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Evaluation of transplant kidney with magnetic resonance imaging: An observational study

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ASBTRACT

Background: The present study was conducted for assessing patients of transplant kidney with magnetic resonance imaging.

Materials & methods: A total of 20 patients with undergoing renal transplant were enrolled. Complete demographic and clinical details of all the patients were assessed. The composite data was tabulated and studied to evaluate the feasibility of functional MRI parameters i.e. the blood oxygen level dependent (BOLD-based R2* values), in order to establish role of functional MRI as one of the reliable noninvasive diagnostic technique for detection of renal allograft function and dysfunction. All the results were recorded and analyzed using SPSS software.

Results: Mean ADC Cortex value among patients with stable renal allograft and allograft dysfunction was 2.56 and 1.85 respectively (p- value < 0.05). Mean ADC Medulla value among patients with stable renal allograft and allograft dysfunction was 2.51 and 1.79 respectively (p- value < 0.05). Mean R2 Cortex value among patients with stable renal allograft and allograft dysfunction was 25.3 and 17.5 respectively (p- value < 0.05). Mean R2 Medulla value among patients with stable renal allograft and allograft dysfunction was 24.2 and 16.8 respectively (p- value < 0.05).

Conclusion:MRI is significantly helpful in assessing renal allograft dysfunction at an early stage.

Key words: Magnetic resonance imaging, Renal

INTRODUCTION

Chronic kidney disease is a major public health problem worldwide. Due to the pathogenic progression of kidney disease, patients with chronic kidney disease are at high risk for progression to the end stage renal disease – a condition requiring dialysis or kidney transplantation to maintain patient's long-term survival. As dialysis does not cure end stage renal disease, a renal transplant offers the closest treatment modality to a normal life.[1-3]

Normal Allograft was defined as the allograft recipient who has maintained nankivelle GFR> 50ml/min without allograft dysfunction in last 6 months, with serum creatinine values within the normal limits and negative or trace urinary protein. Chronic Allograft Dysfunction was defined as the progressive worsening of renal functions for more than 3 months without recovery. Chronic allograft dysfunction is largely due to chronic allograft nephropathy which is ongoing irreversible replacement of renal parenchyma by fibrosis. Histologic changes associated with chronic allograft dysfunction include patchy fibrosis with or without interstitial inflammation, tubular atrophy, glomerular sclerosis, basement membrane abnormalities, and vascular lesions.[4]

In the past decade, magnetic resonance imaging (MRI), conventionally used for tissue anatomic imaging, has been explored as an important and versatile tool for assessing the function of the kidneys. The last decade has witnessed a dramatic progress in MRI techniques for renal function assessment. Techniques, such as dynamic contrast enhanced (DCE) MRI, diffusion-weighted MRI (DWI), blood oxygenation level dependent (BOLD) MRI and arterial spin labeling (ASL), enable noninvasive evaluation of various aspects of renal function ranging from perfusion to filtration to oxygenation. These techniques show promise in replacing the invasive techniques.[5- 7]Hence; the present study was conducted for assessing patients of transplant kidney with magnetic resonance imaging.

MATERIALS & METHODS

The present study was conducted for assessing patients of transplant kidney with magnetic resonance imaging. A total of 20 patients with undergoing renal transplant were enrolled. Complete demographic and clinical details of all the patients were assessed.

Inclusion criteria:

- All consecutive patients with renal allograft

Exclusion criteria:

- Patients with implanted electric or electronic devices in particular heart pacemakers (especially older types), insulin pumps, implanted hearing aids, intracranial metal clips, which formed contraindication for the MR scan

The composite data was tabulated and studied to evaluate the feasibility of functional MRI parameters i.e. the blood oxygen level dependent (BOLD-based R2* values), in order to establish role of functional MRI as one of the reliable noninvasive diagnostic technique for detection of renal allograft function and dysfunction. All the results were recorded and analyzed using SPSS software.

RESULTS

Out of 20 patients, stable renal allograft was seen in 15 patients while renal allograft dysfunction was seen in 5 patients. Mean age of the patients with stable and dysfunctional allograft was 41.6 years and 52.7 yeas respectively (p- value < 0.05). Mean ADC Cortex value among patients with stable renal allograft and allograft dysfunction was 2.56 and 1.85 respectively (p- value < 0.05). Mean ADC Medulla value among patients with stable renal allograft and allograft dysfunction was 2.51 and 1.79 respectively (p- value < 0.05). Mean R2 Cortex value among patients with stable renal allograft and allograft dysfunction was 25.3 and 17.5 respectively (p- value < 0.05). Mean R2 Medulla value among patients with stable renal allograft and allograft dysfunction was 24.2 and 16.8 respectively (p- value < 0.05).

Table 1: Age-wise distribution

Age (years)	Stable renal allograft	Allograft dysfunction	p- value
Mean	41.6	52.7	0.00 (Significant)
SD	5.9	5.6	

Table 2: Comparison of ADC Cortex value

ADC Cortex values	Stable renal allograft	Allograft dysfunction	p- value
Mean	2.56	1.85	0.001 (Significant)
SD	0.32	0.36	

Table 3: Comparison of ADC Medulla values

ADC Medulla values	Stable renal allograft	Allograft dysfunction	p- value
Mean	2.51	1.79	0.0110 (Significant)
SD	0.35	0.23	

Table 4: Comparison of R2 cortex values

R2 cortex value	Stable renal allograft	Allograft dysfunction	p- value
Mean	25.3	17.5	0.001 (Significant)
SD	3.4	4.5	

Table 5: Comparison of R2 medulla values

R2 cortex value	Stable renal allograft	Allograft dysfunction	p- value
Mean	24.2	16.8	0.010 (Significant)
SD	3.3	3.8	

DISCUSSION

End-stage renal disease is a rare but devastating childhood condition that affects approximately 5–10 out of 1 million children each year. Renal allograft is the preferred method of treatment of children with end-stage renal disease, with better long-term outcomes and lower morbidity and mortality than dialysis. Recent advances in immunosuppression have allowed improvements in renal allograft longevity, but allograft recipients continue to require renal biopsies either as part of routine surveillance or for assessment of acute rejection. Although not universally performed, surveillance biopsies are performed at many transplant centres at predetermined time frames to assess for subclinical signs of allograft injury. Early treatment of injury has been shown in studies to prolong allograft survival. In the past decade, magnetic resonance imaging (MRI), conventionally used for tissue anatomic imaging, has been explored as an important and versatile tool for assessing the function of the kidneys. Techniques, such as dynamic contrast enhanced (DCE) MRI, diffusion-weighted MRI (DWI), blood oxygenation level dependent (BOLD) MRI and arterial spin labeling (ASL), enable non-invasive evaluation of various aspects of renal function ranging from perfusion to filtration to oxygenation. These techniques show promise in replacing the invasive techniques.[5- 9]Hence; the present study was conducted for assessing patients of transplant kidney with magnetic resonance imaging.

Out of 20 patients, stable renal allograft was seen in 15 patients while renal allograft dysfunction was seen in 5 patients. Mean age of the patients with stable and dysfunctional allograft was 41.6 years and 52.7 yeas respectively (p- value < 0.05). Mean ADC Cortex value among patients with stable renal allograft and allograft dysfunction was 2.56 and 1.85 respectively (p- value < 0.05). Mean ADC Medulla value among patients with stable renal allograft and allograft dysfunction was 2.51 and 1.79 respectively (p- value < 0.05). In a similar study by Han et al, BOLD-MRI was conducted to differentiate between patients with AR and ATN after transplantation. Their study included 110 patients; 82 with normal allografts (group 1) and 28 with kidney dysfunction, including 21 with AR (group 2) and 7 with ATN (group 3). Group 2 was divided into two subgroups: 13 patients with T-cell-mediated rejection (TMR) and 8 patients with antibody-mediated rejection (AMR). Manual ROIs were placed in the cortical and medullary regions, and CR2∗, MR2∗, and MCR2∗ were compared between different groups. They performed a statistical analysis, and they found that values of CR2∗, MR2∗, and MCR2∗ of group 2 were reduced compared to those of the other two groups.[10]

Mean R2 Cortex value among patients with stable renal allograft and allograft dysfunction was 25.3 and 17.5 respectively (p- value < 0.05). Mean R2 Medulla value among patients

with stable renal allograft and allograft dysfunction was 24.2 and 16.8 respectively (p- value < 0.05). Sadowski et al applied BOLD-MRI to assess 17 kidney transplants. Manual cortical and medullary ROIs were placed on all patients and these patients were divided into three groups: 5 patients with normal allografts (group 1), 4 with ATN (group 2), and 8 with AR (group 3). The MR2∗ and CR2∗ were calculated in the same way as their previous study, and compared between the different groups. Specifically, MR2∗ values of group 3 allografts were decreased compared to those of group 1 and group 2, while no significant difference was observed in MR2∗ values between group 1 and group 2. However, no difference was detected in CR2∗ values among the three groups.[11]

CONCLUSION

MRI is significantly helpful in assessing renal allograft dysfunction at an early stage.

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