Ischemic Colitis:

An Useful Clinical Diagnosis, But is it Ischemic?

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ISCHEMIC COLITIS or, more correctly, vascular disease of the colon has been known for close to 100 years. Early concern equated this condition to colonic infarction secondary to accidental arterial ligation during surgical procedures. During the 1950's colonic infarction occurring after inferior mesenteric artery ligation during colonic surgery for carcinoma or aortic surgery was the primary interest. Although it was known that an occasional patient manifested a relatively benign process after such arterial ligation, it was not until 1963 when Boley and associates[4] reported 5 patients with a disease they labeled "reversible vascular occlusion of the colon" that emphasis upon the milder component of this problem was provided. In 1966 Marston et al,[27] reported on 16 patients who manifested three stages of a spontaneous disease which they labeled ischemic colitis.[28]. Since that time there has been an ever increasing interest in the problem of spontaneously occurring ischemic colitis. However most reports have stressed specific components of the disease, i.e. a new diagnostic point[10,16] or a select group of patients.[17,19,22,33,35] This review is based upon our experience with 55 cases of ischemic colitis that span the currently recognized spectrum of this lesion.

Material

Patients included in this review fulfilled rigid criteria which were deliberately developed to prevent overlap between ischemic colitis and other types of colonic abnormality. It is realized that such rigid selection might have excluded some patients with the lesion, but this was felt to be less important than the problem of significant overlap. Our data include only acute colonic disease occuring in a patient with the following characteristics: 1) over the age of 50 and without similar or subsequent episodes, 2) without evidence of ischemic disease elsewhere within the gastrointestinal tract, 3) not being treated with antibiotics, 4) without evidence of an enteric infection, 5) proctoscopic examination, when positive, indicates an acute mucosal inflammatory disease, 6) radiologic abnormalities, if present, indicate an acute colonic ulcerative or exudative process[42] which in surviving non-operated patients undergoes evolution to healing or stricture and 7) available histologic specimens demonstrating mucosal and/or submucosal destruction, edema or hemorrhage. We recognized that neither the histologic evaluation, nor the barium changes by themselves are specific for this lesion but the criteria used are those which we[40,42,43] and others[4,5,7,22,26,27] have considered as diagnostic of ischemic colitis.

As indicated in Table 1, the 55 patients represent 46 with spontaneously occurring ischemic colitis, four with ischemic colitis occurring early after inferior mesenteric artery ligation, one with ischemic colitis occurring as a complication of a colonic obstruction secondary to carcinoma of the sigmoid and 4 occurring late after an abdomino-perineal resection. Analysis of the clinical features is similar whether or not the groups are analyzed as

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TABLE 1. *Ischemic Colitis*

Patients	Etiology
46	Spontaneous
4	Early after IMA ligation
1	With colonic obstruction
4	Late after abdomino-perineal resection

46 spontaneous cases, as 50 cases including the 46 spontaneous ones plus those occuring late after an abdomino-perineal resection or as an entire group of 55 patients. For example the 46 patients with spontaneous disease were comprised of 23 men and 23 women with an average age of 70.6 years (range 55 to 90 years). Pain was present in 75%, diarrhea was the prominent feature in 61% and when present the diarrhea was bloody in 69%. Of this group 41% were operated upon with a survival rate of 58%. In the 59% that were not operated upon the survival rate was 63% so that the overall survival was 61%. When all 55 patients are considered, there were 29 men and 26 women whose average age was 70.1 years—(the range 50-90 years). Pain occurred in 76%, diarrhea in 62% with 76% of these patients having grossly bloody diarrhea. Forty-two per cent were operated upon with a survival rate of 61% whereas in the non-operated group, a survival rate of 63% was observed. Our data on radiologic evaluation, endoscopic observations and histologic study do not vary from our previous reports.[40,42] The location of the process for the 46 spontaneous cases is shown in Fig. 1. The endoscopic and/or barium studies always documented the full length of the colonic involvement at the time of the first study. In the patient with ischemic colitis secondary to colonic obstruction the barium enema done after the transverse colostomy was established revealed that the ischemia process spared several centimeters of bowel proximal to the carcinoma. A similar tendency to spare the distal several centimeters of colon was observed in the patients with ischemic colitis occurring late after abdominoperineal resection.[43]

On the basis of clinical manifestations we could separate our patients into two distinct groups, those with severe disease and those with mild disease. The prognosis and the therapy varied for such subgroups. The severe group includes those patients with significant peritonitis, either localized or generalized, as well as those patients whose ischemic process was not resolving within 2 to 3 weeks. Others have characterized such patients as having fulminant, gangrenous or necrotizing colitis[17,26,35] or persistent ischemic colitis.[7] The mild group includes: 1) those without significant peritonitis whose clinical manifestations of ischemia have resolved in two weeks, and 2) those with stricture. Such patients have been labeled as transient[4,7,26,27] or stricture cases.[26,27] Using this clinical background, 13 of our patients with spontaneous disease had a severe course. This 28% of the patient population included 8 (44%) of the deaths, and accounted for 10 (53%) of the operations. In this group of 13 patients with severe disease, we observed that 12 had ischemic colitis as their primary problem and only one had ischemic colitis incidental to a more severe generalized problem. Within those 12 patients with primary severe ischemic colitis there were 7 deaths. In contrast, the 33 patients classified as having mild disease accounted for 10 deaths and 9 operations. Of the 10 deaths, 8 were attributed to causes other than the ischemic colitis because they occurred in patients in whom the ischemic colitis was an incidental part of some other severe generalized disease process.

The patient with ischemic colitis secondary to colonic obstruction and all 4 with the lesion occurring late after an abdominoperineal resection had mild disease and all survived. Three of those with ischemic colitis after inferior mesenteric artery ligation had severe disease and all died, whereas, the one with mild disease lived.

Using our current knowledge of the disease process, its

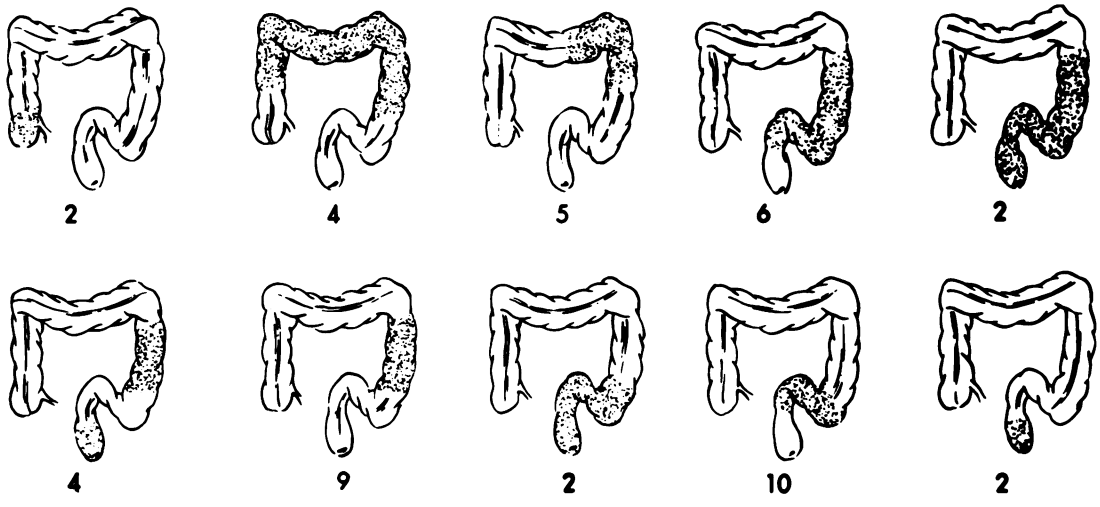

FIG. 1. Distribution of the lesion in the 46 patients with spontaneous disease.

clinical manifestations and proper surgical therapy, we retrospectively evaluated the appropriateness of surgical intervention. In the 46 patients with spontaneous disease, 11 operations (58%) were necessary and appropriate. Seven operations done for stricture or possible colonic carcinoma would not now be performed. One operation was questionable since it was done in the presence of equivocal peritonitis to exclude the presence of gangrenous bowel which was not found. Thus, 37% of the operations performed in our group of 46 patients with spontaneous ischemic colitis could be avoided. Equally important, three patients who were not operated upon clearly had clinical evidence of peritonitis that today would be considered a basis for prompt operative intervention. Thus 11% of the group treated without surgery should have been operated upon. If one considers the entire group using the same criteria, necessary operations were done in 15 patients, (63% of the operations) unnecessary in 8 (33%) and questionable in one (4%). There were an additional 5 patients who should have been operated upon but were not. If the groups are considered according to the severity of their disease, the severe group, which includes 8 deaths and ten operations, contains 3 patients who died in spite of an appropriate operation, 2 patients who died without operations but who clearly needed them, one death in a patient with a questionable operation and one death in a patient whose operation was inappropriate. Of the 33 patients with mild disease, 7 of the 9 operations would now be judged to be unnecessary.

Discussion

Useful clinical entity: A review of the clinical material presented in our series when coupled with that available from other reviews[2,7,9,20,26,27,38] supports our conclusion that ischemic colitis has become a well recognized clinical entity. Although neither the histologic material nor the barium studies are specific by themselves, the total clinical picture is now considered specific.[2,7,9,26,27,38,40] The designation ischemic colitis not only separates this problem from other recognized diseases, especially ulcerative colitis and granulomatous colitis, but also provides both therapeutic and prognostic implications which differ from other colonic processes.

In summary ischemic colitis is an acute colonic process occurring in either males or females of an average age of 70 years. The primary complaint is mild abdominal pain associated with significant diarrhea which is commonly bloody. The disease is diagnosed by observing an acute ulcerative process in the mucosa on barium and/or endoscopic studies, or an exudative process[42] manifest on barium studies as thumbprinting with the associated secondary characteristics of transverse ridging, spasm, or rigidity and on endoscopic examination as hemorrhagic bullae. Histologic evaluation, whether available from endoscopic material or surgical material shows the presence of an acute mucosal process with extensive submucosal edema and/or hemorrhage. There may be an inflamatory component, but a specific type of organism is not essential for diagnosis since the absence of bacterial colonization is not uncommon. The extent of the process is determined by the first examination since progression to other segments of bowel is quite unusual. This observation has not been commented upon before. The lesion is differentiated from other processes that might present with similar manifestations by its rapid change often with observable change in the barium studies and/or the endoscopy findings within 5 to 7 days. Progression to healing or to mild stricture is anticipated in the majority of patients. The location of the lesion has usually been fixed as "around the splenic flexure." However, on the basis of reviews which include over 300 patients[7,26,38] the right colon was involved in 8%, the rectum and rectosigmoid in 5%, the transverse colon (with or without involvement of either flexure) in 14%, and the left colon in 73%. Variations noted in previous reviews which have stressed different locations can probably be explained on the basis of patient selection. For example, Thomas[38] showed that 73% had involvement in the area of the splenic flexure. However, he depended almost exclusively upon barium studies for selection of his patients thereby excluding the majority of patients with the more distal lesions. Marcuson[26] noted a 23% incidence of isolated splenic flexure involvement. However in this review very few severe cases are included, thus this group is heavily weighted by patients with very mild disease.

TABLE 2. *Acute Ischemic Bowel Disease*

	Segmental Ischemic Colitis	Extensive Bowel Ischemia
Clinical	Diarrhea often bloody	Severe diffuse abdominal pain
	Mild lower abdominal pain	Cardiac abnormalities
	Normotensive	Shock and electrolyte imbalance
Etiology	IMA	SMA
	No occlusion 95%	No occlusion 50%
	Occlusion 5%	Occlusion 50%
Prognosis	Fair to Excellent	Dismal

In our experience patients suffering from ischemic colitis, a segmental ischemic process, can be differentiated from those with acute extensive bowel ischemia.[41] Table 2 outlines the principal differences as we have reported before.[42] The differentiation is possible in spite of the fact that patients with extensive bowel ischemia commonly have colonic involvement. Such a separation of patients into groups with extensive or segmental bowel ischemia provides for different diagnostic and therapeutic guidelines.[41,42]

If ischemic colitis is to be a useful clinical entity then

the disease process must not only be characterized on a clinical basis, as has been done above, but one must also be able to provide useful therapeutic and prognostic information. In their article which popularized the term ischemic colitis, Marston et al.[27] suggested three stages: gangrenous, transient and stricture. Since that time many variations or subdivisions have been suggested. Stress has been placed upon a gangrenous, fulminant or necrotizing process,[17,20,29,35] the bacterial component,[26] colonic ischemia with occlusion of the mesenteric arteries,[14,19,24,29,33,46] ischemic proctitis[14,22] or the transient case[4,5,7,26,38,42] with[2,7,9,21,24,26,38] or without stricture. Still others have stressed the association of ischemic colitis with a more generalized disease process[17,20] with colonic obstruction before[8,37,38] or after[9] a colostomy, with a young age[11,13,31] or with the use of contraceptive medications.[12,15,18,23,39] Based upon our experience and our review of the literature, we now feel that little is gained from separating ischemic colitis into other than two categories, severe and mild. The classification is thus based upon clinical manifestations and not upon presumed etiology, special population characteristic or specific process such as stricture.

Some of the variations noted in the literature on ischemic colitis are clearly related to populations being evaluated. For example cases of a severe nature may have been included or excluded. Our data include a 29% incidence of severe cases and Boley's,[7] a 28% incidence; yet Marcuson[26] in his review of 122 cases has but a 12.5% incidence of severe lesions. Further confusion can occur because severe cases of ischemic colitis do occur as a part of some other severe generalized disease,[17,20] but in many instances patients who have both an extensive disease process and bowel ischemia have extensive acute bowel ischemia, with spread of the process into the colon especially the right colon.[41]

Severe cases of ischemic colitis clearly include those with gangrene or a fulminant course as with necrotizing colitis, or clostridal colitis[26] and the cases of colonic infarction secondary to inferior mesenteric artery ligation. There are, however, additional severe cases where the fulminant nature is not obvious within hours[17,21] but develops as the disease progresses over several days. Finally the severe group should include those patients whose process is prolonged without resolution beyond two weeks. Although we have observed a patient who required 5 units of blood and several who needed one or two units of blood transfusion, to date no patient has been recorded who needed emergency resection for control of bleeding due to ischemic colitis. Severe defined in this manner assumes therapeutic importance because all of these patients will require resection. The only real issue is timing. It is clear that proximal decompression and diversion are not appropriate because there are in our own experience, as well as in the literature, a number of cases in which the ischemic process continued in spite of these procedures.

From our own data as well as that in the literature it is obvious that the patients with the most fulminant kind of disease[17,20,21,29,35] may have generalized peritonitis shortly after the onset and/or may have massive colonic distension which is not dissimilar to that seen with toxic megacolon.[2,21,35] These patients should have an emergency operation. The difficulty, as pointed out by a number of authors[17,35,37] is that resection may not be undertaken because the serosal reflection of the ischemia is equivocal, especially when pulsatile vessels are documented either by angiography or, as more commonly, at the operative table. With these findings the possibility of colonic ischemia is dismissed. Although the majority of reports show a high death rate (4 of 5,[35] 7 of 12 in our own experience) there are reports of survivors in 5 of 7 when aggressive resection is undertaken.[17] The patient who has a relatively mild process at the onset but progresses over the course of a few days to a more fulminant disease[7,40] also requires immediate resection. This decision is based upon clinical evaluation for peritonitis, localized or generalized. The last category of the severe ischemic colitis is the patient with persistent disease.[7,40] Although this is more difficult to define, most have agreed that active disease extending beyond two weeks, especially if bloody diarrhea continues, provides a poor prognosis. An exudative process, as documented on barium enema[42] is likewise a poor prognostic sign. It should be noted that stricture has not been included as a criterion of severity and thereby is not included as a specific indication for operation. This will be discussed subsequently.

Patients with ischemic colitis of the mild variety include those usually labeled as transient[4,5,7,26,27,38,40,42] and the majority of those labelled as stricture.[2,7,9,21,24,26,38,40,42,43] Mild ischemic colitis is the type most commonly seen with colonic obstruction.[8,9,17,37,38] As will be discussed in detail later, the mild form can occur after occlusion of the inferior mesenteric artery.[19] Mild ischemic colitis can occur in the course of some other significant generalized disease. While it may contribute to the overall problem, seldom is such mild ischemic colitis the direct cause of death. This was true in 8 of our 10 deaths in the 33 patients with mild disease. The diagnosis of mild ischemic colitis depends upon the absence of the specific features of severe disease as outlined above.

The most critical features for the diagnosis of mild ischemia are related to the previously described changes on barium study and/or endoscopy especially when coupled with a rapid change over a relatively short time.[7,26,38,42] Our review stresses several important ob-

servations for patients in this category: 1) In contrast to our initial suggestion[40] arteriography is not essential to clinical management. 2) When this lesion occurs in association with colonic obstruction, one must recognize that the ischemic colitis is often the most prominent part of the clinical picture and thus could lead to an oversight relative to the precipitating carcinoma, a potentially disasterous result. Of equal importance to the surgeon is the observation that if this lesion occurs after a transverse colostomy[9] or a colonic resection,[9] the mild ischemic colitis can be overlooked or attributed to "disuse atrophy." In these cases the partial obstruction associated with the ischemic colitis can interfere with surgical results from resection and/or closure of the colostomy.

Our inclusion of most cases of ischemic stricture in the mild category of disease requires justification for two reasons: 1) to date most authors have insisted upon separating stricture from other forms, 2) stricture has almost uniformly been an indication for surgical resection. We challenge both the diagnostic and therapeutic implications of such a designation. This separation is based upon the two observations that stricture was neither gangrene nor transient and yet stricture required an elective resection. That severe fibrotic stricture of the colon can occur secondary to ischemic colitis and can lead to a functionally significant colonic obstruction is established.[10,14,21,24,27,33] However as we reviewed the published data we were impressed that only 7 cases[10,14,21,24,27] clearly document a functionally significant colonic obstruction. It must be acknowledged that many reports do not contain sufficient data to be certain as to the degree of obstruction. Nevertheless there are reports in which the stricture was clearly not associated with significant obstruction.[2,9,12,13,14] We[43] and others[2,38] had observed ischemic strictures that remained stable and remained without obstructive symptoms. Finally in a previous report[42] we have stressed the many secondary features of ischemic colitis that interfer with distensibility and/or motility of the colon. If these features are the basis for the diagnosis of stricture, then its prevalence has been over stated. In summary we have not used a separate category for ischemic stricture for the following reasons: 1) the incidence of fibrotic stricture *with* functionally significant colonic obstruction while undetermined to date is probably very low, 2) if the patient's clinical course is mild, as has been true for most recorded strictures, observation over the time required to establish that colonic obstruction is present is safe, 3) if the patient's clinical course is severe, either by virtue of a progressive or a prolonged process, then resection is appropriate on the basis of severe disease.

The issue of ischemic stricture has been compounded because most reviews include patients whose stricture was resected because of a preoperative diagnosis of colonic carcinoma. It is not always clear whether ischemic colitis has been resected because of a stricture with partial obstruction or because carcinoma was suspected. The evolution of the ischemic process as reflected in barium studies is now clear enough so that confusion with carcinoma should not occur. If doubt exists, colonoscopy should be able to settle the issue.[16,45]

The suggested classification of ischemic colitis into severe or mild not only excludes specific processes such as stricture but it also excludes groups designated by etiology or population characteristic. One area of major concern with respect to the problem of ischemic colitis relates to its occurrence in patients younger than the age of 50. The possibility that in these younger patients, venous occlusion, particularly in association with use of contraceptive medications, is a significant etiology is also of concern. We excluded patients below the age of 50 in order not to confuse the process with the other diseases such as ulcerative colitis and granulomatous colitis. We feel that this excluded some patients with ischemic colitis and indeed we have seen two patients at a younger age, who by all other criteria would have been labeled as having ischemic colitis. The available reports on mesenteric ischemia and the use of contraceptive medications contain 12 patients in whom colonic involvement has been the only bowel involvement.[11–13,15,18,23,25,31,32,39] In these 12 patients, one has had an angiogram and two have had resection. Since Polk has established the criteria for venous occlusive disease as documented by angiography,[34] it seems reasonable to conclude that the normal angiogram means that the one patient so far reported did not have any of the criteria of venous occlusive disease. By the same token the pathologic specimens for the two patients with resection do not support venous occlusion as a cause because it has been amply documented that histologic changes induced by either arterial or venous occlusive disease are similar.[25,26,28] Although the rate of progression of the lesion may vary, histologic criteria for differentiation of arterial from venous occlusion are not secure. We therefore conclude that, in spite of suggestions to the contrary, there is no objective evidence available at the present time to support the concept that ischemic colitis occurring in young patients taking contraceptive medication is due to venous occlusion. Further circumstantial evidence for this conclusion is the fact that the literature contains 20 cases of ischemic colitis occurring in patients under the age of 50, none of whom had been taking contraceptive medications.[4,11,13,31] From the available clinical material these patients are, by all criteria other than age, similar to the patients reported as having spontaneous ischemic colitis[7,26,38,42] in this series. Therefore we conclude that ischemic colitis as generally defined does occur in patients under the age of 50 but it is rare.

In an earlier report,[40] we suggested that ischemic colitis occurring as a result of occlusion of the inferior mesentery artery might be a more severe form and therefore might need resection as routine therapy. Our recent experience as well as that provided by other reports does not substantiate that guess. Colonic infarction after surgical procedures that include ligation of the inferior mesenteric artery or its branches is well established.[19,33,43,45,46] What is more significant from the point of view of ischemic colitis as an entity, however, is that in a review of the literature on colonic ischemia after aortic surgery, Johnson and Nabseth[19] found only 99 cases (1.5%) in over 6000 operations. Of these 99 patients with colonic ischemia occurring after inferior mesenteric artery ligation, 26% had mucosal involvement only and 18% had stricture. Thus, although 56% did in fact have the traditional infarction of the colon, an almost equal number manifest more superficial lesions. The therapeutic implications for this type of ischemic colitis do not differ from those presented earlier in this article. However one must remember that only 29% of spontaneous ischemic colitis patients are apt to have severe disease, whereas, 50 to 60% of patients with ischemic colitis after arterial ligation may have severe disease. In this special group the early clinical observations may not always predict the eventual severity of the disease,[33] because the clinical basis for the diagnosis of severe ischemic colitis can be secure in the patient in whom ischemic colitis is the only problem, but can become very insecure in a patient who has recently had a major interabdominal operation. Thus some still suggest early resection when ischemic colitis occurs after inferior mesenteric artery ligation.[33,46]

For spontaneously occurring ischemic colitis, the literature[10,13,21,22,24,27,42] contains 12 patients with an angiogram in which occlusive phenomena was present and 15 others with a non-occlusive pattern. We have done angiograms in 19 of our patients. We attempted to categorize the clinical situation of these 46 patients to determine whether or not the presence of an occlusion significantly influenced the clinical features. The truly fulminant cases in which angiography is available show non-occlusion in all 4 circumstances. Of the 6 patients with angiography who had severe disease with stricture and obstruction 4 were non-occlusive and two were occlusive. Clearly transient disease was present in 5 patients with occlusion and in 22 with non-occlusion. Mild stricture was present in 3 with occlusion and in 3 with non-occlusion. There were 3 patients with angiogram, 2 occlusive, one non-occlusive in whom the clinical course is unknown. Thus 69% of the occlusive group had mild disease whereas 53% of the non-occlusive patients had mild disease (not statistically significant). Survival occurred in 65% of those with occlusive and in 66% of those with non-occlusive disease. We interpret this to mean that when the patients are divided according to the presence or absence of arterial occlusion on the basis of angiograms, the clinical reflection of the ischemic colitis process does not differ. Therefore occlusion or non-occlusion is not the basis upon which one can establish either severity or therapy. It must be acknowledged that the possibility that angiography is being done late, and therefore is being done in selective circumstances exists. In our own series the average time for the angiogram was 6 days into the illness. However in 9 patients it was done less than 24 hours into the illness. The groups do not differ one from the other.

Pathogenesis

In their original article, Boley et al.[4] presented experimental evidence to show that a lesion similar to the one seen in their 5 patients could be produced by techniques that interfered with colonic blood supply. Since that time other experimental reports contain confirmatory observations.[5,25,28,30,34] Although there may be minor histologic differences and variations in the rate of progress of the lesion, the end result is the same whether one uses arterial ligation, venous ligation, microsphere injection or partial occlusion complicated by hypotension. Thus it is clear that mechanical interference with colonic blood supply can reproduce the entire spectrum of ischemic colitis. In addition changes in the luminal pressure within the colon can influence colonic blood flow[6,37] in terms of volume flow to the colon, of distributional flow within the colon wall or of nutritional flow to the colon. Finally repeated increases in colonic pressure can induce prolonged decreases in flow with the flow decreases persisting after the luminal pressure increases are removed. By implication the continued presence of such abnormalities of flow might reasonably be expected to produce the same pathologic process as is demonstrated when one interferes with the blood supply by mechanical means. Thus one could speculate that ischemic colitis occurs in patients with some arteriosclerotic change in the colonic vessels plus some process that increases colonic pressure. Perhaps unusual change in colonic pressure is the precipitating event. Such events might explain the ischemic colitis seen with colonic carcinoma.[8,36,37] Some have suggested that ischemia in obstructed colons is much more common than generally agreed[36] and others have been concerned about ischemic perforations of the colon even in the absence of mechanical obstruction.[1,44] Unfortunately the pressures used in the experimental studies are higher than those seen clinically, the presence of a definite process associated with increased colonic pressure is lacking in the vast majority of patients with ischemic colitis, and evidence for advanced arteriosclerosis is not available.[42]

As noted earlier we have been unable to correlate the

status of the major arteries with the severity of the ischemic colitis. Thus we are forced to consider factors related to blood flow in the smaller vessels and in the colon wall. The higher incidence of ischemic colitis in the splenic flexure area[26,38] has been presumed to be due to such a distal vessel phenomena with "poorer" blood supply in this watershed area between the superior and inferior mesenteric artery systems. Yet in only two of our 19 cases in which we had both angiographic and barium data was the ischemic process in the watershed between the two arterial systems.[42] Selective arteriography with good visualization of the distal vessels is available in 8 of our own patients and 3 more from the literature, all of whom have non-occlusive disease. None have evidence of smaller arterial occlusions or of venous occlusions.[34] In 4 of the 11 an increased vascularity is documented and in 4 of the 8 where it is commented upon there is decrease in transient time. Expressed differently, 5 patients of the 11 with detailed analysis of the distal circulation have evidence to suggest hyperemia. In none is there any evidence to suggest spasm. Certainly such angiographic observations are not consistent with ischemia. However, ischemia cannot be excluded on this basis for several reasons. First, it is well known that angiographic studies are more representative of the volume present in a vascular bed than of the flow to the organ. Indeed one could speculate that the "increased vascularity" is just a reflection of increased volume due to venous occlusion. However none of the well established angiographic criteria for venous occlusion[34] were found in these patients and further a decreased transient time is inconsistent with venous occlusion. Secondly since we were able to show spasm in the major vessels of our patients with the more extensive disease,[41] we conclude that spasm is not present in our patients with ischemic colitis. In 4 of our 8 patients with distal visualization, the study was within the first 24 hours and since these did not differ from those studied later the time of the study does not seem to be important and probably does not account for the lack of spasm.

The process observed angiographically in the colonic wall is very similar to the hyperemia observed by Boijsen and Reuter[3] in many inflammatory and neoplastic conditions. That it is seen both early and late in the course of the disease is not surprising since reactive hyperemia measured by radioactive microspheres after ligation of bowel vessels was observed both early and late.[47] As we suggested before[42] two of our patients have changes in the location of dye within the wall which could be a reflection of distributional shifts. More observations are necessary before we can even speculate about this possibility. We are forced to conclude on the basis of this review that an ischemic process as the basis for ischemic colitis seen in most patients is not yet established since a detailed evaluation of the blood supply to the involved colon is not consistent with spasm or occlusion. Indeed to date it has only shown evidence consistent with hyperemia. By the same token it must be stressed that these data do not exclude ischemia as the pathologic basis of this process. No better etiology has yet been provided.

Conclusions

Based upon our experience with 55 cases of ischemic colitis and a review of the literature we have concluded that the designation is a useful clinical description which permits the patients' problem to be differentiated from the other known colonic problems. This separation provides a basis for rational therapy which entails observation in the majority of patients, those with mild disease, and resection for those patients who can be shown to have severe disease. A fair prognosis exists for those patients with severe disease and an excellent prognosis for those patients with mild disease. Thus the excellent prognosis is significantly different from diseases such as ulcerative colitis or granulomatous colitis. While the colon lesion can be produced experimentally by a number of manipulations to the blood supply of the colon, available angiographic data do not establish a different clinical course for patients who have occlusion to a major artery as opposed to those with no occlusion. Said differently occlusive phenomena in the major arteries or veins is not an essential feature of ischemic colitis. Angiographic data on the distal vessels often shows only reactive hyperemia. To date no one has established the presence of poor blood flow to the involved colonic wall in a human patient with ischemic colitis. Thus one must question whether or not the pathogenesis of the clinically useful designation, ischemic colitis, includes ischemia.

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Discussion

Dr. David B. Skinner (Chicago): Dr. Williams' extensive experience illustrates the broad clinical spectrum of the disease and, I believe, the advice he has given us about clinical management is sound.

I would like to make a few comments about the etiology. Stimulated by similar patients having various manifestations of ischemic colitis and also by Marsten's report cataloguing these lesions, my colleagues, Dr. Zarins, Dr. Moossa and I have carried out and reported experiments in dogs, and more recently in monkeys, which have some bearing on this question of ischemic etiology.

The full range of lesions which Dr. Williams has described, including ulceration, edema, stricture, fistula, bleeding, perforation and even gangrene, can be reproduced by a temporary occlusion of the vascular pedicle to a loop of bowel.

(Slide) If one isolates a bowel loop at the splenic flexure and places an occlusive clamp temporarily across the base of the pedicle for 6–10 hours, depending on the duration of the occlusion, the full range of different lesions can be seen.

When the clamp is released, arterial pulsation is restored. An arteriogram shows patent vessels. Some of these bowel loops go on to gangrene and necrosis, some enter an intermediate stage with stricture or bleeding, and some make a complete recovery with persistent hyperemia in the bowel wall for several days.

(Slide) We've studied these animals at intervals over a month to six weeks with radioactive microsphere scans, comparing the injured area to adjacent bowel. This is a monkey colon segment that is one month after an eight-hour temporary occlusion.

(Slide) After injection of microspheres and resection of the bowel, a tight stricture can be seen in the ischemic area on this radiograph.

(Slide) The microsphere scan shows that this is a hyperemic lesion at this time, with persistence of the microsphere accumulation in the area at the tight stricture.

Temporary hypoperfusion of bowel can result not only from vascular