Case Report

Efficacy of Renal Revascularization in a Patient With Fibromuscular Renal Artery Stenosis and Heart Failure

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Summary

We report the case of a 65-year-old woman with a solitary kidney who developed hypertension due to renal artery stenosis caused by fibromuscular dysplasia. In addition, an echocardiogram revealed severe left ventricular systolic and diastolic dysfunction. Despite antihypertensive drug treatment that included diuretics, her serum concentration of brain natriuretic peptide was persistently elevated and associated with progressive worsening of renal function. She underwent iliac artery to renal artery bypass grafting. After the surgery, blood pressure control was good, the serum concentration of brain natriuretic peptide decreased, and left ventricular diastolic function improved. This case exemplifies the efficacy of renal revascularization in patients with fibromuscular renal artery stenosis and heart failure. (Int Heart J 2010; 51: 432-435)

Key words: Fibromuscular dysplasia, Renal artery stenosis, Heart failure, Renal revascularization

Fibromuscular dysplasia (FMD) is an idiopathic, nonatherosclerotic disease of the musculature of arterial walls that leads to the narrowing of the arterial lumen. FMD is the most frequent cause of renal artery stenosis (RAS) after atherosclerosis. RAS often results in difficult-to-control hypertension, especially in patients with bilateral RAS or its equivalent, RAS in a solitary functioning kidney. In patients with RAS, renal revascularization by percutaneous transluminal angioplasty or surgical reconstruction is indicated to cure hypertension or to improve blood pressure control. Atherosclerotic RAS, which is the most frequent type of RAS and more common in the elderly, is reported to be associated with frequent abnormalities of left ventricular (LV) function and episodes of heart failure, often mediated through labile systemic hypertension and exacerbation of myocardial ischemia. Many of those patients with atherosclerotic RAS and heart failure have been reported to benefit from renal revascularization for the control of blood pressure and also heart failure. In contrast, FMD is more common among females and most cases of FMD correspond to patients younger than 50 years. There have been few reports describing patients with RAS caused by FMD who presented congestive heart failure, and the outcome of renal revascularization in those patients was not clear. Here, we describe the case of a 65-year-old woman with a solitary kidney and hypertension due to RAS caused by FMD who also had LV dysfunction. The patient underwent surgical renal revascularization, which led to good control of blood pressure as well as an improvement of cardiac functioning.

Case Report

The patient was 65 years old at the time of admission. She had developed hypertension at the age of 17, and 8 years later she had undergone surgical reconstruction using a bypass graft of the left renal artery due to stenosis caused by FMD. However, the bypass graft became occluded after the procedure, and nephrectomy of her left kidney was performed. At age 60, she was referred to our hospital again for the management of hypertension. Her blood pressure was 160/80 mmHg. An abdominal bruit was heard and a computed tomography (CT) scan of the abdomen confirmed diffuse narrowing and irregularity of the right renal artery; namely, it disclosed the "string of beads" appearance compatible with FMD. The patient also developed dyspnea on effort, and the chest X-ray revealed cardiomegaly. Echocardiography revealed diffuse LV wall hypokinesis and her LV ejection fraction (LVEF) was 31%. LV end-diastolic and end-systolic dimensions (LVDd/Ds) were 51 mm/44 mm. LV wall thickness was normal. She was suspected to be developing heart failure with LV dysfunction due to cardiomyopathy or hypertensive heart disease. The patient was prescribed antihypertensive drugs and diuretics for heart failure.

At age 65, her blood pressure had increased from 130/80 mmHg to 150/80 mmHg, and her serum concentration of brain natriuretic peptide (BNP) had increased from 80 pg/mL to 390 pg/mL. She was hospitalized for the management of hypertension and congestive heart failure. Electrocardiography showed sinus rhythm, high voltage, and mild ST depression in lead V5. Echocardiography demonstrated LV systolic dysfunction (LVDd/Ds 50 mm/45 mm, LVEF 22%) (Figure 1). The trans-
Fibromuscular dysplasia commonly affects the middle or distal segment of the renal arteries, while atherosclerosis often affects the proximal segment. The cause of the disease is not known, although a variety of genetic, mechanical, and hormonal factors have been proposed. While atherosclerotic RAS mostly affects elderly patients, frequently with renal parenchymal disease, FMD predominantly affects women with normal kidney function in their 30s or 40s. In the present case, the patient underwent surgical renal revascularization for her left renal artery when she was 25 and for her right renal artery when she was 65. Patients in their 60s seldom present with RAS caused by FMD. Nevertheless, in this patient the CT angiography showing the “string of beads” appearance of the renal artery 2 to 3 cm distal from its ostium, and the softness of the renal artery wall noted during the operation indicated FMD rather than atherosclerosis as the etiology of the stenosis.

FMD is the second most frequent cause of RAS, which often results in difficult-to-control hypertension, especially in
patients with bilateral RAS or its equivalent, RAS in a patient with a solitary functioning kidney as in the present case. Unilateral renovascular hypertension in humans corresponds to the animal model of two-kidney one-clip Goldblatt hypertension, in which the ischemic kidney secretes renin that leads to increased angiotensin II formation and elevation of blood pressure. High blood pressure increases sodium excretion by the intact contralateral kidney (pressure natriuresis) resulting in no sodium retention, and PRA is usually high. On the other hand, bilateral RAS or RAS in someone with a solitary kidney corresponds to the animal model of one-kidney one-clip hypertension, in which pressure natriuresis can no longer occur, and sodium retention occurs. The ensuing expansion of plasma volume inhibits renin secretion, resulting in a normal or low level of renin. The reason for elevated PRA in the present case is not clear. No drugs that could elevate PRA were used. Coexisting congestive heart failure with enhanced sympathetic nerve activity might have been involved in the elevation of PRA.

In patients with RAS, renal artery revascularization by percutaneous transluminal angioplasty or surgery is used to cure hypertension or to improve blood pressure control. The technical success rates for percutaneous angioplasty have been reported to be greater than 90%, with hypertension being cured (14 to 52%) or improved (21 to 74%). The technical success rates of surgical reconstruction are over 88%, with hypertension being cured (33 to 36%) or improved (31 to 57%). Currently, revascularization is indicated in certain types of patients: those with hypertension of recent onset; patients whose blood pressure cannot be lowered to the desired goal despite a reasonable medication regimen; patients who are unable to tolerate antihypertensive medications or do not comply with their medication regimen; and patients with loss of parenchymal mass from ischemic nephropathy. In the present case, blood pressure control was difficult to achieve despite the use of a comprehensive antihypertensive regimen. In addition, there was severe stenosis in the renal artery of her solitary kidney, and although her kidney volume was intact, renal failure was gradually worsening. Percutaneous transluminal angioplasty is currently used for most patients rather than surgery, based on similar technical success rates and lower frequency of periprocedural complications. However, in the present case, the risk of embolic complications associated with percutaneous angioplasty leading to renal dysfunction was considered to be avoided because the patient developed RAS in her solitary kidney.

The patient also developed congestive heart failure with LV dysfunction. Atherosclerotic RAS is associated with frequent abnormalities in LV function and episodes of heart failure, often mediated through labile systemic hypertension and exacerbation of myocardial ischemia. In contrast, there are few reports on patients with RAS caused by FMD and with congestive heart failure. The etiology of cardiac dysfunction in the present case was not clear. Coronary angiography revealed normal coronaries. Hypertensive heart disease may be the reason for her cardiac dysfunction. Yet, despite good blood pressure control during the 2-year follow up, echocardiography showed the left ventricular systolic function had not improved leaving the possibility of a cardiomyopathy.

Many of the patients with atherosclerotic RAS and heart failure have benefitted from renal revascularization. The reason for improved heart failure after revascularization may include less activation of the renin-angiotensin-aldosterone system, leading to less retention of sodium and water in the body, lower blood pressure, and prevention of cardiovascular and renal tissue remodeling. In addition, there was a safer utilization of ACE inhibitors or ARBs, which could worsen renal function in patients with bilateral RAS or those with RAS in a solitary functioning kidney. One study in 163 consecutive patients who underwent percutaneous transluminal renal angioplasty for atherosclerotic RAS, reported that heart failure was present in one-third of the patients, and renal revascularization had resulted in improved heart failure control and a reduction in hospitalizations. In contrast, few reports have described the efficacy of renal revascularization in FMD patients with congestive heart failure. In the present case, successful surgical revascularization was achieved without major periprocedural complications; blood pressure was well controlled during the 33 months of follow-up with improved BNP serum concentration and LV diastolic function. Our case exemplifies that renal revascularization could be a good therapeutic choice for the treatment of hypertension and heart failure in patients who suffer from fibromuscular RAS and cardiac dysfunction.

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