BILATERAL RENAL ARTERY STENOSIS - AN INCIDENTAL FINDING DURING CARDIAC CATHETERIZATION
Review of 15 Cases of BRAS Stenting at Queen Alia Heart Institute in Jordan

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ABSTRACT:

Objective: To review the clinical patterns, associated features, in 15 cases of Bilateral Renal Artery Stenosis (BRAS) who underwent Bilateral Renal Artery stenting.

Work Place: King Hussein Medical Centre & Queen Alia Heart Institute, Amman, Jordan.

Methods: We studied patients who had routine renal angiogram during cardiac catheterization for coronary or valve diseases between January 2000 and December 2004. A total of 15 patients had significant bilateral renal artery stenosis who underwent bilateral renal artery stenting. Files were retrieved, clinical and laboratory reviews were done. Unilateral renal stenting cases were excluded. All data were collected and analyzed for individual patient, considering age, risk factors, kidney function test, lipid profile, clinical presentation, severity of coronary artery disease and left ventricle dysfunction. Associated atheromatous vascular diseases and special attention to usage of Angiotensin Converting Enzyme Inhibitors (ACEIs).

Results: Two third were male and 80% were hypertensive, 46% had diabetes and the mean age was 64.4 year. 86% of patients had significant coronary artery disease (13 patients), 6 of them had coronary bypass. Only 2 patients had level of creatinine >2mg/dl while the others had normal level. Taking clinical presentation into consideration, 6 had myocardial infarction, angina also in another 6 patients, 3 presented with pulmonary edema. Bilateral renal artery stenting done with 93% success, one of our patients died after surgery.

Conclusion: Bilateral renal artery stenosis can be an incidental finding during cardiac catherization. Bilateral RAS can occur in patients with little or no hypertension and even normal kidney function. It is commonly associated with coronary artery disease. Bilateral renal artery stenting would decrease progression to ischemic nephropathy and improve cardiac symptoms like pulmonary edema angina and allow usage of angiotensin converting enzyme inhibitors safely in addition to surgery with no renal complications.

KEY WORDS: Bilateral Renal Artery Stenosis, Cardiac Catherization, Incidental Findings, Associated Co- morbidity

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INTRODUCTION

In the recent years, studies have used screening aortography as part of the angiographic study of coronary arteries [1] the abdominal aorta, and peripheral vasculature[2] Results of these studies indicate that atherosclerotic vascular disease in coronary and peripheral vascular beds commonly is associated with renal artery disease. A recent series identified stenosis of more than 50% of the lumen in 19% of hypertensive individuals during coronary angiography. These lesions exceeded 70% steno-

sis in 7% of subjects and were occasionally bilateral.[3]

Given its prevalence in the elderly population, and its propensity for bilateral involvement, ARAS has been estimated to be the cause of 10 to 15% of new onset end-stage renal disease in individuals over 50 years.[4]

Revascularization is considered when the presence of hemodynamically significant RAS is judged to be contributing to poorly controlled hypertension or progressive renal impairment. Other less common but equally important clinical indications for RAS revascularization include episodic pulmonary edema[5], congestive cardiac failure, and unstable angina.[6] Hemodynamic significance of the lesion is usually indicated by a stenosis of at least 50% diameter reduction in angiography results, or the presence of a significant pressure gradient across the lesion (5 mm Hg mean), keeping in mind that functional impact of the stenosis is a continuum, and that the dichotomous definition is inexact. Therefore, the goals of revascularization of RAS are 1) to cure or improve control of hypertension; 2) to preserve or restore renal function; and 3) to treat the physiologic effects of severe RAS, including congestive cardiac failure, recurrent flash pulmonary edema, and angina. One of the manifestations of bilateral RAS may be 'flash pulmonary edema[5], with or without left ventricular systolic dysfunction. The pathogenesis is incompletely understood, but postulated to be related to increased after load from neurohormonal activation and cytokine release.

Use of endovascular stents has substantially improved the acute technical success rate of angioplasty, in particular for the treatment of ostial RAS.[7] The success with renal artery stenting has made it a preferred alternative to the surgical approach, and has led to a lower threshold for intervention for ARAS. The challenge remains to identify in advance which patients are likely to benefit from revascularization.

In our study, we reviewed the clinical profile of 15 patients found to have significant bilateral renal artery stenosis and managed by bilateral renal stenting, and were discovered by abdominal aortography or renal angiogram during cardiac catheterization.

PATIENTS AND METHODS

A total number of 15 patients were found to have significant bilateral renal artery stenosis, and managed by bilateral renal stenting, These cases were selected among all patients who had routine screening aortography during cardiac catheterization, since January 2000 till December 2004 at Queen Alia Heart Institute. Those who had unilateral renal stenting were excluded.

The clinical profiles of those patients were reviewed after retrieving from files. The information retrieved included age, gender, risk factors, cardiac symptoms, laboratory results including serum creatinine level, lipid profile and associated carotid or peripheral vascular disease. Coronary angiographic finding were reviewed, considering severity of the disease and left ventricle function, and management of coronary artery disease either by medical, surgical or interventional treatment. Attention was given to the usage of angiotensin converting enzyme inhibitors, and number of antihypertensive medications.

RESULTS

Demographics and details of associated co-morbidities are given in Table-I.

Table-I: Demographic and associated co-morbidities

Age Range	41-84 Years (Mean 64.4)
Male/ Female	9:6
Hypertension	12 (80%)
Diabetes Mellitus	7(46%)
Hyperlipidimia	11(73%)
Smokers	7 (46%)
Associated atherosclerotic disease	
TIAs	3(20%)
PVD	3(20%)
Drugs: ?2	5(33%)
ACEIs	10 (60%)

***Cardiac presentation*:** In six patients (40%) the main presentation was myocardial infarction, a similar number had angina, and 3 patients (20%) presented with pulmonary edema.

Laboratory results: Serum creatinine more than 2mg /dl in 2 patients only 3.8 and 2.4 mg/dl , hematocrit <35% in 4 patients , total cholesterol >200mg/dl and low density lipoprotein >150mg/dl in eleven patients. (73%).

***Angiographic finding*:** Six patients (40%) had severe three vessel disease, treated by coronary artery bypass, bilateral renal artery stenting was also done before surgery. Three patients had percutaneous coronary intervention while another three patients had mild to moderate coronary artery disease treated by medical therapy. Two patients had normal coronaries one of them with mild left ventricular impairment and the second with infarction on top of normal coronaries. So all in all 86% (13) patients had significant coronary artery disease. Of these four patients had left ventricular ejection fraction < 40%, one female patient had severe aortic stenosis and three patients had peripheral vascular disease.

***Renal artery stenosis*:** 53% of renal artery lesions were ostial and average stents size was 5.87 mm, minimum and maximum length was 13mm and 20 mm respectively. Success was achieved in 14 (93%). Only in one case stent was lost and had to be snared. So we were satisfied with balloon angioplasty to that renal artery. One patient who had low ejection fraction died postoperatively.

DISCUSSION

Interest in the detection and treatment of RAS is increasing with the growing awareness of the prevalence and implications of this disease. ARAS is increasingly diagnosed in the expanding number of elderly population, who also have a high prevalence of hypertension and other atherosclerotic diseases. It is therefore important to make a distinction between RAS and its two major associated disease processes, namely renovascular hypertension and ischemic nephropathy[8]**.** RAS refers to the presence of anatomic narrowing; whereas renovascular hypertension and ischemic nephropathy imply a causative role of this stenosis in the disease processes of hypertension and renal dysfunction. Unfortunately, such a cause and effect relationship is often unclear.

Many of the hypertensive patients with RAS also have coexisting essential hypertension. Furthermore, some individuals with RAS remain normotensive. This uncertainty complicates the decision making surrounding revascularization. Similarly, in any given patient with renal insufficiency, it is often difficult to determine to what degree the RAS is responsible for the impairment of renal function.[9]

Our understanding of renovascular disease has advanced considerably during the last decade. The reasons for this include a greater appreciation of the natural history of both the atherosclerotic and fibromuscular forms of the disease the increasing recognition of atheroembolic disease; the widespread use of Percutaneous Transluminal Renal Angioplasty (PTRA) and the introduction of renal artery stenting;[10] the advent of new and more effective techniques for surgical revascularization; and the realization that bilateral renovascular disease is an important and potentially reversible cause of acute and chronic renal failure in the elderly[11] and of recurrent pulmonary oedema[5,12] in patients with poorly controlled hypertension and renal insufficiency.

Bilateral renal artery stenosis (or unilateral stenosis in a solitary functioning kidney) should be suspected in patients with acute, severe, or refractory hypertension who also have otherwise unexplained renal insufficiency (plasma creatinine concentration above 1.5 mg/dL or 132 µmol/L) or who have developed an acute decline in renal function following therapy with an Angiotensin Converting Enzyme (ACE) inhibitor or angiotensin II receptor blocker**.**[13]

Treatment is indicated both for Blood Pressure (BP) control and, in some cases, for preservation of renal function. It has been estimated, for example, that as many as 24 per-

cent of patients over the age of 50 who have advanced renal failure have bilateral atherosclerotic disease [14]. On the other hand, bilateral renovascular disease can be an incidental finding, occurring in patients with little or no hypertension such patients do not require therapy directed at the renal vasculature.[15,16]

Renal artery stenosis is a particularly relevant comorbid condition in cardiological practice, since the risk factors for coronary artery disease and renal artery disease are identical. Consequently both vascular beds are commonly affected by atherosclerosis in the same patient.[17] Renal artery stenosis causes or aggravates hypertension and / or interferes with its treatment. Renal artery stenosis therefore has a negative impact on both primary and secondary prevention of coronary heart disease. In patients undergoing cardiac catheterization renal artery stenosis is an independent risk factor for mortality which correlates with the severity of the renal artery disease.[18] Moreover, ischemic renal disease is the most rapidly increasing cause of end stage renal disease in the USA.[19]Renal failure impairs the outcome of coronary artery bypass grafting and percutaneous coronary interventions.

Because of the interrelation between arteriosclerotic renal and coronary artery disease cardiologists are frequently confronted with "cardiorenal" problems. They are not only experts in the conservative treatment of atherosclerosis, but they also have the expertise necessary for interventional treatment of the complications of atherosclerosis. The angioplasty / stent implantation of ostial renal artery lesions can be performed effectively with equipment adapted from coronary artery interventions. Indeed, the largest single centre series on primary renal artery stenting comes from a group of cardiologists.[20] This team treated 363 renal artery stenoses in 300 patients between 1993 and 1998 with stent implantation. The procedural success rate was 100% without procedural deaths or emergency surgical procedures. The overall restenosis rate during a median follow up of 16 months was 21%, 12% in renal arteries with a diameter of 4.5 mm These results show that primary renal artery stenting can be performed safely and effectively.

Renal artery stenosis may worsen angina or congestive heart failure in patients with coronary artery disease, left ventricular dysfunction, or cardiomyopathy due to alterations in the renin–angiotensin–aldosterone axis resulting in a state of volume overload and peripheral vascular constriction [5,6,21]. Renal revascularization may result in relief of these cardiac syndromes due to normalization of excess renin production, which reduces sodium and water retention and vasoconstriction caused by aldosterone and angiotensin and causes natriuresis because of improved glomerular filtration. Restoring unobstructed renal blood flow has the additional benefit of allowing safe usage of angiotensin-converting enzyme inhibitors without the risk of worsening renal failure and reducing coronary perfusion. Bilateral renal artery stenosis or stenoses of a solitary functioning kidney are frequently present in a patient with a cardiac syndrome who is likely to receive benefit from percutaneous renal revascularization.[22]More than 70% of 73 patients with cardiac disturbance syndromes with this vascular profile who were treated with percutaneous angioplasty and stent placement were free of congestive heart failure and unstable angina at 12-month mean follow-up. Additional benefits in this patient group also frequently include improvement of hypertension control and renal function.[6,21,22] What is the clinical significance of detecting renal artery lesions when they are otherwise unsuspected? This question has been the subject of controversy in recent nephrologic and cardiovascular debates, particularly since the introduction of endovascular stents. Some authors argue that a substantial number of patients reaching end-stage renal failure have no other apparent explanation and that unsuspected "ischemic nephropathy" may account for 14% to 20% of patients undergoing dialysis.[4] Some argue, therefore, that "open renal arteries are better than closed renal arteries"[23] and that stenoses should be subjected to arterial repair routinely, usually with endovascular

stents. Conversely, others argue that RAS is commonly an incidental "bystander" with little effect on renal function.[24] Follow-up studies of incidentally identified lesions managed without revascularization identify remarkably few cases of progression to advanced renal failure.[25] Recognition that interventional procedures in patients in atherosclerotic disease sometimes pose risks and can worsen both renal function and hypertension control intensifies the debate. In one prospective study, serial duplex Doppler ultra-sonography was performed on 295 kidneys in 170 patients with atherosclerotic renal artery stenosis, almost all of whom were on antihypertensive therapy[26] The cumulative incidence of progression at three years was 28 percent among arteries with an initial stenosis that was less than 60 percent and 49 percent among arteries with more than 60 percent stenosis at entry. Complete occlusion occurred in nine renal arteries (3 percent), seven of which were initially classified as having >60 percent stenosis, so many RAS lesions are thereby identified long before they pose a hemodynamic constraint to blood flow or renal perfusion.

Nearly all reports of improved cardiac status after renal revascularization have been confined to patients with tight stenoses of both renal arteries, unilateral occlusion with tight contralateral stenosis, or tight stenosis to a single functioning kidney.[27] The benefits of renal revascularization in patients with cardiorenal failure and renovascular disease are more consistently cardiac than renal.[28] Failure of revascularization to lower serum creatinine concentration in renovascular disease must reflect other mechanisms in the patho-physiology of renal failure, particularly hypertensive nephrosclerosis (intrarenal artery stenosis) and a theroembolic renal disease.[29] In one study, the pattern of atherosclerotic involvement at presentation was of prognostic importance.[30] Patients with bilateral renovascular disease in whom one artery was totally occluded appeared to be at greatest risk. Among those patients who survived two years, more than 50 percent with initial unilateral occlusion had progressed to end-stage renal disease as compared to only 18 percent of those with bilateral renal artery stenosis without occlusion. Watson et al[31] prospectively studied the effect of renal artery stenting on renal function and size in 33 patients with chronic renal insufficiency and bilateral renal artery stenosis or unilateral stenosis in the presence of a solitary or single functional. Before stent deployment, all patients had evidence of progressive renal insufficiency. After stent deployment, renal function improved in 18 and slowed in 7 patients. Ultra-sonography revealed preservation of renal size. Harden et al[32] studied 33 patients with atherosclerotic RAS undergoing renal stenting. Renal function improved or stabilized in 69% of patients.

Runback[33] evaluated the effect of renal artery stenting in 45 patients with renal impairment (creatinine > or = 1.5 mg / dL) and atheromatous renal artery stenosis untreatable by, or recurrent after, balloon angioplasty. Stent implantation was unilateral in 32 cases and bilateral in 11 cases. With use of life-table analysis, clinical benefit was seen in 78% of patients at 6 months (n = 36), 72% at 1 year (n = 24). In patients with clinical benefit, average creatinine concentration was reduced from 2.21 mg / dL +/- 0.91 before treatment to 2.05 mg / dL +/- 1.05 after treatment. Lower initial serum creatinine concentration was associated with a better chance of clinical benefit. Another study described the use of renal artery stents in the solitary functioning kidney of 21 patients with impaired renal function as a result of atherosclerotic RAS. At follow-up (range, 6-25 months), renal function had returned to normal in five patients (24%), improved in four patients (19%), stabilized in six patients (29%), and deteriorated in six patients (29%). Dialysis was discontinued in all four dialysis patients.

Based on available evidence, the following patient groups appear most likely to derive benefit from revascularization: 1) dialysis-dependent renal failure with RAS and salvageable kidneys; 2) global renal ischemia from bilateral RAS or unilateral RAS supplying single func-

tioning kidney and progressive renal failure, 3) bilateral RAS with recurrent flash pulmonary edema, with preserved or only mildly impaired systolic and diastolic ventricular function; and 4) bilateral RAS in patients with hypertension that is difficult to control.

CONCLUSION

Bilateral renal artery stenosis is associated with severe coronary artery disease , it can be discovered incidentally ,the challenge for cardiologists is to identify patients with cardiorenal failure , and in particular those who will benefit from revascularization in order to improve cardiac problems like angina , heart failure and to decrease medical and surgical complication .

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