Surgical Treatment of Chronic Occlusive Disease of the Enteric Visceral Branches of the Abdominal Aorta

Experience with 119 Operations

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Whenever abdominal circulatory disorders are caused by obstruction of the abdominal aortic visceral branches, adequate blood flow may be restored only by surgical intervention. With the development of symptoms suggesting inadequate collateral circulation and disturbance of splanchnic blood supply, operation is indicated. The choice of operation depends on the nature and the cause of the disease and the type of occlusion. With intravascular obstruction, correction of blood flow may be achieved by a reconstructive procedure. In many patients with extravascular compression of the celiac artery, adequate flow is restored by simple external decompression. The present communication is based on experience with 119 operations, 102 reconstructive and 17 decompressive. Of the 102 reconstructive procedures, 94 were complex with one-stage revascularization of several arteries. Transaortic endarterectomy as described in our method of choice although with widespread lesions resection and replacement is preferred. A thoracolumbar approach is the most expedient incision for reconstruction. The results obtained provide evidence for the effectiveness of surgical treatment of chronic occlusive disease of the visceral branches of the abdominal aorta.

T his report deals with our indications for operation, choice of technique and surgical experiences in reconstruction of the enteric visceral branches of the abdominal aorta for occlusive disease.

Materials and Methods

We studied 303 patients with occlusive disease of various branches of the abdominal aorta. There were 231 men and 72 women ranging in age from eight to 72 years. The etiologic factors and age of the patients are given in Table 1. We rarely encountered occlusion of only a single vessel due to atherosclerosis or nonspecific aortoarteritis. On the other hand, extravascular compression was almost always isolated, involved the celiac artery, and was caused by elements of the diaphragm.

Symptoms which accompany chronic occlusive disease of the abdominal visceral arteries are the result of circulatory insufficiency of the digestive tract, and we are convinced that the process is a progressive one from a mild to a more severe stage. We distinguished three stages as 1) compensated, 2) intermediate, and 3) decompensated.

In the compensated stage collateral circulation is good with an adequate balance of blood supply through the celiac, superior and inferior mesenteric areas. Occlusive lesions at this stage were discovered during examination for circulatory disorders in other arterial areas. When collateral circulation is inadequate, symptoms first appear only when the digestive tract is under a functional load, and they have a vague character consisting of a sense of heaviness, sometimes pain in the epigastric region, fullness and a sense of satiety after small meals and irregular bowel habits of constipation alternating with diarrhea. Further progression of the occlusion or inadequacy of the collateral circulation leads to the decompensated third stage and a specific triad of symptoms: abdominal pain after eating, intestinal dysfunction and progressive loss of weight, a syndrome we call chronic abdominal ischemia. Table 2 shows the relationship of the stage of disease with the number and location of occlusions.

The syndrome of chronic abdominal ischemia presents difficulty in diagnosis. An epigastric systolic murmur is of great value and was heard in 78% of our patients with stenosis of the celiac artery (CA), 52% with occlusion of the superior mesenteric artery (SMA) and 68% of those with both arteries. It should be noted that in the most severe cases, there may be no murmur and, hence, absence of a murmur does not exclude the

TABLE 1. *Age of Patients and the Etiology of the Occlusive Lesions of the Abdominal Aortic Visceral Branches*

	Age of Patients						Total Number
Etiology of Lesion	8–20 Yr	21–30 Yr	31–40 Yr	41–50 Yr	51–60 Yr	Over 60 Yr	
Atherosclerosis	—	—	7	72	79	52	210
Nonspecific aortoarteritis	19	26	17	5	—	—	67
Extravascular compression	3	2	8	6	5	2	26
Total	22	28	32	83	84	54	303

lesion. Signs of vascular disease in other areas may point to the probable vascular origin of the abdominal symptoms. Aortography in the anterior, posterior and lateral views is the main diagnostic tool.

Restoration of adequate blood flow can be achieved by operation only and we support the principle of early surgical correction, believing that the presence of symptoms is an indication for surgery. In most cases, the operation is done through a thoracolumbar approach with displacement of the viscera, including the left kidney to the right and anteriorly. This provides a good view of the aorta and its branches and allows different types of surgical repair. Midline incision is used only in cases of moderate compression of the celiac artery where decompression alone is usually sufficient to restore adequate blood flow. When prolonged cross-clamping of the aorta above the celiac artery is expected, moderate hypothermia (30–31 C) is used.

Between 1962 and 1977, 119 operations were performed to revascularize the arteries of the digestive tract. Choice of the operation varied depending upon the etiology and nature of the occlusion. Release of the extravascular compression of the celiac artery was adequate in many cases but intravascular disease required a reconstructive procedure. Reconstruction was performed in 102 cases, involving 130 arteries (Table 3). We have used endarterectomy, resection and replacement, and replantation.

Endarterectomy

Endarterectomy is used only when the proximal artery segment is involved and we prefer the trans-

aortic method. Since with atherosclerosis and nonspecific aortoarteritis several aortic branches are often involved, we favor a one stage method on the aorta. This is performed as follows: after mobilization of the abdominal aorta and the visceral branches, the aorta is cross-clamped 1.5–2 cm proximal to the celiac artery and distal to the renal arteries (Fig. 1b). A longitudinal incision is made over 5–7.5 cm on the left posterolateral aspect of the aorta. With a special spatula the altered intima and atherosclerotic plaque are delicately detached all over the aortic circumference and this is detached proximal to the celiac artery and distal to the renal arteries. Wide incision on the aorta provides good visual control as the endarterectomy is continued into the affected arteries. Retrograde flow is examined during release of occlusion of the arteries. When necessary, bougienage of the endarterectomized arteries is performed, and once good back bleeding is obtained, the aortotomy is closed with a single layer of mattress sutures. The procedure can be completed in 15–17 minutes and is performed at normal temperature. By means of endarterectomy, the celiac artery was revascularized in 15 cases, the superior mesenteric artery (SMA) in 19 and the inferior mesenteric artery (IMA) in 26. Revascularization of the IMA occurred as a rule, during reconstruction of the terminal aorta. For this purpose, after transection of the terminal aorta, we longitudinally incised its wall up to the level of the IMA.

During aortofemoral bypass the proximal anastomosis is made at the level of the IMA which facilitates the endarterectomy of that artery.

TABLE 2. *Severity of Clinical Picture Depending on the Location and Number of Occlusions*

	Site of Occlusion						Total Number
Stage of Process	CA	SMA	IMA	CA SMA	SMA IMA	All Three Branches	
Compensated	8	7	164	8	2	—	189
Intermediate	9	11	13	22	7	5	67
Decompensated	24	7	—	10	2	4	47
Total	41	25	177	40	11	9	303

CA: Celiac artery.
SMA: Superior mesenteric artery.

IMA: Inferior mesenteric artery.

TREATMENT OF OCCLUSIVE DISEASE

TABLE 3. *Types of Reconstructive Operations and Total Number of Revascularized Arteries*

Nature of Disease	Type of Reconstruction												Resection of Aorta and Reconstruction of Suprarenal Segment
	Endarterectomy			Replacement			Replantation			Ostium Plasty			
	CA	SMA	IMA	CA	SMA	IMA	CA	SMA	IMA	CA	SMA	IMA	
Atherosclerosis	5	10	25	5	9	1	—	—	14	—	1	—	—
Nonspecific aortoarteritis	10	9	1	8	10	—	—	2	4	9	2*	—	2†
Extravascular compression	—	—	—	3	—	—	—	—	—	—	—	—	—
Total	15	19	26	16	19	1	—	2	18	9	3	—	2

* In two cases aneurysm of the intestinal branches was excised.
† In two cases we performed resection of the thoraco-abdominal aorta and lateral plasty of the suprarenal segment by a graft and correction of the blood flow in the celiac and superior mesenteric arteries.

Resection and replacement was performed for more extensive lesions. Allografts, 8 mm in diameter, were used for arterial replacement and in one case autogenous vein angioplasty of the celiac artery was performed. We have replaced the celiac artery in 16 cases and the SMA in 19. In one case replacement of the IMA was performed along with resection of an abdominal aortic aneurysm.

Replantation is considered when, after resection of the affected arterial segment, sufficient length and mobility is obtained to anastomose the aorta without tension. The mesenteric arteries, the main trunk of which is sufficiently long, is usually treated in this way.

Replantation has been done in 20 cases, two of the SMA and 18 of the IMA. When the IMA is small in diameter we replanted it with a button of the adjacent aorta.

Difficulties arise when there are different types of obstructive lesions necessitating revascularization of several viscera. In practice this occurs often.[6,8,13-17] When there are more than two affected visceral branches, in various combinations (Fig. 2), we use the one stage transaortic endarterectomy. This was used in 25 cases, 13 because of atherosclerosis and 12 because of the sclerotic stage of nonspecific aortoarteritis.
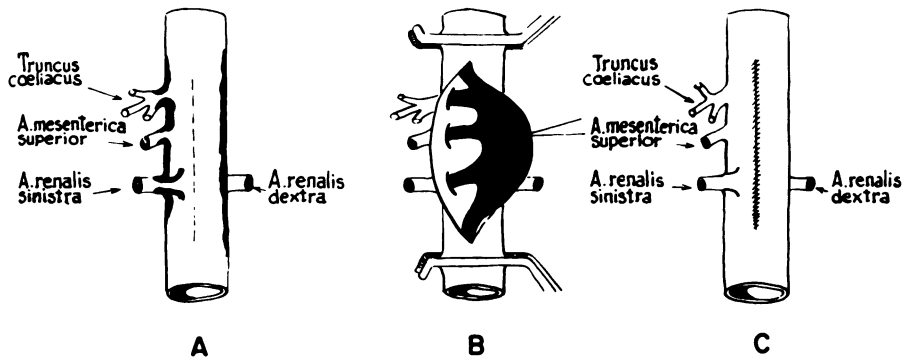
In 18 patients, transaortic endarterectomy was associated with reconstruction of the affected aortic segment, in two patients with resection and replacement of the thoracoabdominal aorta, in four patients with replacement of the infrarenal aortic segment, and in 12 transaortic endarterectomy was associated with aortofemoral replacement. The order of the operation depended on localization of the aortic lesion. When reconstruction of the thoracoabdominal aorta was necessary, we performed replacement first and then transaortic endarterectomy (Fig. 3). Operations are done under hypothermia, anticipating prolonged cross-clamping of the aorta above the celiac artery. When the infrarenal segment was resected, we performed the endarterectomy first (Fig. 4).

When the thoracoabdominal aorta and the celiac artery are affected by nonspecific aortoarteritis, we use a one-stage resection of aorta and plastic repair of the orifice of the celiac artery (Fig. 5). For resection of the aorta the distal incision is made at the level of the celiac artery and a longitudinal incision extends into its upper wall. The distal end of the graft is trimmed and a wide end-to-end anastomosis constructed, extending into the celiac artery. We have done this in nine instances.

When the celiac artery and the SMA, or one of them and the left renal artery, are involved, we use a

FIG. 1. Schematic picture of one-stage transaortic endarterectomy of the abdominal aorta and its branches. (A) Incision on the left posterolateral aspect of the aorta. (B) Aortic lumen is opened and the involved intima is removed from the aorta and affected arteries. (C) Aortotomy is closed with continuous circular suture.
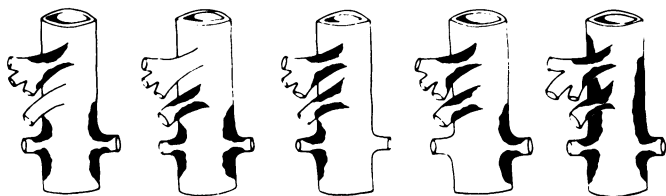
FIG. 2. Indications for one-stage simultaneous transaortic endarterectomy from the abdominal aorta and its branches.

bifurcation prosthesis. End-to-end anastomosis is done to the aorta in the suprarenal segment and subsequently branches are anastomosed end-to-end to the artery to be reconstructed.

Of 102 reconstructions there were 71 of one visceral branch, 29 of two branches and two involving three branches (Fig. 6). Isolated reconstruction of visceral branches was done in ten cases only; replacement of the celiac artery in five cases, the SMA in three and of both arteries in two. In 15 cases we performed one-stage reconstruction of the enteric visceral and renal arteries, in 47 cases of enteric branches and aorta, in 29 of enteric branches, renal arteries and different segments of the abdominal aorta.

One-stage reconstruction of several branches is associated with a significant risk. Although this might be decreased by staged operations, staging aggravates the visceral ischemia from the associated hemodynamic changes and redistribution of blood.

Decompression Operations

Twenty patients were operated on because of extravascular compression of the celiac artery. In three in-
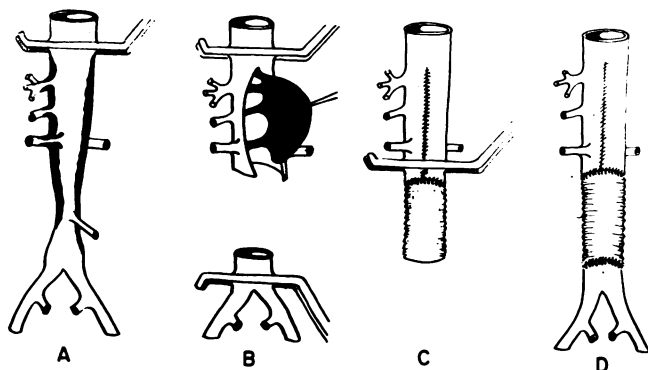

FIG. 4. Illustration of one-stage transaortic endarterectomy combined with resection of the infrarenal aortic segment. (A) Type of pathology. (B) Aorta is cross-clamped above the celiac artery and distal to the renal arteries and it is longitudinally incised up to the level of celiac artery; endarterectomy is done. (C) The aortotomy is sutured and the clamp is placed just distal to the renal arteries. (D) The terminal aorta is replaced.

stances, decompression was then insufficient to restore adequate blood flow because of fibrous reaction of the wall and the remaining 10 mmHg gradient was corrected by resection and replacement (two allografts and one autogenous vein). Thirteen patients (11%) died in the early postoperative period, 12 of them after complex reconstructive procedures with the restoration of flow to several arteries. Four died from acute cardiovascular insufficiency, one from bleeding, one from thrombosis of the reconstructed SMA and resulting gangrene, one from sepsis, one from multiple organ failure, four from acute renal failure and one from respiratory insufficiency associated with empyema and bilateral necrotizing pneumonia. Only two patients (4%) died among 49 patients treated in the last three years.
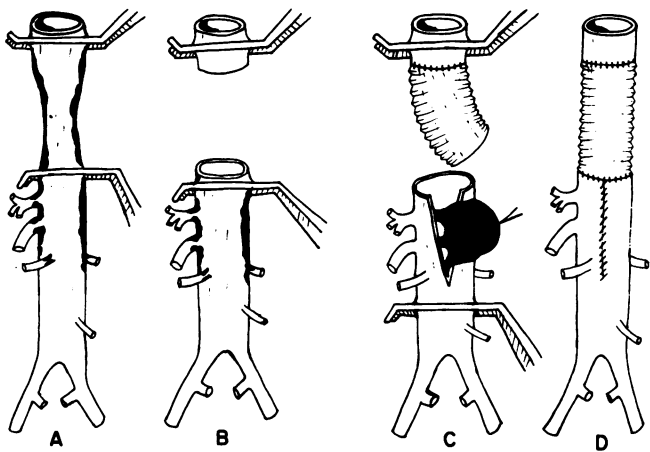

FIG. 3. Illustration of one-stage transaortic endarterectomy combined with resection of the thoracoabdominal aorta. (A) Type of pathology. (B) Thoracoabdominal aorta is resected. (C) Proximal anastomosis is constructed; the aorta is clamped distal to the renal arteries; the aorta is incised longitudinally and endarterectomy is done. (D) The aortotomy is sutured and the distal anastomosis is constructed.
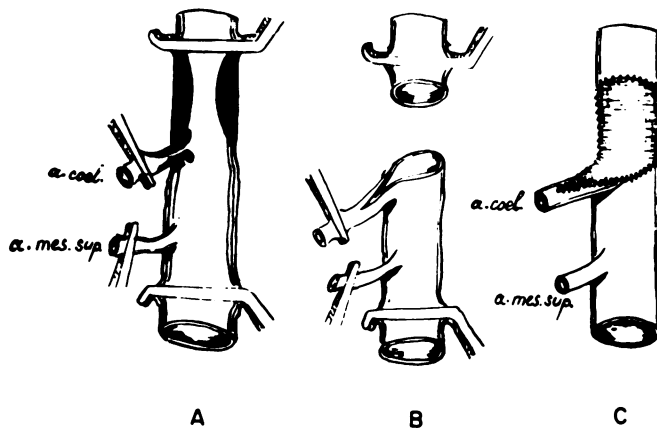

FIG. 5. Illustration of resection of the thoracoabdominal aorta and reconstruction of the Celiac artery. (A) Type of pathology. (B) The aorta is resected and the celiac artery is longitudinally incised. (C) The anastomosis continues on to the arterial wall with the Larsan-Ftorlan prosthesis widening the arterial lumen.

Late results, six months to 15 years after operation, were examined in 79 cases. Eighteen were operated on for extravascular compression of the celiac artery, 61 for atherosclerosis and nonspecific aortoarteritis. Fifty-seven patients were operated on for the syndrome of chronic abdominal ischemia, and a good result with disappearance of ischemic symptoms was obtained in 39 (68%) and in 11 (19%) there was significant improvement. In six patients (10%), five of whom had a decompression operation, the operation was ineffective. One patient died five years postoperative from traumatic bleeding.

Of twenty-two patients having reconstruction in the compensated stage of disease, four died, two from myocardial infarction, one from acute cerebral vascular insult and one from renal insufficiency. Eighteen patients were relieved of symptoms of abdominal ischemia.

Thus, of 79 patients, 68 (86%) obtained good or satisfactory results. Considering the late results, we believe these results are good.

Discussion

There is a divergence of opinion about the indications for operation for occlusive disease of the arteries to the digestive tract. Many authors advocate early operation because of the progressive nature of the process and the severe consequences of ischemia, principally the threat of acute mesenteric thrombosis.[4,8,13,14] Many advised a prophylactic operation believing that acute mesenteric thrombosis is inevitable. Several authors advocate operation only if there is marked clinical evidence of chronic abdominal ischemia.[3,10]

We believe that symptoms of the chronic abdominal ischemic syndrome constitute an indication for operation irrespective of the clinical signs. In asymptomatic patients we withhold operation except in cases where operation is being done for other disease of the aorta or where during reconstruction of the aorta or its branches, the circulation and hemodynamics were so altered that we could anticipate development of ischemia. In such cases we revascularized the asymptomatic visceral branches.

Controversy exists about the surgical procedure in case of associated lesions of the celiac artery and SMA. Several authors[7,10] believe it is sufficient to restore blood flow to the SMA only. Others[8,9,13] decide at the time of operation and restore one artery at a time, attempting to eliminate the pressure gradient in all branches of the aorta. We agree with the authors who advocate revascularization of both arteries.[2,18,19]

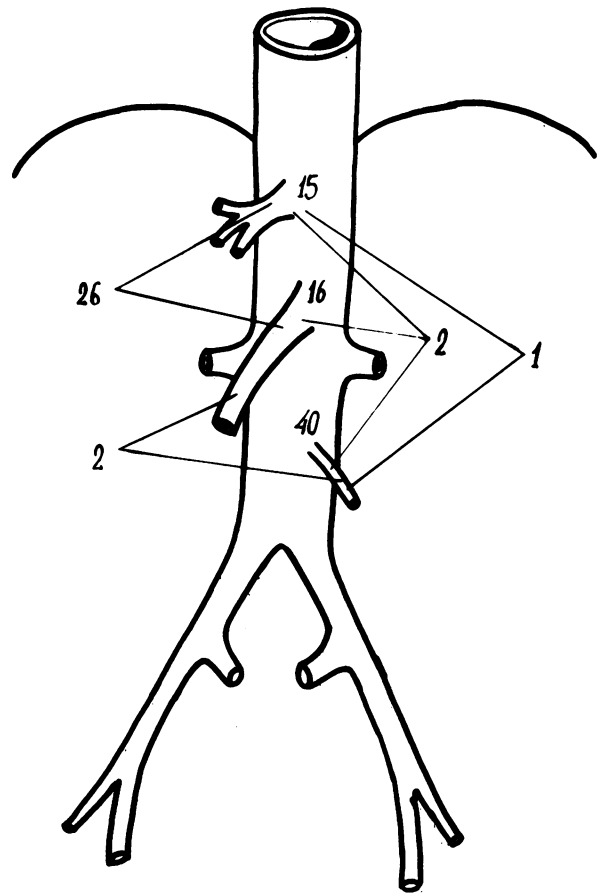On the basis of our study, we believe ischemia may

FIG. 6. Diagram showing number and site of reconstruction of the abdominal aortic visceral branches.

result in the presence of isolated obstruction of the celiac artery and SMA. Collateral flow to these affected areas may result in ischemia of the organs normally supplied by the unobstructed visceral vessel. Therefore, in case of associated lesions with obstruction of the SMA, we try to achieve one-stage revascularization.[5,6,9,13,17]

The choice of an operation is arguable. Most surgeons prefer various types of bypass procedures and fewer speak of endarterectomy. In our opinion, variation of the extent of disease prevents adoption of a uniform technique. A bypass operation is easier, notably because exposure of the arterial orifice which is required with endarterectomy is associated with technical difficulties. Bypass is considered to be less effective hemodynamically, however, when compared to replacement and an end-to-end reconstruction. In many instances of occlusive disease, revascularization of several branches is required and construction of several shunts is difficult on the short aortic segment. Transaortic endarterectomy as proposed allows easier revascularization of several viscera.

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