Experience with 200 Renal Artery Reconstructive Procedures for Hypertension or Renal Failure

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During the past five years, renal artery stenosis has become recognized as the most common surgically correctable hypertensive state. The incidence of renovascular hypertension now would appear to overshadow greatly all other forms of reversible hypertension, such as coarctation and the various adrenal medullary and cortical lesions. Although aberrations in renal vascularity have been recognized for at least 30 years as a cause of hypertension, the full scope of the clinical problem was not appreciated until the advent and application of refined techniques of renal arteriography and renal arterial reconstruction. With due consideration for the incomplete understanding of certain physiologic mechanisms producing renovascular hypertension, the fact remains that more than two thirds of hypertensive patients with renal arterial lesions respond to arterial reconstruction with good to excellent results. Accumulation of clinical experience with renal arterial reconstructive procedures has reached a stage that makes statistical review relevant and timely. For this purpose, an analysis has been made of 200 hypertensive patients who have had definitive renal artery reconstructive operations.

Ages of patients in this surgical series ranged from 8 to 72 years, with 83 per cent of cases derived from the age range between 21 and 60 years. Seventy-seven per cent of patients were over 40 years of age, reflecting the significance of arteriosclerosis as a cause of renal artery stenosis (fig. 1). Distribution as to sex was 65 per cent male and 35 per cent female. Only two Negroes were represented in the series, and it is remarkable that neither of these patients had the common arteriosclerotic type of renal artery stenosis. A 36-year-old woman had unilateral fibromuscular disease, and a 56-year-old man had thrombotic occlusive disease associated with bilateral renal artery aneurysms. A low incidence of renovascular hypertension in Negroes is in accord with the impression of other centers interested in this condition.

Duration of hypertension was less than 2 years in 40 per cent of cases and from 2 to 4 years in 25 per cent. Although 35 per cent of patients had known hypertension of more than 5 years' duration, the majority of these either had recent increase in blood pressure or had become relatively unresponsive to antihypertensive agents.

An assessment of the incidence of various arteriopathic lesions was made by combined arteriographic interpretation and operative findings in each case and often was supported by pathologic study of arterial tissue. Atherosclerosis was identified in 83 per cent of cases and fibromuscular intimal and medial hyperplasia in 13 per cent. Renal artery aneurysms were present in 4 per cent of patients. Bilateral renovascular disease was apparent and was surgically corrected in 31 per cent of cases. Localization of the stenotic process was limited to the ostia or proximal third of the renal artery in 75 per cent of cases. Fibromuscular hyperplasia tended to involve most of the linear extent of the main renal artery, often with intermittent areas showing poststenotic dilatation or aneurysm (fig. 2). Fortunately, the primary branches were characteristically uninvolved by the fibromuscular process.
Excretory pyelography was a routine and useful element in the diagnostic evaluation of these patients. However, both renal size and excretion were considered normal in 59 per cent of patients having unilateral stenosis. In the case of bilateral stenosis, 30 per cent of patients had normal excretory pyelograms, 53 per cent demonstrated only a unilateral abnormality, and 17 per cent showed bilateral abnormalities.

The isotope renogram, like the excretory pyelogram, was employed as a routine element of diagnostic evaluation. Although this study showed some abnormality suggesting a vascular lesion in 87 per cent of patients, errors in localization as to side of involvement, particularly with bilateral lesions, were common.

Enthusiasm for employment of split-function studies with individual ureteral catheterization was never great because of a variety of technical and clinical problems as well as increasing awareness of troublesome sequelae, the most common being urinary tract infection. In some 23 patients with unilateral main renal artery stenosis in whom the test was considered technically satisfactory, its accuracy was 100 per cent. At the present time, however, usage of this procedure has been limited to research application and special problems.

Renal arteriography is the most significant factor in the diagnostic evaluation of the hypertensive subject suspected of having a renovascular lesion. Translumbar aortography has been the most commonly employed technique for this purpose.

**Surgical Technics**

The operative approach for treatment of renal
artery stenosis was through a midline abdominal incision. After systematic exploration of the abdomen, thorough palpation of the kidneys and adrenal glands was carried out. Following exposure of the renal artery, pulse pressure tracings were made to establish the presence of a gradient between the aorta and the renal artery distal to the occlusive process.

The type of revascularization ultimately selected for application in each case depended largely on individual anatomic and pathologic variations combined with surgical experience with a variety of revascularization techniques to meet specific problems. Bypass graft revascularization was employed in 60 per cent of cases. Common employment of aorta to renal artery bypass reflects not only its versatility in meeting anatomic and pathologic variations but the safety and success experience has brought to the technic. Patch-graft angioplasty, usually combined with endarterectomy, was employed in 30 per cent of cases. Four per cent of patients had resection of renal artery aneurysms associated with hypertension. In seven of these cases, aneurysmorrhaphy was readily accomplished because of the saciform character of the lesion. In one case, resection and graft replacement were necessary. Splenorenal arterial shunt was performed in six cases, or three per cent. Endarterectomy through the aorta and renal ostia was used in six other cases. Associated operative correction of aortic aneurysm or occlusive disease was carried out in 24 per cent of patients.

Results
At present, 200 patients have had renal artery reconstructive procedures for hypertension. Revascularization was bilateral in 24 per cent of cases (fig. 3). Pressure gradients determined at operation were less than 25 mm Hg in 24 per cent of patients, between 25 and 50 mm Hg in 34 per cent, and over 50 mm Hg in 42 per cent. There appeared to be no correlation between the significance of the pressure gradient and the blood pressure response to revascularization. This is not sur-
prising when one considers that a constriction of at least 50 per cent is necessary to produce any gradient.

The average period of observation following operation in these 200 patients was 1.6 years, with a range between operation and last examination or communication being 3 months to 5 years. Eighty per cent of patients are now normotensive. To ascertain normal systolic blood pressure in our patients, 5 mm. Hg was added to 140 mm. Hg for each decade over 30 years of age. Maximal normal diastolic pressure at any age was 90 mm. Hg. In about 40 per cent of patients a salutary blood pressure response was immediately apparent after operation. Another 30 per cent required up to 3 months for blood pressure to return to normal, and 10 per cent required 3 months to 1 year for this to occur. Eight per cent had a significant lowering of diastolic blood pressure but retained moderate systolic elevation. Six per cent were unimproved, and 6 per cent were operative mortalities or have subsequently died.

The primary goal of operation in 12 patients was reversal of renal failure due to severe bilateral impairment of renal blood flow or marked unilateral stenosis and absence of the contralateral kidney. One of these patients died, but in each of the remaining 11 cases improved renal function followed renal revascularization, with control of hypertension in the majority of cases. This remarkable experience with a definitive surgical attack on the problem of azotemia in the hypertensive patient merits some discussion. In the approach to this serious problem, special factors deserve consideration. Renal arteriography is the definitive diagnostic procedure to differentiate an extreme renal arterial occlusive process from renal parenchymal disease, but its potentially deleterious effect on an already failing kidney is obvious. Also well recognized are bleeding propensities, poor
healing, and potential infection in the azotemic surgical subject. Translumbar aortography was carried out on these patients, limiting the contrast material to 10 to 15 ml. after producing an osmotic diuresis with intravenous fluids and mannitol. These simple protective measures usually so mask the effects of aortography that blood urea nitrogen remains unchanged or falls following the study. Because potential risk for major operations in the presence of renal failure is high, the extent of the surgical procedure was limited to the primary objective of therapy—improvement in renal function. Therefore, only a unilateral renal artery reconstruction was usually performed. The results of this surgical approach in these 12 seriously ill patients are considered highly gratifying. Eleven are alive and have resumed relatively normal activities, and essentially normal renal function has been restored in all but two of these patients.

Summary
Renovascular hypertension is the most common form of reversible hypertension.

An analysis of 200 renal artery reconstructive procedures identified atherosclerosis as the arteriopathic lesion in 83 per cent of cases and fibromuscular hyperplasia in 13 per cent of cases. Bilateral renovascular disease was found in 31 per cent of cases.

Renal arteriography is the most significant factor in the diagnostic evaluation of the hypertensive subject.

Bypass graft and patch-graft angioplasty were the most commonly employed principles of renal artery reconstruction in this series.

The occlusive process in the renal artery produced a pressure gradient exceeding 25 mm. Hg in 76 per cent of cases.

The average period of observation following operation in these 200 patients was 1.6 years, ranging between 3 months and 5 years. Eighty per cent of patients are now normotensive.

The primary goal of operation in 12 patients was reversal of renal failure due to severe bilateral renal artery occlusive disease. Disappearance of azotemia with improved renal function followed revascularization in 11 of 12 patients.

References
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