

## RENO-MESETERO-AORTO-ILIAC THROMBOENDARTERECTOMY IN PATIENT WITH MALIGNANT HYPERTENSION

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IN RECENT years there has been mounting interest in the revascularization of ischemic organs (specifically the brain,<sup>10, 18</sup> lung,<sup>22</sup> heart,<sup>1, 17</sup> kidney,<sup>7, 20</sup> and intestine.<sup>23</sup> Early work on the direct surgery of occlusive arterial disease was focused on the lower extremities, not only because of the prevalence of involvement there, but because the symptoms of arterial insufficiency were clear-cut and methods of diagnosis were precise. In contrast, ischemia of visceral organs often resulted in vague symptoms, and diagnostic methods were frequently inexact. A further deterrent to reconstructive arterial surgery was the widely held view that major vessel occlusion to many visceral tissues would result in irreversible damage with such rapidity that reconstitution of arterial blood flow would be fruitless. It is now realized that this is often not the case and that all tissues of the body (under the appropriate circumstances) may react to extensive devascularization with diminished function rather than by necrosis.

The present report documents a case in which there was interference with the major arterial supply of both kidneys as well as partial occlusion of the superior mesenteric artery—complicating an extensive aortoiliac thrombosis. The patient presented with intermittent claudication, malignant hypertension, abdominal pain, and rapid weight loss. Treatment consisted of thromboendarterectomy of all involved vessels, with relief of the cardiovascular and gastrointestinal complaints.

### CASE REPORT

W. J. (USVAR 23482), a 62-year-old white man, had been in a mental institution (with a diagnosis of schizophrenia) for 19 years prior to the present admission on Oct. 2, 1958. Occasional blood pressure determinations were normal until late 1955 when he was noted to be hypertensive (blood pressure 200/100 mm. Hg). Subsequently, the hypertension progressed despite drug therapy. During the first 9 months of 1958 blood pressures ranged from 200/90 to 300/160 mm. Hg. During the 6 months preceding admission he had developed severe headaches, sporadic chest pain, and intermittent claudication. During the 6 weeks preceding admission he had lost 30 pounds, and had developed constipation and remittent abdominal pain (provoked by eating). ECG was normal until March, 1958, when a left ventricular strain pattern was first noted.

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*Physical Examination.*—This was a well-developed, withdrawn white man who appeared chronically ill. Blood pressure was 220/100 to 300/160 mm. Hg during the preoperative period (Fig. 1, A); pulse rate was 80 to 100. Ophthalmoscopy showed blurring of both discs, bilateral retinal hemorrhages, and extreme arteriolar narrowing. The apical heartbeat was in the sixth intercostal space, 11 cm. from the midline. Running inferomedially from the lower anterior chest to the abdomen were pulsating serpiginous collaterals. Similar vessels, some as large as lead pencils, were also in the lower abdomen. The abdominal aorta could be palpated in the epigastrium, but no lower. A very feeble right femoral pulse was detectable (subsequently shown to be due to collateral flow), but there were no other pulses in either leg. On rectal examination, pulsating collaterals could be felt on the surface of the prostate.

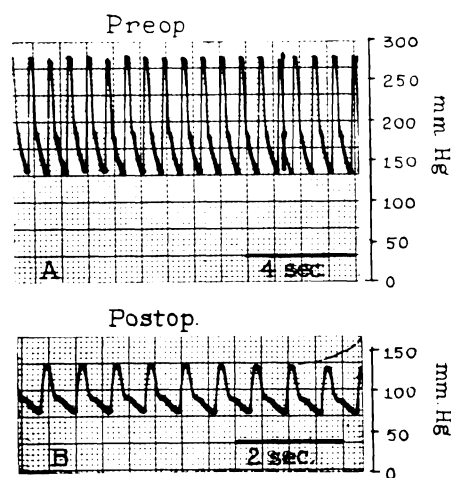


Fig. 1.—Direct brachial artery blood pressures before (A) and 9 weeks after (B) surgery.

*Laboratory Studies.*—Hemogram and coagulogram were normal. Urinalysis was normal except for a few hyaline casts; specific gravity 1.015. Blood urea nitrogen was 15. Fasting blood sugar, serum proteins, Bromsulphalein, prothrombin time, and Wassermann test were normal. There was slight cardiomegaly on chest x-ray and ECG showed left ventricular hypertrophy. Analysis of 3-day stool specimen revealed total daily fecal fat of 2.3 grams, neutral fat of 1.9 grams, and fatty acids of 0.66 gram per day. Aortogram (50 per cent Hypaque) on Oct. 16, 1958, revealed complete thrombosis of the abdominal aorta with nonvisualization of the left renal artery and stenosis at the origin of the right renal artery (Fig. 2). The aortic occlusion began just at the mouth of the superior mesenteric artery (Fig. 2), but this vessel filled with dye.

*Renal Function Studies.*—Prior to aortography, a number of renal function studies were done. Blood urea nitrogen was 15 mg. per cent. Intravenous pyelogram was reported as normal with good excretion bilaterally. Phenolsulfonphthalein (PSP) excretion was 13, 13, 14, and 13 per cent at 15, 30, 60, and 120 minutes (total 53 per cent). Urea clearance during diuresis was 33 (about 40 per cent of normal). Radioactive Diodrast renograms were interpreted as showing a comparatively reduced vascular phase on the left.

Split functions during diuresis were determined (Table I) after bilateral ureteral catheterization.<sup>6</sup> These showed a marked reduction in volume, sodium concentration, and phenolsulfonphthalein excretion on the left as compared to the right.

*Course in Hospital.*—On Oct. 17, 1958, exploration was carried out under systemic hypothermia (31° C.), attained with a combination of blanket and intragastric balloon cooling.<sup>12</sup> A thoraco-abdominal incision was employed with a midline abdominal component extended into the eighth intercostal space. The femoral arteries were exposed

TABLE I. SPLIT RENAL FUNCTIONS

DETERMINATION	RIGHT KIDNEY	LEFT KIDNEY	BLADDER
Preoperative			
30-minute volume	40 c.c.	7 c.c.	9 c.c.
30-minute PSP	25%	4.5%	
Sodium concentration	54 mEq./L.	28 mEq./L.	13 mEq./L.
Postoperative (12 weeks)			
30-minute volume	35 c.c.	20 c.c.	0
30-minute PSP	23%	11%	
Sodium concentration	44 mEq./L.	89 mEq./L.	

in the femoral triangle. The spleen, stomach, pancreas, and left colon were reflected to the right. The common iliac arteries, aorta, celiac axis, superior mesenteric artery, and both renal arteries were encircled with tapes. The superior mesenteric artery and celiac axis pulsated, the former somewhat weakly. The left renal artery did not pulsate and in the proximal 1.5 cm. was not compressible. Distal to the origin of the right renal artery a sharp thrill was palpable, and pulsations were weak.

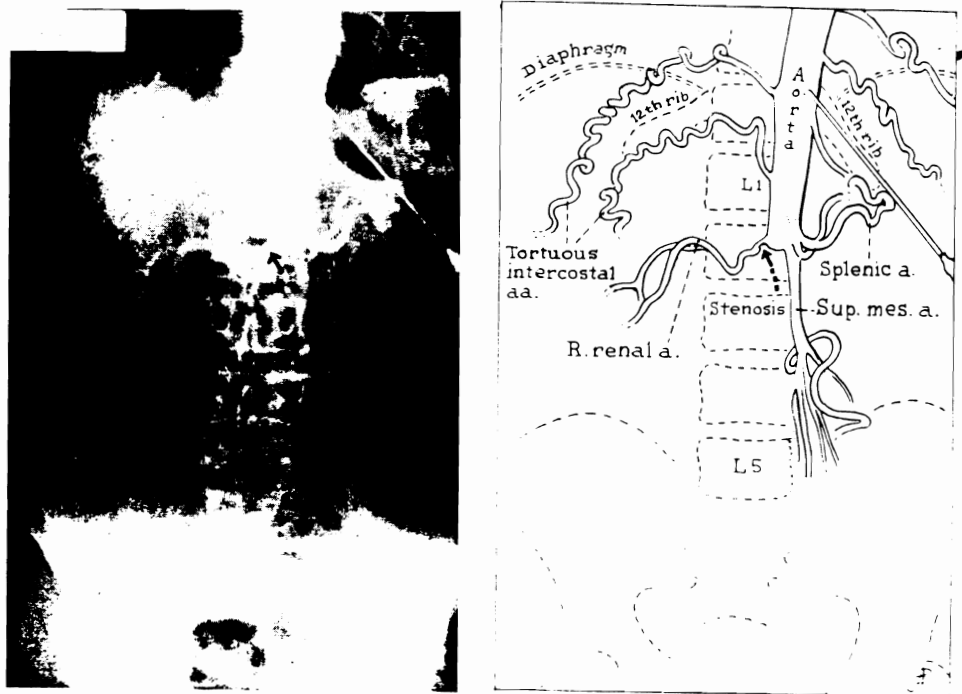


Fig. 2.—Preoperative aortogram.

Distal thromboendarterectomy was carried out first, from the superficial femoral arteries to the aorta, with strippers placed through incisions in the common femoral and common iliac arteries. An anterior aortic incision was then made and the iliac thrombi were extracted superiorly (Fig. 3). The linear aortic incision was extended superiorly above the origin of the superior mesenteric artery and the occluding core was removed in retrograde fashion. The cleavage plane in the media was well developed. When the level of the renal vessels was reached the aorta was cross-clamped (for a total period of 40 minutes) below the celiac axis and above the superior mesenteric artery. The

superior mesenteric artery was similarly cross-clamped to prevent back-bleeding. Endarterectomy of the left renal artery was then carried out from the aortic interior with a combination of gentle traction on the firm thrombus, distal traction on the renal artery adventitia, and development of the endarterectomy plane with the spatula (Fig. 3).

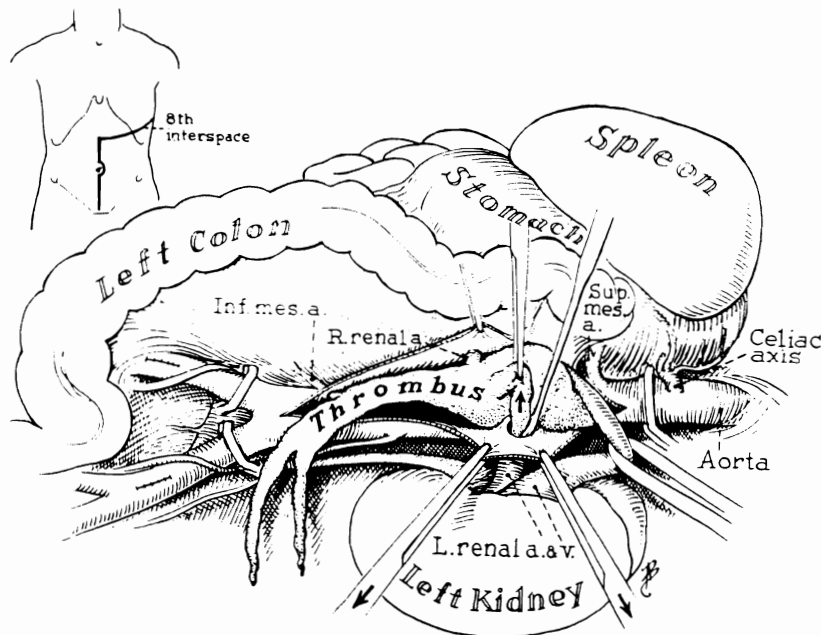


Fig. 3.—Transaortic left renal thromboendarterectomy.

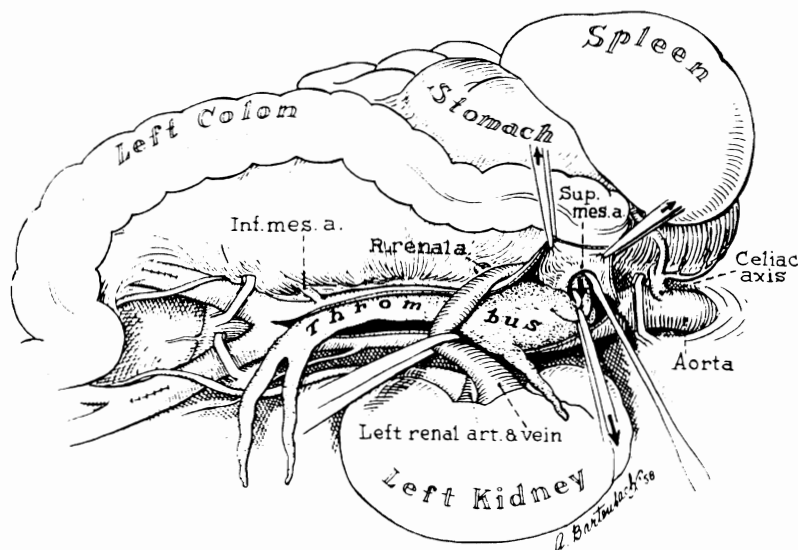


Fig. 4.—Transaortic thromboendarterectomy of superior mesenteric artery.

Endarterectomy was carried distally 1.5 to 2 cm. before the specimen broke off at a point where a lumen was present and where the intimal layer seemed delicate. Back-bleeding was brisk. The aortic specimen was then rolled to the left, and it was seen

that there was infringement on the orifice of the superior mesenteric artery by the proximal end of the aortic thrombus. Superior mesenteric thromboendarterectomy was consequently done on the proximal 1 cm. of this vessel (Fig. 4). Finally a similar trans-aortic thromboendarterectomy was done on the proximal 1.5 cm. of the right renal artery, following which there was good backflow from this vessel.

The aortic thromboendarterectomy was then terminated just below the celiac axis and the specimen was removed. A firm gray-white ligneous thrombus had completely occupied the lumen of the aorta starting 1 cm. below the renals and extending to the origin of both external iliacs (Fig. 5). Above this a soft brown (apparently more recent) thrombus extended for 2 cm., occluding and extending into the left renal artery and partially occluding the right renal as well (Fig. 5). The proximal end of the thrombus was at the level of and partially occluded the superior mesenteric artery (Fig. 5).

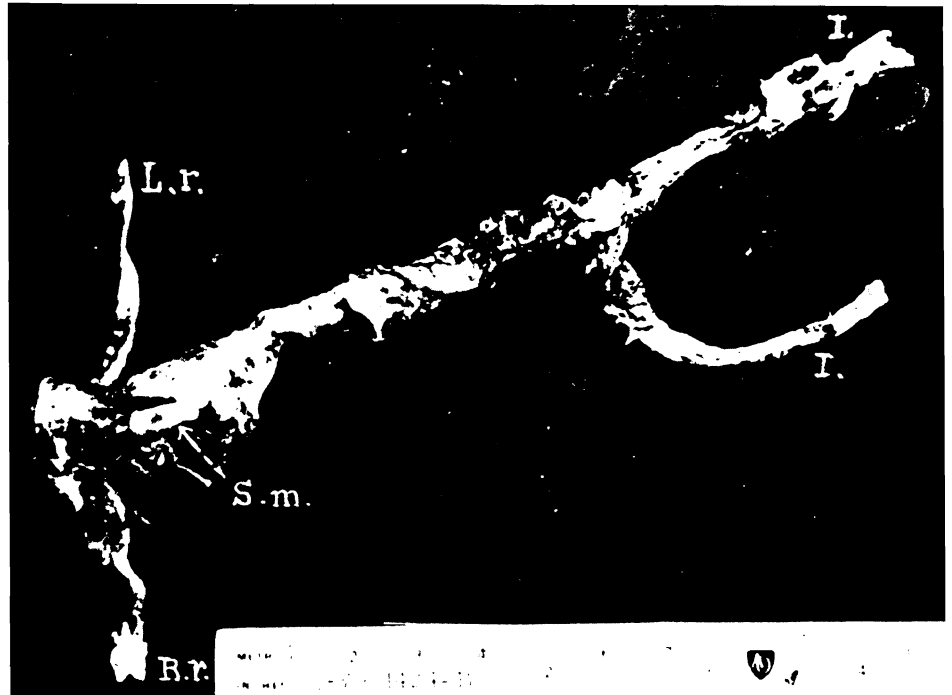


Fig. 5.—Thromboendarterectomy specimen. (R.r.) Right renal; (L.r.) left renal; (S.m.) superior mesenteric; (I) iliac.

The long aortotomy was closed and blood flow was re-established to the lower half of the body. After some minutes the left external iliac artery clotted at a place where the adventitia was injured during thromboendarterectomy, and it was necessary to replace this segment with a pre-clotted knit Teflon graft. When blood flow was re-established, bleeding through the wall of the prosthesis was excessive and did not cease for almost a half hour. The wounds were then closed. Tracheotomy was performed at the conclusion of the procedure,<sup>24</sup> and the patient was taken to the recovery room. Blood replacement (10,000 c.c.) had been necessary during the operation. As the abdomen was being closed, diuresis started, and 1,000 c.c. of urine was eliminated during the next 2 hours.

During the first postoperative night evidence of intra-abdominal bleeding developed, necessitating 10 more transfusions during the first 14 postoperative hours. Blood samples on October 18 did not clot in 24 hours. The abdomen was then re-explored on October

18 and multiple small bleeding points in the retroperitoneal space were ligated. Splenectomy was performed, and the abdomen was drained and closed. Subsequently slow bleeding into the peritoneal cavity continued for 48 hours and then ceased. On the second, third, and fourth days brisk gastrointestinal hemorrhages occurred. Additional transfusions during this period increased total blood replacement during and after operation to 44 units.

After one week, the patient resumed oral intake. The tracheostomy was removed in 10 days. Blood urea nitrogen rose steadily to 144 mgm. per cent during the first 10 days and then declined to 16 mgm. per cent by the twenty-fifth postoperative day. For the first 4 days after the second operation, oliguria was present (400 to 600 c.c. per day) but after this diuresis of about 2,000 c.c. daily continued for more than 2 weeks. Electrolytes remained normal throughout. All peripheral pulses in the legs have remained palpable. The abdominal wall collaterals disappeared almost immediately after surgery.

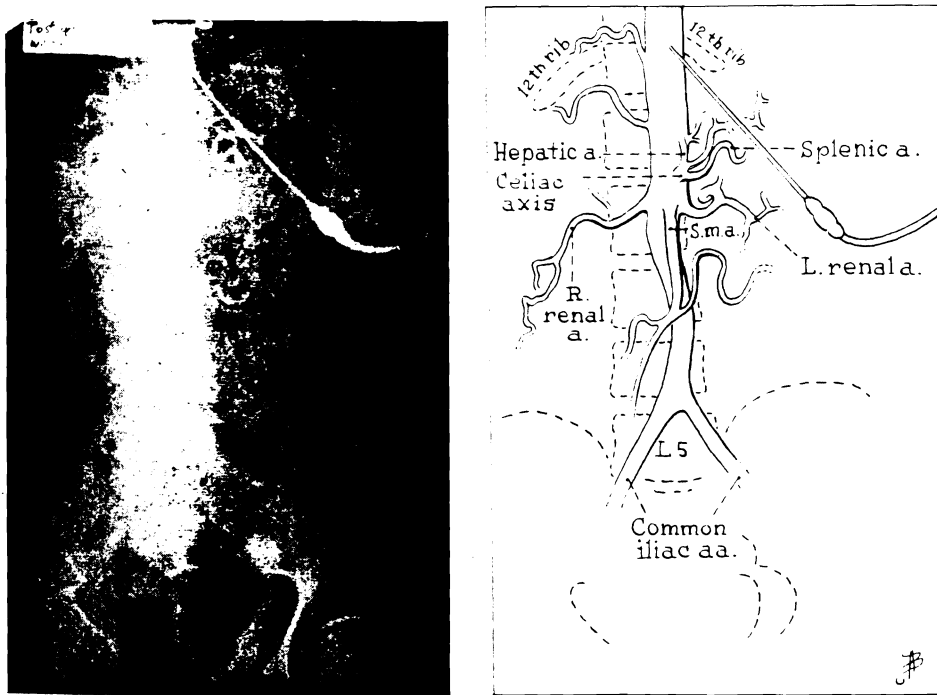


Fig. 6.—Postoperative aortogram (9 weeks).

After the immediate postoperative convalescence, his condition remained good. The preoperative complaints of chest pain, headache, intermittent claudication, and abdominal pain were not present. He was kept in the hospital for psychiatric care for several months, and was discharged to the mental institution from which he came on Feb. 25, 1959, 4½ months postoperatively.

*Postoperative Laboratory Studies.*—Chest x-ray revealed regression of the cardiomegaly within one month. ECG 2 months postoperatively was normal. Daily fecal fat content (3-day collection) was 1.16 Gm. 2 months after operation. Aortogram (Fig. 6), 9 weeks postoperatively, showed good filling of the aorta, celiac axis, both renal arteries, superior mesenteric artery, and iliac arteries.

*Postoperative Renal Function Tests.*—Blood urea nitrogen determinations after the first 3 postoperative weeks ranged from 10 to 15 mgm. per cent. Phenolsulfonphthalein excretion 2 months after operation was 10, 12, 22, and 12 per cent at 15, 30, 60 and 120

minutes (total 56 per cent). Split renal functions 3 months postoperatively revealed a marked comparative increase in sodium concentration, PSP excretion, and volume from the left kidney.

*Effect on Blood Pressure.*—By the end of the third postoperative day, the blood pressure was established at normotensive levels (Fig. 1, B). Readings were obtained every 4 hours during the remainder of the hospitalization, and no sustained elevation was ever noted. The average blood pressure during the third, fourth, and fifth postoperative months was 126/84 mm. Hg. The highest individual pressure during this 10-week period was 160/100 mm. Hg.

#### DISCUSSION

The first case of Goldblatt hypertension successfully treated with reconstructive arterial surgery was reported by Freeman and co-workers<sup>11</sup> in 1954. Subsequently, a small number of patients with either congenital or arteriosclerotic renal artery occlusion have been treated with excision of the stenosis and re-anastomosis or homograft.<sup>7, 13, 20</sup> Splenorenal arterial anastomosis beyond the occlusion,<sup>7, 14</sup> or renal thromboendarterectomy.<sup>7, 13</sup> Of particular interest was Poutasse's patient<sup>21</sup> who had bilateral renal artery stenosis corrected with a homograft first on one side and then the other (14 days later). There was no gross deviation from the pre-existing urinary function after either procedure, but ureteral catheterization studies shortly after each operation showed an increase in sodium concentrating ability first on one side and then the other.

Until the present report the only other patient with bilateral renal artery occlusion relieved at one stage was described by Castillo and Barrera.<sup>5</sup> In this case a fresh thrombus formed proximal to a pre-existing chronic aortic occlusion, closing the mouths of the renal vessels. Treatment consisted of extraction of the fresh aortic thrombus without treatment of the chronic distal occlusion. In contrast to the present case, the thrombus did not extend into the renal arteries, and no other treatment of these vessels was necessary. It is interesting that in this case, as in ours, there was immediate striking diuresis which started as the abdomen was being closed. A similar but less extensive case has been reported by Cannon<sup>3</sup> in which an aortic thrombus which involved the renal arteries was extracted from below.

So much has been written about the clinical characteristics<sup>6, 7, 19</sup> and laboratory diagnosis<sup>6, 7, 20</sup> and of Goldblatt hypertension that it would be purposeless to review the matter here. In this patient, it was clear from differential function tests that the left kidney had a much greater functional impairment than the right. Since these tests depend on the comparison of an abnormal kidney to the opposite normal organ, it is impossible to quantitate the degree of impairment of the better kidney in a case such as the one described. The diagnosis must be made by aortography and confirmed at surgery as previously pointed out by Poutasse.<sup>20</sup>

After the aorta had been opened in this patient, a high degree of occlusion of the superior mesenteric artery was found. This vessel had been visualized well on the aortogram and pulsated on external examination. Endarterectomy on this vessel was carried out partly because clean removal of

the adjacent aortic occlusion was not otherwise possible, and partly because some of the preoperative complaints (vague abdominal pain aggravated by eating, rapid weight loss) were suggestive of "intestinal angina." These symptoms have been absent since operation.

Information concerning the effect of slow occlusion of the splanchnic blood supply has accumulated during the last 20 years. It is known experimentally that gradual occlusion of the celiac axis and or superior mesenteric arteries may not result in bowel necrosis,<sup>2-16</sup> that many cases of massive mesenteric infarction due to slow occlusion of the blood supply are preceded by weeks or months of premonitory symptoms,<sup>9</sup> and that the diseased portion of the superior mesenteric artery is almost always confined to the mouth or first 2 cm.<sup>4-7</sup> A clinical syndrome of relative arterial insufficiency of the bowel has crystallized,<sup>17-23</sup> and recently 2 patients with "intestinal angina" and subsequent frank small bowel infarction have been successfully treated with superior mesenteric thromboendarterectomy.<sup>23</sup> The present case is thought to represent the third instance of successful relief of mesenteric insufficiency.

#### SUMMARY

1. A case is documented in which there was complete occlusion of the left renal artery and partial occlusion of the right renal and superior mesenteric arteries, complicating extensive aortoiliac thrombosis.

2. The patient presented with malignant hypertension, intermittent claudication, and abdominal complaints suggestive of "intestinal angina."

3. Treatment consisted of thromboendarterectomy of all involved vessels, following which the patient became normotensive and had cessation of the abdominal symptoms.

4. The case is thought to be the first successful bilateral simultaneous renal endarterectomy, and the third successful case of superior mesenteric endarterectomy.

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