

Resection of Suprarenal Aortic Aneurysm With Autotransplantation of the Kidney

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This is a report of a patient with renovascular hypertension associated with a suprarenal aortic aneurysm that was treated by nephrectomy, resection of the aneurysm and autotransplantation of the kidney. The autografted kidney was preserved on the Mox-100 perfusion-preservation apparatus for over four hours, during which time the aneurysm was resected and replaced with a Dacron bifurcated graft. The authors believe this is the safest method for the management of aneurysms of the suprarenal aorta, especially when associated with renovascular disease, and it deserves wider application in treating major renovascular disease.

THE REMOVAL OF ANEURYSMS that extend above the renal arteries is one of the most difficult tasks the surgeon can undertake. We combined nephrectomy, kidney preservation (on the Mox-100 Perfusion System),^{19,20} and autotransplantation of the removed kidney to facilitate the excision and replacement of a suprarenal aortic aneurysm.

Kidney autotransplantation, alone, has been used for the treatment of high ureteral stricture since 1963¹⁴ and for renovascular hypertension in adults since 1965.^{8,9,17,18,22,27} The scope of autotransplantation was widened when it was introduced as the treatment of renovascular hypertension in children,^{15,25} and for resection of tumors within the renal parenchyma.^{4,5,13}

In combination with the accumulated experience and success of kidney preservation,^{3,20} autotransplantation is a safe alternative to operative expertise alone in the management of major vascular disorders (suprarenal aortic aneurysms, aneurysms of the renal vessels, and dissecting aneurysms of the aorta with dissection of the renal arteries).

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Case Report

The patient is a 61-year-old-man who was first seen at the University of Minnesota Hospitals in 1966 for a minor injury to the hand. At that time he had a duodenal ulcer with one episode, in 1954, of gastrointestinal hemorrhage.

In 1972 he was readmitted to this hospital with a two-year history of uncontrolled hypertension and a second episode of gastrointestinal hemorrhage in 1971. Aggressive medical treatment controlled his hypertension during his one month hospitalization, and for about six months on an outpatient basis. He was back to the hospital within nine months with uncontrolled hypertension for further evaluation and treatment.

During this last admission and while on high doses of methyldopa, hydralazine hydrochloride, hydrochlorothiazide, and propranolol hydrochloride, his blood pressure fluctuated from 160/80 to 220/120 mm Hg. His BUN was 34 mg/100 ml, and serum creatinine was 2.2 mg/100 ml. His creatinine clearance ranged 30–34 ml/min/1.73 m². An arteriogram revealed complete occlusion of the right renal artery and 95% occlusion of the left renal artery. Renal vein renins were 13 ng/ml/hr on the right and 26 ng/ml/hr on the left.

These findings clearly indicated that surgical management was necessary, and that it would be extremely difficult. The laparotomy was through a midline incision. We found that the aneurysm was 12 cm wide at its maximum transverse diameter, and appeared to begin just below the superior mesenteric artery (Fig. 1). After we removed the left kidney with its ureter, the stenotic portion of the renal artery was excised. We flushed the kidney with cold saline before placing it on the Mox-100 perfusion apparatus for preservation (Fig. 2). Following systemic heparinization the aorta was clamped just below the superior mesenteric artery and the aneurysm was incised anteriorly. We removed the laminated clot from inside the aorta and replaced the suprarenal abdominal aortic aneurysm with a 25 mm Dacron bifurcated graft. A long aortoplasty, extending up to the superior mesenteric artery, was necessary to decrease the diameter of the aneurysmal aorta for the aorta-Dacron graft anastomosis (Fig. 3). After the clamps were released and flow was re-established, we proceeded with the standard technique of transplanting the kidney in the right iliac fossa.²⁴ The kidney had been preserved for 4 hours and 30 minutes.

Because of the previous chronic obstruction of the renal artery, arterial perfusion and flow to the renal parenchyma was temporarily unsatisfactory (for about 10 min). Adequate urinary production was evident, however, before we closed the bladder (Fig. 4). Urinary output during

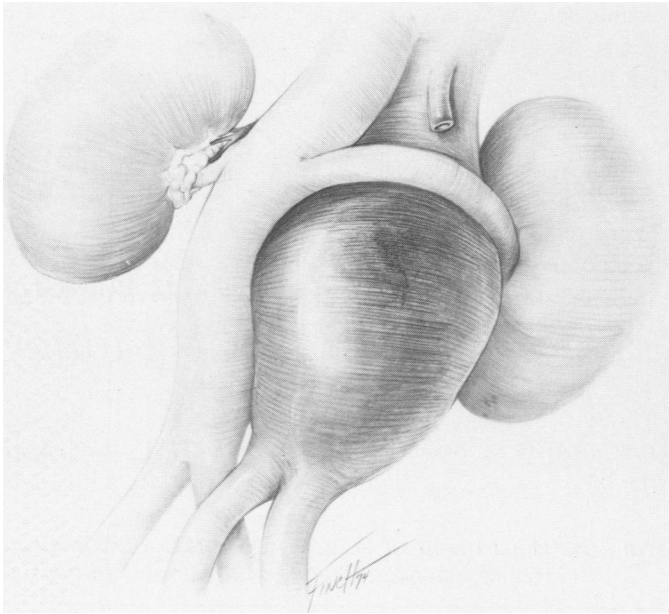


FIG. 1. Position of the aneurysm in relation to the left renal vein and the superior mesenteric artery.

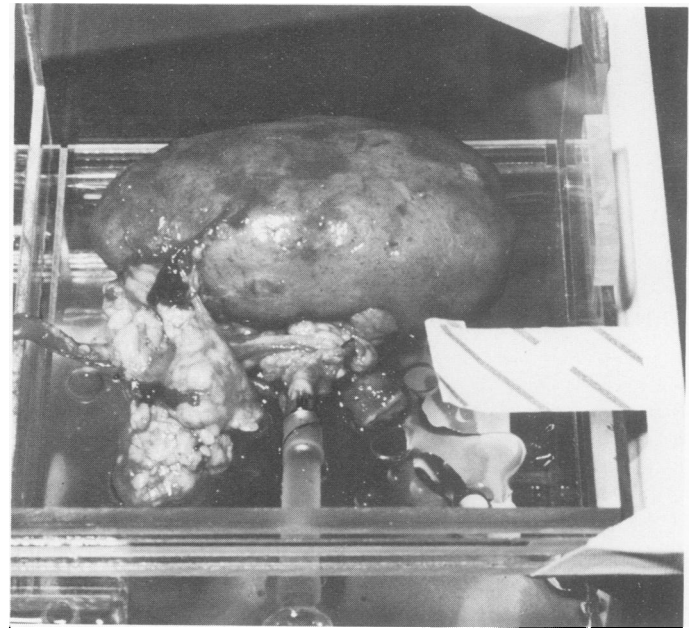


FIG. 2. The left kidney was preserved on the Mox-100 perfusion-preservation machine for 4 and 1/2 hours.

the first 48 hours exceeded 16 liters. The day after surgery the patient's serum creatinine level was 3 mg/100 ml, while his BUN was up to 74 mg/100 ml. At the end of the first week the serum creatinine went down to 1.8 mg/100 ml, the BUN had decreased to 42 mg/100 ml, and the creatinine clearance level ranged from 40–44 ml/min/1.73 m². Serial

renograms showed progressive improvement of the autotransplanted kidney and an intravenous pyelogram demonstrated a normal collecting system and flow of dye to the bladder.

When the patient was discharged on the 20th day after surgery, his blood pressure was 150/80 mm Hg. At that time he was receiving 250 mg

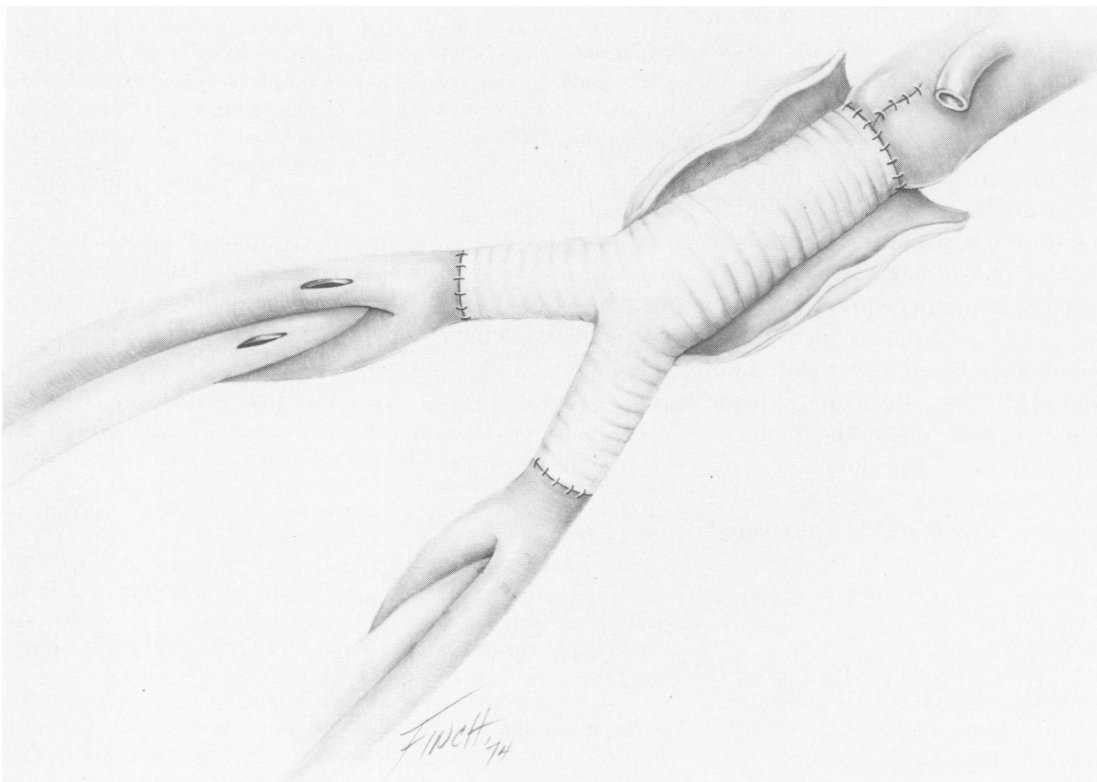


FIG. 3. The aortic aneurysm was replaced by a 25 mm Dacron graft. An extensive aortoplasty was done to reduce the size of the aneurysmal aorta and to facilitate performance of the proximal anastomosis.



FIG. 4. In the completed procedure the aneurysm has been replaced by a Dacron graft, and the left kidney has been autotransplanted into the right iliac fossa.

of methyldopa three times daily. Currently he requires no antihypertensive medication, and his serum creatinine is 1.4 mg/100 ml, while his BUN is 19 mg/100 ml and creatinine clearance is 44 ml/min.

Discussion

Suprarenal aortic aneurysms are rare. It is estimated that less than 5% of all aneurysms of the abdominal aorta extend above the renal arteries. According to De Camp and Birchall¹¹ an aneurysm of the abdominal aorta is rarely associated with renal artery stenosis. In the past an aortic aneurysm associated with renal artery stenosis was treated by unilateral nephrectomy, resection and replacement of the aneurysm with an artificial graft.¹ Of course, such treatment is inappropriate if the function of the remaining kidney is inadequate.

DeBakey *et al.*¹⁰ and Garrett *et al.*¹² have reported successful treatment of aneurysms of the thoraco-abdominal aorta. In DeBakey's series, 44% of the patients died when the aneurysms were associated with hypertension and renal disease. Although they did not report the causes of death, we assume that acute renal failure of the borderline kidney was the most likely reason for the high mortality in these patients.

Before diuretics like Mannitol and furosemide were

available, Sheranian *et al.*²³ reported that renal failure accounted for 20% of their deaths associated with elective aneurysmectomy. Even today acute tubular necrosis is associated with a high incidence of death. Tilney *et al.*²⁶ reviewed their experience with renal failure after surgical repair of ruptured abdominal aortic aneurysms and reported a 90% mortality.

From our review, we could see that a high death rate results whenever suprarenal aortic aneurysms or thoraco-abdominal aneurysms associated with renovascular hypertension are treated conventionally. Recent technical advancements, however, have made available several approaches to concomitant problems.

As far back as 11 years ago Hardy¹⁴ introduced autotransplantation for the treatment of a patient with a high ureteral stricture. Before autografting the removed kidney was restored by perfusion with a cold glucose solution. Since then several investigators have modified Hardy's technique.^{15-18,21,22,27}

Belzer *et al.*² first suggested a new approach to renal autotransplantation in 1970. Their method included flushing the removed dog kidney by gravity flow until the venous effluent was clear, then perfusing the kidney until autotransplantation. Corman *et al.*⁹ enlarged on Belzer's approach. In 1973 they reported 3 patients whose kidneys were removed, cooled, perfused with an asanguineous fluid, and studied angiographically in their extra-corporeal state. All of these kidneys were autografted successfully.

Enough experience has been accumulated^{8,6} to assure that *ex vivo* hypothermic perfusion is a safe tool for preservation of the kidneys. There is subsequent good renal function even after 24-68 hours of hypothermic perfusion.

We believe that in cases of aneurysms of the thoraco-abdominal aorta, suprarenal aortic aneurysms, dissecting aneurysms when the renal arteries are involved, and aneurysms of the renal artery itself, surgical expertise and "heroism" should be avoided. One or, if necessary, both kidneys should be removed and maintained on a perfusion-preservation unit while the vascular lesion is being repaired. Subsequently, when hemodynamics are stable, autotransplantation completes the procedure. This combination of techniques apparently works in the management of renovascular hypertension associated with a suprarenal aortic aneurysm since our patient is well and completely rehabilitated.

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