ORIGINAL ARTICLE

Retrospective Study of Renal Artery Doppler Evaluation of Hypertensive Patients

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ABSTRACT

Introduction: Doppler study is a good screening test for initial screening of renal artery stenosis however controversies exists regarding its use as screening study. This study aims to evaluate the Doppler study findings in patients with atypical hypertension.

Methods: The study was a retrospective hospital record based study conducted in Metro Radiological and Imaging Center, Kathmandu. Reports of Doppler studies performed for atypical hypertension were reviewed for the duration of 6 years (2009 to 2014). Doppler studies were performed by two experienced radiologist with more than 5 and 20 years of experience. Patients with transplant kidney, patient with accessory renal artery and patient with known chronic kidney disease were excluded from the study. Data was entered in predesigned proforma and analysis was done with SPSS 21.0.

Results: A total of 1001 Doppler studies done during the study period revealed abnormalities in 227 patients. The most common abnormality was elevation of main renal artery and lobar renal artery resistance index, alone which was seen in 187(82.4%) patients. Renal artery stenosis was noted in 30(13.2%) cases with 10 patients each having renal artery stenosis involving left and right renal arteries respectively and 10 patients had bilateral renal artery stenosis.

Conclusion: Non-specific raised resistance index indicating renal impairment is the most common abnormality in atypical hypertensives. The presence of renal artery stenosis in atypical hypertensive is around 3%.

***Keywords**:* Hypertension, Renal Artery Doppler, Renal artery stenosis and Resistance index.

INTRODUCTION

Renovascular hypertension, the nosology indicates a relationship between renal vascular abnormality and hypertension.[1,2] Renal artery stenosis resulting in reduced renal blood flow via the Renin Angiotensin Aldosterone pathway results in Renovascular hypertension.[3] The importance of this condition lies in the reversibility of the

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condition if detected early and treated with revascularization procedures. Radiological evaluation of renovascular hypertension ranges from Angiotensin Converting Enzyme (ACE) inhibitor scintigraphy, Doppler studies, MR angiography, CT angiography and the invasive and gold standard conventional angiography.[1] Doppler study is a good screening test for initial screening of renal artery stenosis however controversies exists regarding its use as screening study. The advantages of Doppler study are non-invasive nature and inexpensive tool and its disadvantages are wide interobserver variability, technical difficulty in obese and uncooperative patients.[1,4] Apart renal Doppler can also predict usefulness of revascularization procedure and is also useful in primary hypertensive.[4-7]

This study aims to evaluate the abnormalities in Renal Doppler examination performed for evaluation of atypical hypertensive patients suspicious of renal artery stenosis.

METHODS

The study was a retrospective hospital record based study conducted at a multimodality imaging center at Kathmandu, Nepal. Renal artery Doppler study examination performed during period of 6 years from January 2009 to December 2014 for evaluation of hypertension atypical of essential hypertension was included in the study. Patients with transplant kidney, patients with accessory renal artery and patients with known chronic kidney disease were excluded from the study.

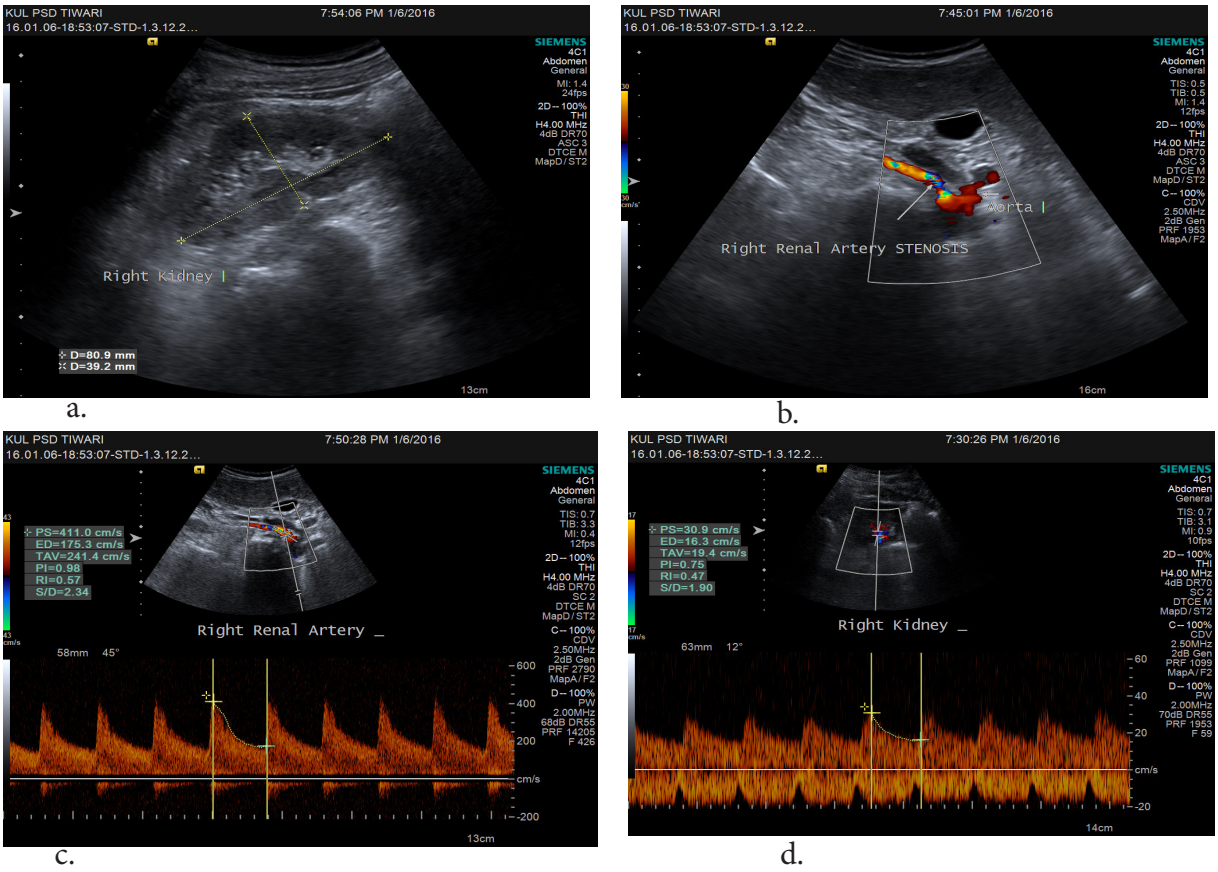

Figure 1: *Ultrasound and Doppler images of 56 year old hypertensive patient showing right renal artery stenosis.* ***a.*** *Ultrasound image shows small size of right kidney.* ***b.*** *Color Doppler shows turbulent flow at the proximal segment of right renal artery (arrow).* ***c.*** *Spectral Doppler shows high velocity of 411.0 cm/sec in right renal artery suggestive of significant stenosis.* ***d.*** *Intrarenal interlobar artery shows low resistant flow with resistance index of 0.47.*

All renal artery Doppler examinations were performed by two radiologists with experience of more than 20 and 5 years in Ultrasound and Doppler examinations.

Renal artery stenosis was defined as more than 50% stenosis of renal artery diagnosed on the basis of Direct Doppler criteria of visualized luminal narrowing with aliasing and peak systolic velocity of more than 180 cm/s at the narrowing (Fig 1). Interlobar renal arteries were also interrogated one each at both poles and one in inter-polar region. A marked discrepancy in Doppler tracing and parameters in one of the lobar artery suggesting intra-renal arterial stenosis were excluded from the study.

All data acquired was entered in a predesigned proforma and entered in SPSS spread sheet. Data analysis was done with SPSS 21.0.

RESULTS

Out of total 1001 renal arteries Doppler study performed for evaluation of hypertension, 227 Doppler studies showed some form of abnormality and were included in the evaluation.

The age of the patients ranged from 8 years to 91 years with mean age of 54.65±18.02 years and median of 58 (interquartile range -25) years. There were almost equal number of males (110; 48.5%) and females (117; 51.5%) in the study.

Main abnormal findings of the study are summarized in Table 1. The most common abnormality was elevation of main renal artery and lobar renal artery resistance index, alone which was seen in 187(82.4%) patients. Renal artery stenosis was noted in 30(13.2%) cases. Complete occlusion of renal artery was noted in 4(1.8%) cases. Aortic stenosis was noted in 9(4.0%) cases; aortic occlusion was noted in 2 (0.9%) cases and 4 (1.8) cases were associated with aneurysm of the infra renal aorta.
The mean length of right kidney was 9.36 ± 1.46 cm and of left kidney was 9.77±1.24 cm.

Increase in renal echogenicity was noted in 13 (5.8%) cases; grade I 5(2.2%) cases and Grade II and III in 4(1.8%) cases each. Kidneys with size less than 9 cm was seen in 77(33.9%) cases on right side and 54(23.8%) of cases on left side and kidney size less than 8 cm was seen in 44(19.4%) kidneys on right and 21(9.3%) cases on left side.

There were 30 cases of renal artery stenosis, among which 10 cases each was noted involving single left or right renal artery and 10 cases involving bilateral renal arteries. Renal artery stenosis was diagnosed based on the direct and indirect criteria. The prevalence of renal artery stenosis in the whole series (1001 cases) was 3.0%. The mean age of patients with renal artery stenosis was 38.67±20.02 years with median of 34.5(Interquartile range

Table 1: Abnormal Doppler findings in the study.

S.No.	Findings	n (Total =227)	Percentage (%)
1.	Increased RI	187	82.4
2.	Renal Artery Stenosis	30	13.2
3.	Renal Artery Occlusion	4	1.8
4.	Aortic Stenosis	9	4
5.	Aortic Occlusion	2	0.9
6.	Infrarenal Aortic Aneurysm	4	1.8

RI = Resistance Index

16.5) years. Almost 60% of patients were under 40 years of age. Females (18; 60%) were higher in the group than males (12; 40%) with male to female ratio of 2:3. The length of right kidney was 8.86±2.14 cm and left kidney was 9.94±1.37 cm. Right kidney less than 9 cm was noted in 12(40%) cases; which were seen in 5 cases with right renal artery stenosis; 5 cases with bilateral renal artery stenosis and 2 cases of left renal artery stenosis and less than 8 cm was noted in only 4 patients with right renal artery stenosis. Small left kidney less than 9 cm in size was seen in 6(20%) cases, among which there were 3 cases of left renal artery stenosis, 2 cases of bilateral renal artery stenosis and only one case of right renal artery stenosis and left kidney less than 8 cm was noted in 1 case of left renal artery stenosis. There were 6 (20%) cases with increased resistance index (RI>0.8) among patients with renal artery stenosis.

DISCUSSION

Doppler Ultrasound examination of Kidneys is one of the most important and initial non-invasive tests in evaluation of suspected renovascular hypertension. Many variables and measurements are in use to diagnose renal artery stenosis but the ones in play are the main renal artery peak systolic velocity of more than 180 cm/s and renal to aortic ratio of peak systolic velocity of 3.5 or greater. Apart some indirect criteria obtained from segmental renal artery are also used like delayed acceleration time, decreased acceleration index and parvus tardus waveform appearance.

Renal artery resistance index is an important parameter that has been used in diagnosis and progression of medical nephropathy. Renal artery resistance index provides useful information regarding the alteration of renal blood flow in various disease processes.[7] Intra renal resistance index has been correlated with the arteriolar resistance and thus increase in resistance index correlates well with progression of renal disease and so does persistent hypertension.[5-8] In our study the most common abnormality was the raised resistance index, alone which indicates that these patients had medical nephropathy. The prevalence of nephropathy among all patients evaluated with Doppler examination was high 18.7%. Increase in resistance index in patients with renal artery stenosis indicates a poor prognosis due to damage to intra renal vasculature and contradiction to revascularization; and in primary hypertension may indicate subclinical renal dysfunction.[9] In our study 20% of the patients with renal artery stenosis had increased resistance index indicating poor prognosis.

In our study only 3% cases had renal artery stenosis with high proportion of cases having normal results and non-specific raised resistance index alone. The prevalence of renal artery stenosis varies among studies and has been stated to be 1-5%.[10] However other studies have state higher prevalence of renal artery stenosis, where 20% of patients were found to have renal artery stenosis.[11] The low prevalence might indicate over investigation of hypertensive patients in our setup. However the clinical presentation of renovascular disease varies significantly between patients, ranging from incidental findings of renal artery stenosis on angiography to severe hypertension and progressive loss of renal function, which makes it difficult to make an absolute clinical prediction rule. [4]

Renal Length has been classically used as a marker of poor renal function with lower limit of cut off being considered as 9 cm. However size between 8-9 cm should be viewed in the background of patient phenotype and only those with less than 8 cm have definite nephropathy.[8] In our study as well size less than 9 cm had high false positive rate but size less than 8 cm had large number of false negative cases. Thus renal length alone is not a good indicator of nephropathy. Renal

volume and renal parenchymal thickness are other useful measurements that correlate with renal function.

Increased echogenicity is one of the most frequently used ultrasonological marker of nephropathy.[8] Increased echogenicity was seen in 6% of cases in our study, which might be late presentation of these patients with associated hypertensive nephropathy or hypertension secondary to nephropathy. However the renal echogenicity has variable sensitivity and specificity for diagnosis of nephropathy with sensitivity and specificity for grades I and II being of 62% and 58%, and grade III being 20% and 96%, respectively.[8]

Our study had certain limitations. Firstly it was a retrospective hospital record based study evaluating patients undergoing Doppler for evaluation for atypical hypertension with suspicion of renal artery stenosis. The study results may not be generalized to all hypertensive patients. The patients were not followed up for evaluating prognosis.

CONCLUSION

Renal Doppler examination is a very useful non-invasive tool to evaluate hypertensive patients. Firstly it can aid in diagnosis of renal artery stenosis, which can be used as a screening tool, secondly it can be used to prognosticate patients with renal artery stenosis and finally in patients with primary hypertension it can be used to evaluate for subclinical renal dysfunction. Renal artery stenosis had incidence of 3% among suspected hypertensive. Renal length is an insensitive indicator for predicting renal artery stenosis. Renal echogenicity and renal artery resistance index can be a promising tool in evaluating renal dysfunction in hypertension.

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