ORIGINAL ARTICLE

Diagnostic Accuracy of Ultrasonography for Prediction of Outcome of Renal Artery Stenosis Therapy taking Angiography as Gold Standard

SAULAT SARFRAZ[1], SEHRISH MASOOD[2]
[1]*Associate Professor Radiology, Shaikh Zayed PGMI, Lahore*
[2]*Registrar, Radiology Department, Shaikh Zayed PGMI, Lahore*
Correspondence to Dr. Saulat Sarfraz, Email: saulatsarfraz@gmail.com Cell: 0321-4334992

ABSTRACT

Background: Renal artery stenosis (RAS) is caused by a vast variety of pathophysiologic factors. Amongst various causes fibromuscular dysplasia and atherosclerotic RAS are the most common. A reduction in the diameter of the renal arteries results in development of hypertension, renal dysfunction and/or pulmonary edema. Majority of the cases of RAS remain asymptomatic.
Aim: To assess the diagnostic accuracy of ultrasonography for prediction of outcome of renal artery stenosis therapy taking creatinine clearance as gold standard
Methods: This cross sectional study was conducted in the Department of Radiology, Shaikh Zayed Hospital, Lahore during a period of six months from 22-03-2017 to 19-09-2017
Results: The mean age of patients was 51.47±17.69years. The sensitivity, specificity and diagnostic accuracy of USG RI was 93.81%, 91.15% & 92.38% respectively taking renal angiography as gold standard.
Conclusion: Ultrasonography for prediction of outcome of RAS therapy is useful and reliable diagnostic tool.
Keywords: Prediction, Stenosis, Angiography, Ultrasonography

INTRODUCTION

Renal artery stenosis (RAS) is caused by a vast variety of pathophysiologic factors. Amongst various causes fibromuscular dysplasia and atherosclerotic RAS are the most common. Whether and which patients need to undergo revascularization for atherosclerotic RAS is controversial[1].

A reduction in the diameter of the renal arteries can lead to hypertension, renal dysfunction and/or pulmonary edema. About 90% of sufferers with RAS have atherosclerosis, and 10% have fibromuscular dysplasia.[2] Specialists have acknowledged for a long time that RAS is the major cause of renovascular hypertension and that it can account for 1-10% of the 50 million hypertensive humans in US. In addition to a well understood cause of hypertension, RAS is also being increasingly identified as an important factor leading to chronic renal insufficiency and end-stage renal disease. As the renal artery lumen gradually becomes narrow, blood flow across renal vasculature decreases. Eventually, the renal function and structure becomes compromised due to decreased perfusion.[2, 3]

Prevalence of RAS has been found to range from 1-5% of all hypertensives in the general population up to 30% of a highly selected referral population.[4] Amongst the patients clinically suspected to suffer from coronary artery disease and undergoing diagnostic coronary angiography for confirmation, the prevalence of significant RAS(≥50% diameter stenosis) has been reported to vary from 25%-34%[5]. A study conducted in Germany has reported that USG with RI<80 had a sensitivity of 96%, specificity of 53%, PPV of 71% and NPV of 91% for prediction of outcome of RAS therapy (n=35)[6]. Another study has also found that the sensitivity and specificity of ultrasonography were 85% and 92%, respectively, in detecting outcome of RAS therapy.[7]

Rationale of this study is to assess the diagnostic accuracy of Doppler ultrasonography for prediction of outcome of RAS therapy taking angiography as gold standard. Through literature, is has been noticed that USG can be helpful in prediction of RAS treatment through revascularization but conventional results have been found in literature, as one study showed high sensitivity but low specificity while in another study, sensitivity is low but specificity was high. Therefore purpose of conduction of this study is to confirm whether USG may be helpful in predicting the outcome/prognosis of renal angiography or revascularization in RAS cases. This study will help us to implement the use of USG for screening of RAS and prognosis of therapy applied for RAS.

The objective of the study was to assess the diagnostic accuracy of ultrasonography for prediction of outcome of renal artery stenosis in whom intervention (angioplasty with stenting) was fruitful from those patients who were not benefited from angioplasty taking creatinine as gold standard.

METHODOLOGY

It is a cross sectional study carried out in the Department of Radiology at Shaikh Zayed Hospital, Lahore within a period of 6 months from 22-03-2017 to 19-09-2017. Following approval from hospital ethical committee, 210 cases that met inclusion criteria were enrolled in study referred to the Department of Radiology, Shaikh Zayed Hospital, Lahore. Informed consent was taken. Demographic data (including name, age, gender) was noted. Then patients were undergone ultrasound examination by using GE Voluson 730 Expert with the use of a multi frequency curved-array transducer (3 to 5 MHz) and a focal zone at the depth of

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the renal arteries. Doppler evaluation of intrarenal segmental arteries was done. RI was noted and patients were reported as positive or negative (according to operational definition). Then patients were undergone renal angiography (revascularization) by a single interventionist team. After angiography patients were advised to attend a follow-up appointment in OPD after 7 days. After 7 days, improvement was noted and managed as per departmental protocol. All the information was written down on a pre-designed proforma .All the collected data was entered and analyzed through SPSS version 20. Quantitative data like age was represented as mean and standard deviation. Qualitative data like gender good or poor outcome RAS (on Doppler and angiography) was expressed as frequency and percentage. 2x2 table was generated to calculate sensitivity, specificity, PPV, NPV and diagnostic accuracy of USG taking angiography as gold standard (creatinine clearance). Data was stratified for gender and age. Post-stratification, Chi square test was used taking p-value ≤ 0.05 as significant.

RESULTS

The mean age of the patients was 51.47±17.69 years with minimum age of 20 and maximum age of 80 years(Table1). 98(46.67%) patients were male and 112(53.33%) patients were females. Male to female ratio of the patients was found to be 0.87:1 (Fig. 1).

In our study ultrasonography diagnosed good outcome in 101(48.1%) patients and it diagnosed poor outcome in 109(51.9%) patients (Table 2). Renal angiography diagnosed good outcome in 97(46.19%) patients and it diagnosed poor outcome in 113(53.81%) patients (Fig. 2)

The results of this study showed the sensitivity, specificity, PPV, NPV and diagnostic accuracy of USG to be 93.81%, 91.15%, 90.1%, 94.5% & 92.38% respectively taking renal angiography as gold standard (Table 3).

The study results showed that in patients with age ≤50 years, the sensitivity, specificity and diagnostic accuracy of ultrasonography was 95.35%, 89.29% and diagnostic accuracy of 91.92% respectively taking renal angiography as gold standard. Similarly in patients with age >50 years, the sensitivity, specificity and diagnostic accuracy of ultrasonography was 92.59%, 92.98% and diagnostic accuracy of 92.79% respectively taking renal angiography as gold standard (Table 4).

The study results showed that in male patients, the sensitivity, specificity and diagnostic accuracy of ultrasonography was 97.62%, 94.64% and diagnostic accuracy of 95.92% respectively taking renal angiography as gold standard. Similarly in female patients, the sensitivity, specificity and diagnostic accuracy of ultrasonography was 90.91%, 87.72% and diagnostic accuracy of 89.29% respectively taking renal angiography as gold standard (Table 5).

Table 1: Descriptive statistics of age (years)

Age in years	n	210
	Mean	51.47
	SD	17.69
	Minimum	20
	Maximum	20

Figure 1: Distribution of gender

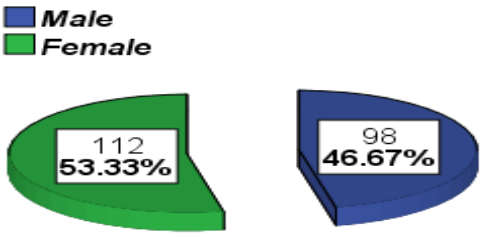

Table 2: Frequency distribution of USG RI

		Frequency	Percent
USG RI	Good (positive)	101	**48.1**
	Poor (negative)	109	**51.9**
	Total	**210**	**100.0**

Figure 2: Frequency distribution of renal angiography

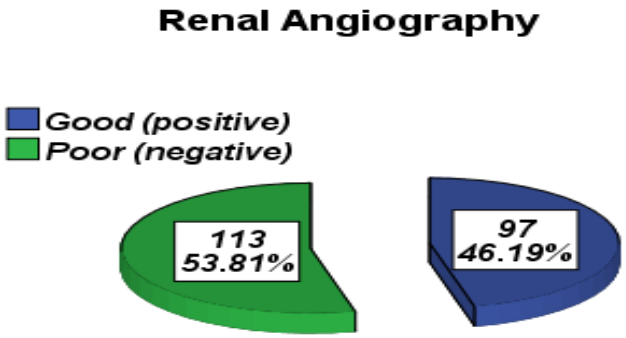

Table3: Comparison of USG RI with renal angiography

		Renal Angiography		Total
		Positive	Negative	
USG RI	Positive	91	10	101
	Negative	6	103	109
Total		97	113	210

Sensitivity	93.81%
Specificity	91.15%
PPV	90.1%
NPV	94.5%
Diagnostic Accuracy	92.38%

Table 4: Comparison of USG RI with renal angiography stratified by age

Age (years)	USG RI	Renal angiography		Total
		Positive	Negative	
≤ 50	Positive	41	6	47
	Negative	2	50	52
> 50	Positive	50	4	54
	Negative	4	53	57

USG RI	Age (years)	
	≤ 50	>50
Sensitivity	95.35%	92.59%
Specificity	89.29%	92.98%
PPV	87.23%	92.59%
NPV	96.15%	92.98%
Diagnostic Accuracy	91.92%	92.79%

Table 5: Comparison of USG RI with renal angiography stratified

Gender	USG RI	Renal angiography		Total
		Positive	Negative	
Male	Positive	41	3	44
	Negative	1	53	54
Female	Positive	50	7	57
	Negative	5	50	55

USG RI	Gender	
	Male	Female
Sensitivity	97.62%	90.91%
Specificity	94.64%	87.72%
PPV	93.18%	87.72%
NPV	98.15%	90.91%
Diagnostic Accuracy	95.92%	89.29%

DISCUSSION

Diagnosis of RAS is complex and expensive. RAS is the commonest treatable cause of hypertension and is an important cause of end-stage renal failure. Assessment of hypertensive patients with Doppler ultrasound has been resulted increase in the diagnosis of renal-artery stenosis. Those patients who have more than 50% renal artery diameter stenosis are treated either with angioplasty (with or without stenting) or surgery for reduction of blood pressure or preservation of renal function[6,8].

In this study the sensitivity, specificity, PPV, NPV and diagnostic accuracy of ultrasonography was 93.81%, 91.15%, 90.1%, 94.5% & 92.38% respectively taking renal angiography as gold standard. Some of the studies are discussed below showing the results in favour of our study.

A study by Granata et al[4] documented that color-Doppler Ultrasonography is a noninvasive, repeatable, relatively cheap diagnostic procedure which can used for accurate screening for renovascular diseases if conducted by an expert. Further, the evaluation of the RI at Doppler Ultrasonography may be very beneficial in patients with RAS to detect the response to revascularization.

In a study conducted in Germany has reported that USG with RI<0.8 had a sensitivity of 96%, specificity of 53%, PPV of 71%, and NPV of 91% for prediction of outcome of RAS therapy (n=35)[6]. Another study has also showed that the sensitivity and specificity of ultrasonography for detection of outcome of RAS therapy were 85% and 92%, respectively[7].

Schwerk et al[69] demonstrated that Color Doppler and spectral evaluation of intrarenal arteries are recommended as a valuable and noninvasive test for diagnosis and grading of RAS. However in cases where renal artery stenosis is bilateral and is more than 50% of diameter, RI value undergrads the stenosis.One study by Radermacher et al showed that color Doppler ultrasound study for assessment of renal-artery stenosis helps us to detect luminal narrowing of renal arteries of at least 50% (i.e., a reduction in area of at least 75%) with a sensitivity of 97% and a specificity of 98%[8].

One more study by Shawn et al[10] revealed in their study that Renal duplex sonography is useful in detection of significant restenosis after PTAS. Renal duplex sonographic criteria for significant native RA stenosis is well comparable with optimal RDS criteria for restenosis assessed by ROC curves.Duplex ultrasonographic study when performed by experienced hands has high sensitivity and specificity ; however, it can be tiresome and time-taking, is actually operator-dependent, is not reliable for visualization of accessory or multiple renal arteries, and 8% to 15% of examinations are non-diagnostic[11-14].

CONCLUSION

Our study concluded that the ultrasonography for prediction of outcome of RAS therapy is useful and reliable diagnostic tool taking creatinine clearance as gold standard

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