IS THERE AN ASSOCIATION BETWEEN RENAL RESISTANCE INDEX AND EARLY POST RENAL TRANSPLANT FUNCTION?

Leelavathi Venkatesh[1], Ramalingaiah Karadakere Hanumegowda[2]

[1]Assistant Professor, Department of Nephrology, Institute of Nephro-Urology, Victoria Hospital Campus, Bangalore.
[2]Associate Professor, Department of Radiology, Institute of Nephro-Urology, Victoria Hospital Campus, Bangalore.

ABSTRACT

BACKGROUND

The Intrarenal Resistance Index (RI) measured by colour Doppler ultrasound early after renal transplant period is to assess renal allograft function, although significance of resistive index remains unclear. Hence this study was done to find out if there is association between RI and graft function.

MATERIALS AND METHODS

It is a retrospective study of hospital based medical records of all transplant recipients during April 2009 to December 2016. 139 transplant recipients were included in the study. Their clinical, biochemical, radiological RI index data were analysed with SPSS version 20.

RESULTS

There were 139 transplant recipients, of which 118 (84.8%) were male and 21(15.2%) were female and with mean age of 30.4 years. Live donor transplant recipients were 117 (84.2%) and the remaining were deceased donor recipients 22 (15.8%). Mean RI was 0.5. There was no difference in mean RI between male and female recipients and age. There was significant association between RI > 0.7 and slow graft, delayed graft, deceased donor, dialysis vintage time and length of hospital stay.

CONCLUSION

A renal artery resistance index higher than 0.7 predicts graft dysfunction among early post renal transplant recipients.

KEYWORDS

Doppler ultrasound, intra renal artery, kidney transplant.

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BACKGROUND

Renal transplant is the choice of therapy in patients with end stage kidney disease resulting in decline of morbidity and mortality, improved survival and good quality of life.[1,2]

In United Kingdom, 1 and 5 year graft survival rate for renal transplant is 96% and 89% for living donor organ and 93% and 83% for deceased donor organ respectively.[3,4]

Various factors affect graft survival which includes, recipient age, number of Human Leucocyte Antigen (HLA) mismatch, delayed graft function, slow graft function, prolonged ischemia time, acute rejection episode and infection alone or in combination have an impact on graft survival.[5-7]

Colour doppler ultrasound of intra renal arteries is important examination done in kidney transplant recipient.[8,9] Intra renal resistance index depicts intrinsic state of allograft. It depends on Aortic pulse pressure and stiffness of aorta, hence on central hemodynamic factors.[10-14]

Renal Resistance Index (RI) depends on recipient vascular compliance and accentuation of RI occurs in Acute rejection (AR) and Acute Tubular Necrosis (ATN).[15,16] RI assessment during early transplant presumed to be a good indicator of short term allograft function.[17]

However, the value of RI remains unclear, hence study was undertaken to find out is there any association between resistance index and early post-transplant renal function.

MATERIALS AND METHODS

It is a retrospective hospital-based record study of renal transplant recipients between April 2009 to December 2016, at Institute of Nephrourology, Bangalore. Since it is a medical record-based study Ethical clearance was not taken. Data of 139 renal transplants were available for this time period. All their clinical, biochemical, Radiological Doppler findings were analysed.

Doppler Examination

Colour Doppler was done by a single radiologist in all 139 patients. The test was performed 4-5 hrs of post-transplant surgery and repeat examination done based on clinical status.

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Corresponding Author:
Dr. Ramalingaiah K. H,
Associate Professor,
Department of Radiology,
Institute of Nephro-Urology,
Victoria Hospital Campus, Bangalore- 560002.
E-mail: drrams2009@hotmail.com
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Renal artery Doppler was performed with 3.5 MHz convex-array transducer (PHILIPS ENVISER) scan machine in supine position in deep inspiration. Both intra renal arteries and hilum artery RI was calculated using the system software programme.

$RI = V_{max} - V_{min}/V_{max}$

V_{max} - Peak systolic velocity.

V_{min} - Minimum diastolic velocity.

Three different spectra sampling were calculated to get mean RI.

RI is normal if it is <0.7, elevated if >0.7. If RI is 1, there is absent diastolic flow.[18]

Study Subjects

All patients who underwent renal transplant in above said period were included in this study analysis. There were total of 139 renal transplant recipient, among them cause of End stage renal failure was due to chronic glomerulonephritis 97(69.7%), Chronic interstitial nephritis 32(23%), Diabetic kidney disease 3(2.1%), Hereditary nephritis 2(1.4%), Reflux disease 4(2.8%) and Renal calculi 1(0.7%).

All patients were started on triple immunosuppressive regimen consists of Wysolone, Tacrolimus, Mycophenolate Mofetil.

Transplant patients were categorised in to three groups: Patients whose serum creatinine at day seven was lower than 2.5mg form excellent graft function (EGF), more than 2.5 mg form Slow Graft Function (SGF) and those requiring dialysis within one-week form delayed graft function (DGF).[19]

Statistical Analysis

All data were analysed with IBM SPSS version 20.

RESULTS

There were 139 transplant recipient, of which 118(84.8%) were male and 21(15.2%) were female with mean age of 30.4 years (12 -55 yrs.). Live donor transplant recipients were 117(84.2%) and the remaining were deceased donor recipient 22(15.8%). Mean dialysis vintage time is 18.5 months. Post-transplant biopsy was done in 25(18.8%) patients, majority of them had biopsy proven acute tubular injury 19(13.6%), antibody mediated injury 4(2.8%) and acute cellular rejection 2(1.4%) (Table 1).

Mean RI was 0.5 (Figure 1). The mean RI was not different in male and female recipient and also in their age (Table 2). There was significant association between RI and slow graft, delayed graft function (P =0.010), deceased donor type (P=<0.001), dialysis vintage time (p=0.012) and length of hospital stay (p=0.009). RI was not significantly associated with HLA mismatch, number of antihypertensive drugs, proteinuria, donor age and transplant kidney size (Table 3 and 4).

Recipient age (mean years)	30.4
Donor age (years)	42.5
Serum creatinine (mean (mg/dl)	1.5
Proteinuria (<200 mg/day, %)	68.3
Pretransplant dialysis vintage (<12 months %)	57.5
Human leucocyte antigen (HLA mismatch (3/6%)	43.1
Delayed graft function (%)	6.6
Slow graft function (%)	28
Antihypertensive drugs (2 drugs/day %)	49.8
Post-transplant biopsy (%)	18.8
Tacrolimus level (>12 ng/ml %)	20.2
Resistance index (mean)	0.5

Table 1. Clinical Characteristics of the Recipients

Attribute		Resistance Index		p value#
		< 0.7	> 0.7	
Mean Age (in years)		30	34	0.236
Sex	Male	108	10	0.688
	Female	19	2	

Table 2. Distribution of Recipient Age and Sex with RI

Independent-Samples T Test applied for comparing the means.

*Statistically significant at p <0.05.

Independent Samples Mann Whitney U Test.

Attribute	Resistance Index				p value#
	< 0.7		> 0.7		
	Mean	Standard Deviation	Mean	Standard Deviation	
Length of stay in hospital (in days)	17	7.19	24	8.57	0.002*
Dialysis vintage (in months)	17	15.47	36	27.78	0.009*
Donor age (in years)	44	9.81	42	6.32	0.66
USG Transplant kidney size	10.2	0.93	10.7	0.55	0.075

Table 3. Relationship of Continuous Variable with RI

Independent-Samples T Test applied for comparing the means

*Statistically significant at p < 0.05

Independent Samples Mann Whitney U Test

Attribute		Resistance Index				p value#
		< 0.7		> 0.7		
		N	(Row %)	N	(Row %)	
	Excellent graft function	87	(95.60%)	4	(4.40%)	0.010*
	Slow graft function	34	(87.18%)	5	(12.82%)	
	Delayed graft function	6	(66.67%)	3	(33.33%)	
Donor type	Live	112	(96.55%)	4	(3.45%)	<0.001*
	Deceased	15	(65.22%)	8	(34.78%)	
Dialysis Vintage range	<6 months	31	(93.94%)	2	(6.06%)	0.012*
	6 months - 1 year	46	(97.87%)	1	(2.13%)	
	1 year - 2 years	34	(91.89%)	3	(8.11%)	
	> 2 years	16	(72.73%)	6	(27.27%)	
HLA mismatch	>4/6	23	(100.00%)	0	(0.00%)	0.817
	3/6	56	(94.92%)	3	(5.08%)	
	<2/6	31	(100.00%)	0	(0.00%)	
No. of antihypertensives	0	17	(94.44%)	1	(5.56%)	0.952
	1 drug	63	(91.30%)	6	(8.70%)	
	2 drugs	28	(87.50%)	4	(12.50%)	
	>3 drugs	19	(95.00%)	1	(8.33%)	
Disease	CGN	90	(92.78%)	7	(7.22%)	0.288
	CIN	29	(90.62%)	3	(9.38%)	
	DKW	2	(66.67%)	1	(33.33%)	
	Hereditary Nephritis	2	(100.00%)	0	(0.00%)	
	Reflux Nephropathy / PUV	3	(75.00%)	1	(25.00%)	
	Calculi	1	(100.00%)	0	(0.00%)	
Tacrolimus levels	< = 12	100	(90.09%)	11	(9.91%)	0.459
	> 12	27	(96.43%)	1	(3.57%)	
Urine protein on routine	absent	86	(90.53%)	9	(9.47%)	1.000
	trace	25	(92.59%)	2	(7.41%)	
	1 - 3 g	16	(100.00%)	0	(0.00%)	

Table 4. Categorical Variable with RI

*Statistically significant at p <0.05.

#More than 20% of cells in this sub-table have expected cell counts less than 5. Hence, Fisher's exact test has been used to test significance of difference between the 2 groups based on RI.

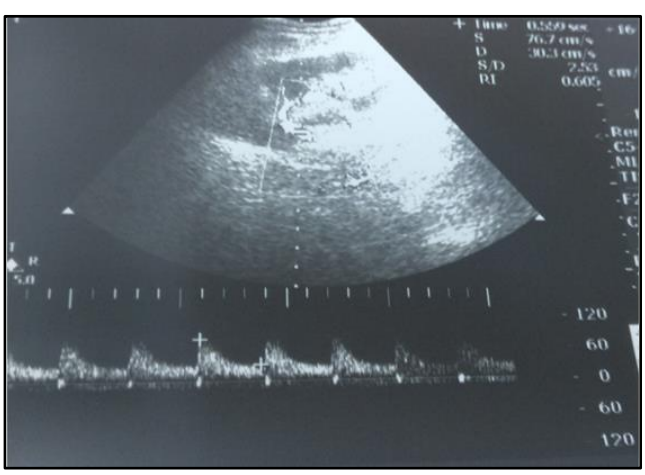

Figure 1. Doppler US Showing Normal Resistive Index of a Transplanted Kidney (RI-0.6)

DISCUSSION

The present study helps understand the importance of RI with respect to graft function. It is performed with in 5 hrs after the surgery and repeated based on clinical condition.

In our study there was significant association between RI with donor type, dialysis vintage which is similar to McArthur et al study.[3]

In our study live kidney recipients was higher (84.1%) compared to Radermacher et al[20] and in a study by Gerhardt et al[21] there were no live kidney recipients. The resistive index in live kidney recipients differs from those of deceased kidney recipients which could be attributed to prolonged cold ischemic time and age of the cadaveric donor.[22]

According to Saracino et al,[1] Krumme et al,[5] Heine et al,[14] Ikke et al[23] there was close association between RI and recipient age which not found in our study. They concluded that vessel wall caliber of the recipient is affected by atherosclerosis which is an age dependent process. Ikke et al[23] demonstrated that there was close association between biopsy proven atherosclerosis of intrarenal vessel wall and recipient age.

In our study there was no association between RI and donor age unlike Saracino et al[1] study it was significant because of age related angiosclerosis modification of intrarenal arteries of donor kidney that decreases diastolic

perfusion of transplant kidney and increases RI and they also found that increase RI obtained within first month after transplant had poor long-term graft function.

The limitation of this study was there was no follow up of RI serially to predict long term graft function.

CONCLUSION

There is an association between RI and transplant graft dysfunction in early transplant period. Increased RI was found in deceased donor transplant recipient, those with delayed/slow graft function requiring prolonged hospital stay.

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