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January 2003

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Recommended Citation

Rabbani, M. A., Zaidi, A., Ali, S. S., Anas, B., Younus, A., Shah, S. M. (2003). Renovascular hypertension: factors affecting the outcome following surgical revascularisation. *Saudi Journal of Kidney Diseases and Transplantation, 14*(4), 469-474.
Available at: https://ecommons.aku.edu/pakistan_fhs_mc_med_nephrol/39

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Saudi J Kidney Dis Transplant 2003;14(4):469-474
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Saudi Journal of Kidney Diseases and Transplantation

Original Article

Renovascular Hypertension: Factors Affecting the Outcome Following Surgical Revascularisation

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ABSTRACT. This study was conducted at the Aga Khan University Hospital, Karachi, Pakistan to evaluate factors that affect outcome following revascularisation in patients with renovascular hypertension. We included all the patients diagnosed to have renovascular hypertension, confirmed by renal angiography, between July 1997 and September 2000. Of the total 15 patients, nine were males and six were females. Eleven patients received venous grafts, three received polytetraflouroethyline (PTFE) grafts while one patient underwent angioplasty and stenting. All were followed-up for a period of nine months (median) with the range from 2 to 84 months. A total of 33.3% of the study patients were completely cured, as they became normotensive without anti-hypertensive therapy after operation, while 27% showed marked improvement in blood pressure control post-operatively. Thus, extended cure or improvement of renovascular hypertension was achieved in 60% of patients. Normal pre-operative serum creatinine level, high pre-operative unstimulated peripheral renin levels and renal vein renin ratio of at least 1.75:1 were the most significant predictive factors for favorable outcome ($p < 0.012$). The pre-operative severity and duration of hypertension as well as degree of disparity in kidney sizes did not predict the post-operative improvement in renal function and blood pressure control.

Key words: Renovascular hypertension, Angiography, Surgical revascularisation, Renal vein renin ratio, Unstimulated peripheral renin level.

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Introduction

Renovascular hypertension (RVH) is the most common form of secondary hypertension. [1] The exact prevalence of RVH in the general population is not known and the diagnosis may be missed in many patients. [2] It is important to diagnose this condition at an

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early stage since it is a potentially curable form of hypertension, apart from being a potentially reversible cause of chronic renal failure.

After angioplasty for RVH, about 80% of patients require less medication for control of hypertension [3] while in about 48% of these patients, no anti-hypertensive therapy is required after the procedure. [4]

The major difficulty in curing RVH however, is identification of the patients with disease. There are no clinical characteristics that distinguish patients with RVH from those with essential hypertension with any degree of certainty. However, there are several features that suggest the presence of RVH. They are:

a) Recent onset of hypertension
b) Age less than 30 or greater than 50 years
c) Accelerated or malignant hypertension
d) Sever hypertensive retinopathy
e) Refractory hypertension
f) Abdominal or flank bruit

The physical sign that correlates best with the presence of renal artery stenosis is an abdominal or flank bruit. Approximately two-third of patients have occlusive changes in the renal arteries due to atherosclerosis and the remaining one-third have changes due to fibromuscular dysplasia.

Surgical revascularization is an established method of treating patients with severe hypertension and/or renal insufficiency resulting from renal artery occlusive disease. With the availability of effective anti-hypertensive medications and the use of percutaneous angioplasty in the treatment of certain patients with stenotic renal arteries, the role of surgical treatment has become less clear.

Patients and Methods

This study was conducted at the Aga Khan University Hospital. It included all the patients diagnosed to have RVH confirmed by renal angiography between the years 1997 and 2000. Patients with extrinsic compression of renal arteries or stenosis of renal graft vessels were excluded.

Record files were reviewed and the following data were noted: age, sex, clinical presentation, laboratory investigations including serum creatinine (SCr), serum electrolytes, ultrasound of the kidneys, duplex scan, captopril DTPA scan and conventional angiography. Pre- and post-operative blood pressure recordings, renal function and renal and peripheral venous samples for renin estimation were also assessed. All the data was analyzed using SPSS software (Release 8.0, standard version, copyright c SPSS; 1989-97). Using paired-sample T test, several pre-operative factors including duration of hypertension at the time of presentation, renal vein renin ratio (affected versus non-affected kidney), disparity in kidney sizes, renal function at the time of presentation and unstimulated peripheral renin levels were analyzed for their ability to predict post-operative improvement of blood pressure and renal functions.

For descriptive purposes patients were divided into cured, improved and failure groups. Cure was defined as normalization of renal function and blood pressure without the need for any anti-hypertensive therapy. Improvement was defined as a >20% decrease in post-operative SCr and post-operative blood pressure of less than 160/100 but greater than 140/90 mm Hg. Failure was defined as rise in SCr of > 20% as compared to pre-operative levels and blood pressure of >160/100 in the post-operative phase.

Results

Demographic features

The clinical and biochemical data from 15 patients with RVH who were subsequently

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operated upon and followed-up for a period of nine months (median) with a range of 2 to 84 months are summarized in Table 1. There were nine males and six females. Of them, 11 patients received vein grafts, three received polytetraflouroethyline (PTFE) grafts while one patient underwent angioplasty and stenting. According to criteria set before starting the study, five patients were cured, four showed improvement while six patients showed no improvement. Thus, nine out of the 15 patients (60%) benefited from the surgical interventions. The mean age of the cured group was 45 years (range 15-64 years), 30 years (range 22-38) in the improved group and 35 years (range 27-52 years) in the failure group.

Renal Function

In the cured group, renal function was normal in three patients at the time of presentation while it was abnormal in two patients. Renal function normalized in one and showed marked improvement in the other patient, over a period of nine months.

In the improved group, the SCr was high in three of the four patients (SCr range 150.3 - 344.8 μmol/L) and normal in one patient at the time of presentation. Of the three patients with high SCr at presentation, the values normalized in one patient post-operatively and showed marked improvement in the other two patients over the period of follow-up.

Four of the six patients in the failure group had high SCr at the time of presentation, (mean 220 μmol/L, range 141.4-221 μmol/L) and all of them showed further worsening over a mean period of 17 months. In the remaining two patients, the renal function was normal at the time of presentation but deteriorated over a mean period of four months.

Blood pressure (BP)

The mean pre-operative BP was 183/111 mm Hg in the cured group, 220/128 mm Hg in the improved group and 188/106 mm Hg in the failure group. The mean duration of hypertension in the cured group was 60 months, in the improved group 74 months and in the failure group it was 106 months.

Disparity in kidney size

The mean disparity in kidney size in the cured group was 2.9 cm (range 2-4), in the improved group it was 2.5 cm and in the failure group, it was 2.33 cm (range 0.0-4.10).

Renal vein renin ratio (RVRR)

The mean renal vein renin ratio (affected to non-affected kidney) in the cured group was 3.23:1 (range 2.50-5.50: 1). In the improved group the ratio was 1.96:1 (range 1.75-2.2: 1) and in the failure group it was 0.83:1 (range 0.51-1.1: 1).

Peripheral Renin Level

Mean peripheral renin level in the cured group was 10.72 ng/ml/hr/ (range 8.2-15.5), in the improved group, 15.2 ng/ml/hr (range 10.0-19.7) and in the failure group it was 5.13 ng/ml/hr (range 4.1-6).

Discussion

Renovascular hypertension is the most common curable form of high blood pressure. Several new concepts have emerged in recent years relative to atherosclerotic renal artery stenosis. Most notably, the indications for intervention have changed. [5,6] The enhanced efficacy of medical anti-hypertensive therapy has decreased the number of patients who require intervention solely to treat renovascular hypertension.

On the other hand, recent studies of the natural history of atherosclerotic renal artery stenosis have shown that progressive vascular obstruction occurs commonly in patients treated medically and in most of cases leads

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to deterioration of renal function. [7] This information has reinforced the importance of relieving renal arterial obstruction to preserve renal function in these patients. [7] However, in some patients with atherosclerotic renovascular disease, it is difficult to determine whether the hypertension is truly renovascular or the progression of atherosclerosis due to long standing hypertension caused the renal artery stenosis. Thus, more extensive investigations, particularly in elderly patients, may be necessary to confirm the renovascular mechanism of hypertension before surgical treatment is recommended.

While patients with atherosclerotic renal artery stenosis were formerly considered high-risk candidates for operative therapy, [8] it has been demonstrated that surgical revascularization can now be done safely and successfully even in older patients with extensive extra-renal vascular disease. [9-11] This has been accomplished predominately through vigorous preliminary screening and correction of existing coronary or cerebrovascular occlusive disease. In addition, the development of more effective techniques for surgical revascularization has made possible operating even on a badly diseased abdominal aorta. [12]

In our study, the long-term clinical outcome following surgical revascularization in terms of blood pressure response and post-operative renal function was evaluated. Extended cure or improvement of RVH was achieved in 60% of patients with low pre-operative SCr level, renal vein renin ratio of at least 1.75:1 and high unstimulated peripheral renin levels all of which constituted significant predictive factors for the outcome ($p < 0.012$). Of the 15 patients in the series, 33% were completely cured, as they became normotensive after operation without anti-hypertensive therapy, while 27% showed marked improvement in blood pressure control post-operatively needing less medications.

These results compare favorably to those of Laurie et al who noted a favorable blood pressure response to surgical revascularisation in 82% of 919 patients, followed-up for a period of six years. [13] However, when both kidneys are involved the situation becomes more complex as there is no normal kidney to excrete the retained sodium and water. In such patients, the renin and aldosterone levels may become normal but hypertension persists because of the increased plasma volume.

In a compilation of 58 different series of patients, Rudnik et al calculated a sensitivity of 80% and specificity of 62% for renal vein renin ratio. [14] Our study has shown that individuals with renal vein renin ratio of at least 1.75:1 have either marked improvement or complete cure.

Disparity in kidney sizes as well as severity and duration of hypertension did not affect the overall post-operative results.

Conclusion

The results of this study confirm the long-term effectiveness and safety of renovascular reconstruction in the relief of severe hypertension. The results further suggest that normal renal function and renal vein renin ratio of at least 1.75:1 and high unstimulated peripheral renin levels at the time of presentation are associated with most favorable post-operative outcome. Pre-operative severity and duration of hypertension and degree of disparity in kidney sizes do not seem to affect the overall results in terms of post-operative improvement in renal function and blood pressure control.

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