of diverticula of the colon in a study of five hundred cases at necropsy, or a percentage of four and twenty-five hundredths per cent.

Telling and Gruner (68) found that diverticulosis of the colon preponderates in males and that the average age is from forty to sixty-five.

Ashhurst (1) in 1908 reported a case of diverticulitis in a youngster of seven years and nine months. This case was diagnosed as an acute abdomen and when operated was found to have an inflamed diverticula of the sigmoid and a normal appendix.

Foggie (21) states that diverticulitis is a condition which generally occurs in those of middle age.

Masson (43) reviewed the one hundred sixteen operations for diverticulitis at the Mayo Clinic since 1902: male, eighty-one; female, thirty-five; youngest, fifteen; oldest, seventy-five; average, fifty-two years. Overweight has been considered a strong predisposing factor, the heaviest subject weighed two hundred thirty pounds; lightest, one hundred nine; average, one hundred seventy pounds.

Lockhart-Mummery (34) states that diverticulitis is a disease of advanced life. Average age, fifty-five

years. This same view is expressed by Boyd (5) and Larimore (32).

In one thousand examinations of the alimentary tract by x-ray, Spriggs and Marxer found diverticula on one hundred fifty-eight occasions. Diverticulosis of the large intestine was observed in ten per cent of cases. The diverticula are small and multiple, may be found in any part of the colon but commonest in pelvic segment. Of the one hundred cases of diverticulosis of the large intestine, twenty-nine were women and the youngest patient was thirty-five; the oldest seventy-seven; the average age was fifty-eight years. (65)

Twelve patients with diverticulitis is commented on by Rizer (58): eight men, four women; average age, fifty-seven plus.

The incidence of diverticulosis is set forth by Mayo (48): records at the clinic show a total of one thousand, nine hundred eighteen cases. Robertson's observations on necropsy service show over five per cent of persons over forty have diverticulosis and his data approximate those based on x-ray evidence. Thus, from 1924-1928 inclusive, twenty-six thousand, six hundred ninety-nine x-ray examinations of the colon were made for diagnostic purposes, and in one thousand, five hundred seventy-four, diverticula were present. Only sixteen of these patients were less than forty. Of those one thousand, nine hundred eighteen recorded cases, active diverticulitis was present in six hundred

fifty-three at the time patients were examined. Inasmuch as prior to 1916, only the cases of diverticulitis were recognized, these figures are of no value in establishing the frequency with which diverticulosis gives rise to diverticulitis. Statistics of the later period give over twelve per cent of diverticulosis resulting in diverticulitis, but for obvious reasons this is probably over-estimated. A study of the sex-incidence in this group of cases show sixty-four per cent men, thirty-six per cent women. As constipation is more common in women, these figures would seem to show it is not an important factor in the causation. Nor can much significance be attached to obesity, inasmuch as the percentage of patients under was about the same as those overweight.

Incidence is chiefly among short, overweight men between forty and fifty years old. (19)

Edwards (17) reported on a rather large series of cases. From 1925-1931, at King's College Hospital, six hundred twenty-one x-rays of the colon were made, diverticula found in fifty-five. Under thirty-five, one hundred fourteen examined and no diverticula found. Average duration of symptoms definitely attributable to the presence of diverticula was, in thirty-five cases, seven and one-half years, so the average age at which symptoms first arise is nearer fifty than sixty. Symptoms as a rule are due to imflammation of preexisting diverticula, ie. to diverticulitis hence development of diverticula at less than fifty years. Forty to fifty age incidence

of greatest number of diverticulosis. Sixty to seventy age incidence of greatest number of diverticulitis.

During the year covered, seven per cent of two thousand, nine hundred eighty-four patients examined by x-ray after barium enema were discovered to have diverticulosis, suggesting the approximate incidence. Diverticulosis was evenly distributed among the sexes, diverticulitis and particularly the complications were more common in males. Therefore diverticula, like hypertension and many other conditions, should be viewed with greater concern when noted in men. Uncommon before forty years, most common in latter half of sixth and first half of seventh decades. (53)

Kocour (31) in a study of seven thousand consecutive necropsies at the Cook County Hospital (Chicago) found that the incidence of diverticulosis was one-third again as much in white females as it was in white males.

Wilkinson (70) attempted to show a relationship between diverticulosis and cholecystitis. They both are more prevalent in short stocky, heavy individuals.

Kirchner (30) decided that diverticulosis is more prevalent in mid- and late life than is realized. While in itself a harmless and often symptomless condition, it has the potentialities of producing an acute or chronic symptomatology associated with the intestine and with the pelvic colon more especially, and the seriousness depends on the existing pathology and resulting complications.

Buie (9) had Weber prepare some reviews for him and they concluded that the incidence of diverticulosis, among patients who consult physicians for investigation of the cause of some disability, was about six per cent and that about thirty to forty per cent of these patients develop diverticulitis.

ANATOMIC SITUATION

McGrath (38) in 1912 stated that every division of the large intestine may contain diverticula, especially the sigmoid. A similar statement was made by Drummond (16).

In forty-two cases operated by Mayo (46), he found diverticula in the sigmoid in thirty-six cases, transverse colon in one case, ascending colon in one case, hepatic flexure and cecum in one case, rectosigmoid junction in one case, and rectum in two cases.

Foggie (21) states that the main site for diverticula is the sigmoid flexure.

In a study of the subject by Gant (23) it is stated that diverticula are rare in the appendix, duodenum and jejum, occasionally in the ileum, common in the cecum, very frequent in the descending colon and sigmoid flexure, and also involves the rectum more often than published cases and post-mortem statistics indicate.

Lockhart-Mummery (34) states that diverticula are found throughout the large bowel, but not in the rectum. Judd and Pollock (29) agree with Lockhart-Mummery, but they further state that diverticulitis is peculiar to the sigmoid flexure.

Boyd (5) states that diverticula are found along the convexity of the gut, frequently in two rows, and almost always multiple. Most commonly they enter into the appendices epiploicae.

Larimore (32) found the sigmoid flexure by far the most often involved in diverticulosis. He found the transverse colon the next most often involved in isolated diverticula, while the descending colon was the next most often involved in multiple diverticula.

Fifield (20) studied a large series of cases, and in the great majority of the cases the pelvic colon was the part affected, but diverticula were found in every part of the large gut, including rectum. It was interesting to note how frequently diverticula of the pelvic colon ceased suddenly at the rectosigmoidal junction. They were usually multiple, sometimes numbering hundreds, but occasionally only one was present. They varied in size from grape to grape seed.

Diverticula are found with increasing frequency in the lower part of the intestinal tract, are comparatively rare in the right half of the colon and most common in the sigmoid. (53)

Buie (9) summarizes most of the authors by stating that, although diverticula may occur in all segments of the colon, the left half has been reported by all investigation to be the most common site. He also states that diverticulitis seldom is found elsewhere than in the sigmoid or immediately adjacent to it.

Buie (9) also states, "Much has been said about those portions of the circumference of the bowel in which diverticula are likely to occur but it is doubtful if the significance of the available conclusions

is worthy of the amount of time which has been given to the subject. Those noteworthy factors which appear to have been established in this regard are that the deformities are more prevalent in those areas where blood vessels pierce the wall of the bowel and along the mesenteric border. A more significant observation is that any portion of the lumen of the bowel is commonly broken through to form these pouches, with the exception of that part which is augmented by the longitudinal bands as they attach themselves to the serosal surface."

PATHOLOGY

Drummond (16) has shown that there is very good evidence that the diverticula start at those points where the blood vessels perforate the muscular coat of the colon. These points represent weak places in the coat of the bowel in the same way that the exit of the spermatic cord from the abdomen represents a weak place and results in hernia.

Telling and Gruner (68) discuss rather fully the secondary pathological processes. They begin with the statement that, diverticula once formed, tend to become progressively larger and that then two factors enter into the secondary pathology. First is a mechanical factor, the formation of fecal concretions in the diverticula, torsion of a diverticulum or lodgement of foreign bodies within the diverticular sacs. Secondly there is the resulting inflammatory process--diverticulitis of which he names five types; gangrenous, acute, subacute, chronic and latent. This inflammatory process may result in: Passage of organisms without perforation; peridiverticulitis with chronic proliferative inflammation and tendency to stenosis of the bowel; perforation with general peritonitis, local abscess, fistula or suppuration in a hernial sac; the formation of adhesions; chronic local peritonitis; chronic mesenteritis of the sigmoid loop; metastatic suppuration; carcinoma.

Lockhart-Mummery (34) states that the pathology

which may occur in diverticulosis is practically identical with the pathology that may occur in the vermiform appendix. The pouches once formed, tend to enlarge and to elongate beneath the peritoneum. Inflammation follows retention of feces, then an ulcer which may perforate a fibrous stricture may occur.

Judd and Pollock (29) observed that diverticulitis may remain unchanged for years, apparently not progressing.

Mailer (40) pointed out that the pathological findings in tuberculosis of the colon and in chronic proliferative diverticulitis are fairly similar. Demonstration of the bacilli in the tissues is, of course, the conclusive link, but in this type of tuberculosis of the bowel they are exceedingly scanty.

In diverticulitis, there is chronic inflammation of the pelvic colon, arising at first from one or more diverticula, but now involving all the coats of the gut and neighboring organs. (66)

Mailer (41) has observed that the mucosa and submucosa have traversed spaces in the muscular layers. Sometimes, he has noted that the protrusions fail to break through the longitudinal layer, but pushes it ahead, and later the longitudinal layer undergoes disintegration from pressure atrophy.

Slesinger (63) states that as the diverticula fill with fecal concretions they increase in size, and there have been cases of "pistol shot" perforation.

The inflammatory changes are by far the commonest and the most important. The change most often seen is one of chronic inflammation which is associated with thickening and rigidity of the bowel, which may be mistaken for a growth on abdominal exploration.

Black (4) in reporting a case describes the gross appearance of the pathology. He says, "On investigating the left iliac region a boggy mass was found to be the pelvic colon, heavy with edema. At about its center a perforated diverticulum surrounded by fatty adhesions was discovered. It contained a small fecalith which was dislodged into the bowel.

Diverticulitis is the final stage of diverticulosis where the small pouches become involved and destroyed in the chronic inflammatory process, which in the first place arose in themselves. (14)

The pathology of diverticulitis is discussed quite completely by Carling (11). "The pathology is very like appendicitis. So long as the normal contents are free to escape there is no trouble, but if the contents be abnormal or too long retained, or the virulence of the bacteria be enhanced, organisms invade tissues. The result may be mere catarrhal swelling of the mucosa, with further obstruction; or an abscess may form and burst in, leaving an ulcer; or burst out, leading to peritonitis. Even if no gross abscess is formed, adhesive inflammation may lead to attachment of sigmoid to bladder or to other parts of the intestinal tract,

or to uterus and adnexia. Again, it may produce widespread cellular infiltration of the bowel wall, formation of granulation tissue and, in due course, the proliferation of fibrous tissue and fat, with formation of a considerable tumor; finally resulting in a fibrous stricture, narrow and string-like or extensive and tubular. In many there are copious deposits of fat in appendices, subperitoneal space, and mesentery. The inflamed diverticulum, when evaded, may lead to long fistulous tracts, winding towards serous surface. Apart from narrowing, the general mucosa of the affected bowel is not often abnormal."

Diverticulitis which results in a chronic inflammation and induration of the wall leads to constriction of the lumen, and the resulting symptoms are those of obstruction. The inflamed and indurated portion of bowel, due to diverticulitis, often forms a tumor-like mass which may be difficult to differentiate from carcinoma. (30)

Marshall (42) suggests that diverticulitis with symptoms results when a diverticulum has become completely obstructed, and as a result of severe swelling and rigidity, the obstruction is further increased. In most cases, when the inflammation subsides, the diverticulum becomes sealed over by fibrous tissue.

Morley (50) in a discussion of the pathology of acute and chronic diverticulitis points out that the histologic features of the latter placed it in a group

of lesions described in recent literature as non-specific granulomata of the intestine.

The irritation resulting from the presence of dried feces may be the cause of the inflammatory process. This inflammatory process may spread into the mucosa of the bowel, conversely, diverticulitis may result from a spreading of inflammation from the mucosa of the bowel. (9)

SYMPTOMATOLOGY

Telling and Gruner (68) in 1917 were the first to evaluate the symptomatology of diverticulitis. They described: Pain in the lower abdomen, especially colicky and recurrent pain; tenderness, especially in the left lower quadrant with muscle rigidity; tumors in thirty per cent of the cases; abscesses in about twenty-nine per cent of the cases; fever which is moderate; leukocytosis which is moderate; stools, either constipation or diarrhea; bladder symptoms such as frequency, burning, etc.

The signs and symptoms of diverticulitis are the same as those for appendicitis except that they are left sided. (46)

Roberts (59) in 1918 stated that diverticula give rise to lower abdominal disability in a large majority of cases; sometimes to pain in other regions of the abdomen; sometimes to severe abdominal colic.

Gant (23) stated that the diverticular sacs may remain inactive for years, or they may at any time become infected and inflamed causing symptoms frequently mistaken for appendicitis, peritonitis, chronic intestinal obstruction, new growth or pelvic abscess. Symptoms are presant in fifty per cent of cases.

Diverticulitis was divided into two types by Lockhart-Mummery (34): (1) cases with tumor formation and (2) those with abscess formation. In spontaneous disappearance or cure of carcinoma, it was probably diver-

ticulitis. Pain brought on by jolting and irritability of the bladder may be those of abscess or generalized peritonitis.

Diverticulitis may at times be manifested by the evidence of irritability of the colon, with or without demonstration of actual filling of diverticula. (33)

Fifield (20) stated that the clinical features of acute diverticulitis have been well described as those of acute appendicitis in the left iliac fossa. They include the usual constitutional disturbance with elevation of temperature, pulse, etc., and pain, tenderness and rigidity in left fossa with or without the presence of a lump. Sometimes these signs and symptoms were in the hypogastrium or right fossa.

Corkill (15) in 1927 reported an interesting experience in which a man was operated on twice for other than diverticulitis. The two operations were fourteen years apart. Diverticula were noted at the first operation and fourteen years later the only change noted was an enlargement of the diverticula. No symptoms referable to the diverticula had ever been noted.

Spriggs and Marxer (66) state that diverticula, short of diverticulitis, may be quiescent for years. There may be clinical evidence of irritation of the bowel, or less oftan, of the peritoneum or bladder, with frequently flatulence, pain, distention or indigestion, generally below the navel and most on the left side.

Diverticulitis, clinically, the features are those of a low form of inflammation in the large bowel, usually in the left lower abdomen, spreading to neighboring structures. Pain may be intermittent, severe and often accompanied by general ill-health; there may be a dragging sensation and backache. General flatulence and a feeling of distention are common and may be the only symptoms. Increasing constriction leads slowly to obstruction with symptoms referable to obstruction. A sausage-shaped tumor, sometimes tender is palpable in the left iliac fossa. It may become acutely inflamed, with pyrexia and vomiting. Hemorrhage from the rectum is not usual. (66)

Slesinger (63) states that in any patient over forty who complains of pain in the lower part of the abdomen, especially in the left iliac fossa, associated with constipation, irritability of the bladder and occasionally attacks of slight pyrexia, diverticulitis must be thought of as a possible diagnosis.

In the inflammatory type the attack may begin quite suddenly with acute pain after a heavy meal, when straining at the stool, after an aperient or during administration of an enema. The local signs are similar to those of appendicitis, but on the opposite side. The obstructive type is the one most often mistaken for carcinoma. Often the history and symptoms are strikingly similar. There is pain and tenderness in the left iliac fossa and often considerable pyrexia which is unusual in car-

cinoma. In the genito-urinary group the main symptoms are referred to the bladder. Following intermittent pain in the left iliac fossa for a week or so, there is a sudden attack of urgent, burning and painful micturition, accompanied by the passage of small grape-seed-like fecal particles from the urethra. The urine has a heavy sediment and a fecal odor. (63)

Benjamin (3) stated that the symptoms of diverticulitis are misleading and sometimes attributed, merely, to indiscretions in diet.

In a series of thirty-six cases of diverticulitis studied by Conway and Hitzrot (14), they found that the symptoms in order were: Pain across the abdomen usually more pronounced in left lower quadrant; constipation; flatulence; nausea; palpable mass; diarrhea; melena and urinary urgency.

Carling (11) agrees with the other writers but hesitates that the stools may be normal, or of late smaller than usual; neither blood nor mucus is constantly present and never in great amount; neither diarrhea nor constipation is a regular feature, and rarely is either conspicuous. The passage of gas from the urethra suggests a fistula of diverticular rather than neoplastic origin.

Roberts (60) in a discussion of Morley's paper on diverticulitis, suggested the possibility of intestinal diverticula, giving rise to toxemia from absorption of infective products of food stagnation, thus

giving rise to various degrees of toxemia.

Diverticula may cause no symptoms, or they may aggravate constipation and intestinal intoxication. Not infrequently, however, they become acutely or chronically inflamed. The symptoms of acute diverticulitis are similar to those of appendicitis, except that the local manifestations are usually in the left lower abdominal quadrand. Pain, tenderness, rigidity of the abdominal muscles, fever, and leukocytosis constitute the syndrome. Vomiting sometimes occurs; constipation is usual, although diarrhea may develop. Except when concealed by meteorism, a tumor can usually be felt in the left lower quadrant of the abdomen. (52)

A chronic inflammatory process originating in a diverticulum may result in great thickening of the wall and cause partial obstruction of the colon. This is frequently mistaken for carcinoma. (52)

Soper (64) states that diverticulitis is associated in its earlier stages with constipation in addition to abdominal discomfort and a general distention from gas; often-times, however, the constipation not uncommonly alternates with diarrhea and the pain becomes localized in the region of the sigmoid, producing the symptoms much like those of appendicitis, but on the left side. The diarrhea observed in the affection is of the carcinoma of the prostate type, that is, the lower bowel is filled with hard fecal masses, which produce an irritability of the bowel and frequent

desire for defecation. On account of prolonged retention the fecal masses may be so channeled that the movements pass through in a liquid state.

DIAGNOSIS

Giffin (25) in 1912 stated that he believed that a probable clinical diagnosis of diverticulitis of the sigmoid might be made in certain cases. Given a patient with a tumor of the sigmoid, the points which would favor a diagnosis of the chronic proliferative type of diverticulitis are: (1) absence of a general picture of malignancy; (2) tendency to obesity and maintenance of good nutrition; (3) long history of attacks of abdominal pain localizing in the left lower quadrant; (4) history of former formation of a mass and subsequent disappearance; (5) failure to obtain a more or less continuous history of frequent macroscopic blood in the stools; (6) demonstration of vesical fistulas which, on cystoscopic examination appear to be inflammatory, and (7) failure to demonstrate malignancy positively by sigmoidoscopic examination.

Left sided pain, with mass or not, with tenderness, rigidity, etc., one can feel relatively certain of diverticulitis. In previously known or surmised malignancy of the sigmoid, then such acute evidences point to ulcerating perforation above the malignancy. (18)

Telling and Gruner (68) state that the sigmoidoscope is disappointing and that the x-ray is quite helpful in making a diagnosis of diverticulitis.

George and Leonard (24) in 1920 stressed the value of x-ray in the study of diverticulitis of the colon.

In diverticulitis there is practically never any

ulceration or involvement of the mucous membrane; in carcinoma there is extremely frequent involvement of the mucous membrance. (5)

Spriggs and Marxer (66) state that clinically, there are vague persistent or recurrent abdominal symptoms in a middle-aged, well nourished person, without physical signs, which do not yield to simple medicine. Roentgenography establishes the diagnosis of diverticulosis.

Slesinger (63) states that there will be pain and discomfiture associated with tenderness, and often the inflamed area can be palpated through the abdominal wall. Irregular pyrexia, moderate leukocytosis, absence of blood from the stools and irritability of the bladder help to confirm the diagnosis. X-ray affords the only means of diagnosing the presence of diverticula with certainty. Both an opaque meal and an opaque enema should be used.

Carling (11) states that upon suspicion of diverticulitis, x-rays after an opaque enema should be taken and that not only antero-posteriorly but also with more than one axis of obliquity; not only with bowel filling and filled, but also emptying and emptied, this last especially, since it may be only when the main barium mass has passed that the still-full diverticula throw clearly defined shadows.

Marshall (42) suggests the value of palpation under anesthesia, especially in emergency surgery and he says

that in diverticulitis a mass will almost invariably be felt.

As no symptoms are characteristic of diverticulitis recognition is dependent upon x-ray or proctoscopic examination. In some cases of diverticulosis, history of previous attacks of diverticulitis can be elicited. (53)

Niles (52) states that x-ray examination is the only method by which diverticulosis can be definitely diagnosed.

Lynch and Hamilton (36) state that to diagnose diverticulosis and diverticulitis, symptoms should be evaluated and then x-ray and proctoscopic examinations should be done. Chronic cases are suggested by pain in left lower quadrant and constipation.

Buie (9) suggests the use of x-ray and proctoscope in diagnosis of diverticulitis. He states that the proctoscope is of great value in diagnosis of this condition because practically all superimposed pathologic states which develop in these deformities occur in those which lie in the sigmoid, the distortion produced should be visible, in most instances, on proctoscopic examination.

DIFFERENTIAL DIAGNOSIS

Giffin (25) in 1912 states that in carcinoma of the lower bowel there is usually an early loss of flesh. Pain is not prominent until obstruction advances, and the mass or tumor steadily enlarges, whereas, in diverticulitis there is no loss of weight, the patient is usually rather obese, pain is present and is usually recurrent, and the tumor is apt to disappear and then reappear again.

Carman (12) in 1915 discussed the value of x-ray in differentiating carcinoma and diverticulitis.

Telling and Gruner (68) state that diverticulitis can be differentiated from carcinoma by: absence of malignancy shadows, obesity and good nutrition, long history of pain in left lower quadrant, tumor that disappears, absence of blood in stool, vesical-fistula, negative sigmoidoscope, as regards malignant disease, x-ray demonstration of diverticula, and pyrexial attacks. Diverticulitis can not be differentiated from sigmoiditis. Hyperplastic tuberculosis is rare in this section of the bowel. Actinomycosis, more likely to occur in the cecal region. Syphilis rarely occurs in this part of the bowel. Most pelvic lesions are accompanied by more generalized pelvic pain, but they are hard to differentiate from diverticulitis.

Diverticulitis may be differentiated from carcinoma by careful radiographical study. (33)

Spriggs and Marxer (66) state that the diagnosis

of diverticulitis is less difficult when a good history and physical examination is used in conjunction with x-ray. The conditions to be differentiated include malignancy, left-sided appendicitis, actinomycosis and pyosalpinx.

Radiologically, the prediverticular state must be distinguished from colitis. The latter causes inhibition or spasm without affecting the symmetry of the segments; the outline is smooth or any irregularities are nondescript. In the prediverticular state the symmetry is disturbed and if there is inhibition the irregularities show small twin convex impressions. (66)

Slesinger (63) states that the clinical distinction between carcinoma and diverticulitis may be very difficult. Tenesmus and painful defecation are commoner in carcinoma as is also the passage of blood. Mucus, that may be passed in both diseases is commoner in carcinoma. The pain in carcinoma usually radiates through the back, which it seldom does in diverticulitis. Pyrexia and leukocytosis are usual in diverticulitis and rare in carcinoma.

Carling (11) in his paper on diverticulitis states that differential diagnosis is difficult: In colitis, the amount of mucus passed is much greater; diarrhea is more severe and constipation more capricious--blood and membrane are likely to be passed freely. The extent of the tenderness is distributed much more uniformly round the colon, and temperature is not infre-

quently subnormal. In stricture there is a history of dysentery--or of perimetritis or of proctitis--or it may be evidence of past syphilis. Fecal accumulation is more likely and more obvious. In adenoma with chronic partial intussesception there is sharp hemorrhage, and the sigmoidoscope may give positive evidence. The real difficulty arises with carcinoma. The duration of symptoms is in general shorter; blood and mucus of some amount, more constant; diarrhea may be troublesome, and stools fetid; distention of the abdomen is slowly and steadily, though insiduously, progressive; while loss of weight may be obvious and of appetite pronounced. There is much less tenderness, pain and spasm. Absence of fever is just worth noting.

The main difficulties of diagnosis are to distinguish acute diverticulitis from appendicitis, and chronic diverticulitis from carcinoma. Where a colovesical fistula formed the probability was strongly in favor of diverticulitis. (50)

Lynch and Hamilton (36) strongly advocate the use of x-ray, proctoscope and stool examinations in making a definite diagnosis of diverticulitis.

TREATMENT

Mayo (45) in 1912 discussed the surgical treatment of diverticula. He favors a resection with bowel-union at the time of operation with preliminary colostomy, or the operation is made in the two-stage Mikulicz method. He describes the technic of these operations. He also states that Bloodgood's side-to-side, end together anastomosis, with ends of the stump brought into the incision beneath the skin as a safety valve to be opened if desired, is an excellent operation.

Mayo (46) in 1917 stated that when a primary resection was made, they employed an end-to-end union, but as a rule found it wise either to suture the anastomosed area well up into the peritoneum and leave the suture line exposed, or to pass a folded strip of rubber tissue entirely around the anastomosis to suspend it in the wound, as there was a tendency to late infection, and unless provision was made for drainage, slowly progressing peritonitis occasionally caused death.

Telling and Gruner (68) advised surgery in diverticulitis, unless operative interference is specially contra-indicated. All diverticulum-bearing gut should be removed. Care to be exercised in handling the gut. Lastly, no case of supposed carcinoma of bowel, in the future, to be regarded as inoperable, either before or at laparotomy, unless diverticulitis has been remembered fully considered, and systematically investigated.

In 191[illegible], Roberts (59) pointed out that non-operative

treatment of the diverticula gave remarkably satisfactory results.

Mayo (47) in 1921 stated that in acute cases, especially if the patient is old, obese and a poor risk, the treatment should be tentative. If pus collects and becomes well encopsulated it should be evacuated. More radical treatment, if necessary, can be postponed to a more favorable time. In acute obstruction, a colostomy as close as convenient, so later excision can be made through the same incision.

It is usually wise to resect the chronic stenotic tumors of the sigmoid which may result from diverticulitis, with end-to-end anastomosis, in one or two stages. (47)

Masson (43) in 1921 stated that during acute manifestations of the disease the expectant treatment advised by Ochsner for appendicitis after twenty-four hours is generally advisable. Even if rupture takes place, general peritonitis seldom follows, and operation during the acute stage is frequently unsatisfactory, and furthermore they are followed by a much higher death rate than those performed later.

Gant (23) advised palliative measures, laxatives and oils--never purgation--hot fomentations, belladonna and morphine, fluid diet and warm high enemas, to be used to keep the patient comfortable while being prepared for operation. He believes that diverticulitis is a surgical condition, that there is no other way to

destroy the sacs.

As regards diverticulitis of the colon, Rogers (61) believes the surgical treatment in any given case must depend upon the severity of the symptoms, the condition of the patient, and the judgment of the operating surgeon. From his own experience and a careful review of many cases reported, he is convinced that simple drainage in most cases will be followed by cure. He states that in three of his cases, resection seemed necessary, but drainage resulted in cure.

Judd and Pollock (29) stated that many patients with diverticulitis were relieved by dietary and medical management. If an abscess formed from perforation or extension of the infection through the wall of the colon, drainage was advisable. Surgery in fistula formation and in cases where there is any suspicion of carcinoma.

Primrose (56) found that under favorable circumstances massive tumors from diverticulitis disappeared spontaneously after the bowel was opened above the obstruction and an artificial anus established.

Peck (55) states that diverticulosis without symptoms is common and that it calls for no treatment. Many cases of diverticulitis are capable of subsiding without surgical treatment, even when a tender inflammatory mass can be felt, though such patients should be kept under careful observation, until the danger of abscess formation or perforation has passed. Perfora-

tion with localized abscess or peritonitis calls for prompt intervention; simple drainage being often sufficient. Persistent chronic inflammatory thickenings or mass with subacute symptoms, demands exploration and often resection to exclude malignancy, or to remove a definitely thickened and diseased segment.

Diverticulitis if diagnosed early and treated may be kept in check. When fully developed it is often grave and a colostomy is probably the procedure of choice with a subsequent resection. The ideal procedure is a resection with end-to-end anastomosis and temporary cecostomy. (35)

Spriggs and Marxer (66) state that medical treatment consists in keeping the body, the alimentary canal and especially the colon, as healthy and clean as possible. Any source of sepsis should be removed. The diet should be simple and regular. The bowels are kept regular by diet, paraffin, and especially by attention to habit. The colon is washed out with saline every other day, for a time, but at low pressure.

Mailer (41) advised conservative treatment and in severe cases conservative surgery such as multiple stage operations.

Monsarrat (49) states that radical surgery is practically never indicated in diverticulitis. He has found that colostomy is often curative in patients with stenosis. He believes that if simple colostomy with a low mortality is so often curative, then it is certainly

the preferable procedure over radical surgery with its high mortality.

Slesinger (63) states that in treatment of diverticulitis, prophylaxis must be considered. Sufficient paraffin must be given to keep the movements soft, and a diet should be chosen which leaves the minimum of solid undigested residue. If the attack is a mild one and complications such as peritonitis are absent, medical treatment should be tried. In surgical treatment, no attempt should be made at radical removal of the area of the bowel affected in the presence of peritoneal infection. In general peritonitis the treatment must be directed to that alone. In less acute cases with abscess formation, the abscess should be drained and a colostomy or cecostomy performed. Resection may be used in the obstructive or stenosing type, but this is best performed by the three-stage method of Mickulicz.

Sennet (62) reports a case of immediate operation upon a patient with a perforated diverticulum which was followed by a complete recovery.

Benjamin (31) states that treatment should be directed toward preventing further progress when possible.

Erdmann (19) states that diverticula and diverticulitis should be treated much like appendix and appendicitis. Operate the acute cases and observe the chronic cases.

The mildest cases should be treated by paraffin,

lavage and atropia. Graver cases call for colostomy, which should be kept open for three, six or more months, x-rays indicate progress and suggest the time for closure. If carcinoma is suspected, a resection should be performed. (11)

Morley (50) states that in chronic diverticulitis the treatment was generally medical, and that operation was only called for when symptoms of chronic intestinal obstruction arose, that would not yield to non-operative measures. In that event, radical excision was rarely feasible, but colostomy well above the obstruction had to be performed.

Marshall (42) states that there is not a great deal of extravasation in perforations of the sigmoid flexure. He doesn't see the necessity for immediate operative intervention. In resection he advocates the Paul-Mikulicz operations.

Niles (52) states for diverticulitis the patient should be kept in bed with hot fomentations over the abdomen. When the tenderness is localized, an ice-bag is preferable. The diet must be bland, and enemas should be employed for emptying the colon. The formation of an abscess demands incision and drainage. Resection of a portion of the colon is rarely necessary for relief of an obstruction.

Medical treatment of diverticulitis consists of rest, application of heat, regulation of diet, olive oil. (8)

Kirchner (30) states that chronic diverticulitis of the discrete type, under proper dietetic and medical treatment, may show a marked and lasting improvement. Acute and localized diverticulitis, simulates acute appendicitis, and because of the danger of perforation and the resulting peritonitis, prompt intervention is indicated.

Jones (28) suggests that possibly the safer operative procedure would be to wait for localization rather than operate during the acute phase.

Treatment of sigmoid diverticulitis as advocated by Clendining (13) is massive doses of barium and bismuth. This procedure fills the pockets with a non-toxic unabsorbable, bland substance instead of putrefactive feces. Surgery is seldom necessary. Avoid cathartics and enemas. Agar-agar in large doses may be helpful. For acute attacks, rest in bed, no cathartics, hot water bag to abdomen.

Buie (9) states that he believes in conservative methods of treatment. He doesn't believe that generalized peritonitis occurs very often, and he believes that after several periodic inflammatory attacks, there is less likelihood of generalized peritonitis.

COMPLICATIONS

McGrath (38) in 1912 stated that the complications of diverticulitis are peritonitis with or without perforation and peridiverticulitis. He also stated that carcinoma may develop on this inflammatory process.

Telling and Gruner (68) in 1917 enumerated a series of unusual complications such as; pulmonary embolism, left sided phlebitis, pylephlebitis, fat necrosis, severe rigors and suppuration in a hernial sac.

Diverticulitis is of special importance because it is a strong predisposing factor to malignancy. Seventeen in a series of one hundred sixteen had malignant changes at operation. Thought to be secondary to diverticulitis and irritation of mucous lining by fecoliths. (43)

Foggie (21) in 1921 reported a case of diverticulitis which was complicated by metastatic suppuration.

Rankin and Judd (57) in 1922 reported a case of emphysema of the scrotum from perforative diverticulitis of the sigmoid. This was in a patient forty-six years old who had suffered pain and soreness for three years.

Lockhart-Mummery (34) state that diverticulitis gives rise to the following: (1) Tumor or swelling; (2) abscess; (3) stricture of the colon; (4) adhesions to other organs; (5) fistulae; (6) vesico-colic fistulae;

(7) carcinoma; (8) general peritonitis; (9) deformity and contraction of the mesosigmoid.

In twelve patients with diverticulitis commented on by Rizer (58), no evidence of carcinoma could be found.

Slesinger (63) states that chronic diverticulitis may lead to the following secondary pathological results; generalized or pelvic peritonitis, abscess formation, adhesions to the bladder or small intestine. He also states that it is by far the commonest cause of vesico-colic fistula.

Mayo has shown that carcinoma is especially likely to develop on the basis of chronic diverticulitis. (64)

PROGNOSIS

In 1912, McGrath (38) stated that diverticulitis gives pathological processes and sequelae which are often most grave.

Erdmann (18) states that prolonged chronic diverticulitis does frequently become cancerous, in which cases the prognosis becomes quite poor.

Prognosis in diverticulitis is very uncertain and it depends on the conditions present. Permanent colostomy gives a better prognosis than short-circuiting. (34)

Niles (52) in discussing the prognosis for individuals with diverticula, states that in the majority of cases, diverticula produce few or no symptoms and are accidentally found. Perforation occurs very rarely. Inflammation is not uncommon, but usually subsides with treatment. An abscess occasionally develops, and rarely, chronic inflammation with connective-tissue formation produces sufficient obstruction to require operative treatment.

Brown and Marcley (8) take up the prognosis of diverticulitis and diverticulosis of the colon. Follow-up data was obtained in eighty-six per cent of five hundred ninety-six cases of diverticulitis or diverticulosis. In a few cases of simple diverticulitis, complications may develop and require surgical treatment. Surgical treatment was employed in ninety-nine cases of diverticulitis; fifty-seven patients were cured and forty-seven per cent either continued to have trouble

or died after operation. It is impossible to say how many who have diverticulosis, later will suffer from complicated or uncomplicated diverticulitis. Medical treatment of diverticulitis consists of rest, application of heat, regulation of diet and olive oil. In sixty-three per cent of cases this treatment was successful but in thirty-seven per cent results were only fair or poor. However, many of the latter group were able to live in comparative comfort. The results of observations confirm previous opinion that the relationship between diverticulitis and carcinoma of the colon probably is incidental rather than actual. In one-third of the cases of diverticulitis, the symptoms are the result of inflammation and in two-thirds of obstruction and inflammation.

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