

The renal transplant score - a different way of evaluating renal transplant pathology

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Abstract

The renal transplant is a notoriously difficult organ to assess for pathology.

Radionuclide imaging can help, but, although sensitive, the evaluation is not very specific. For this reason, a different approach was used to examine renal images and results were correlated with histology. The transplant score is determined from images of perfusion

and function on certain criteria such as time of appearance of the kidney after tracer injection, intensity of background, size and homogeneity of tracer uptake by the kidney. Although small, the pilot study could distinguish between hyperacute rejection, acute rejection, chronic rejection and cyclosporin toxicity.

Introduction

Attempts have previously been made to detect renal transplant pathology scintigraphically, usually with ^{99m}Tc DTPA. The most successful of these is probably the perfusion index.^{1,2} Others include functional imaging³ and fractional mean transit time.⁴ With all these aids at hand, diagnosis of renal transplant pathology is still difficult. Serial scintigraphy of both perfusion and function often over a period of days or weeks is necessary for decent monitoring of the progress in renal transplants.

To aid the detection of pathology in renal transplants, a different approach to reading the scintigram was tested, based on renal and background information on the scintigram.

Renal perfusion, uptake and excretion using ^{99m}Tc Glucoheptonate

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was scored on selected criteria. The score was compared to the histological diagnosis of various transplants. Glucoheptonate was chosen for interpretation of function (perfusion and early excretion) and parenchymal integrity (delayed views after furosemide injection).

Method

Eight renal transplants were imaged using 99m Tc Glucoheptonate and biopsied within 24 hours of the scintigraphy for histological diagnosis.

150 MBq of 99m Tc Glucoheptonate were injected into an antecubital vein while a dynamic acquisition of 60 frames of one second was in progress, anterior to the patient. The camera field of view included the renal transplant, large blood vessels, spleen, ureter and bladder.

The first acquisition phase was immediately followed by a second phase of 120 frames of 15 seconds, imaging kidney function. A delayed static view of the transplant was acquired 3 hours later after 20 mg furosemide injection.

The perfusion frames were combined to 15 frames of 4 seconds and the 120 frames of function were combined to 15 frames of 2 minutes. A renogram was generated and frames were displayed, assessed and scored for perfusion, uptake and excretion.

Perfusion criteria (phase 1) included:

Background score:

- 0 - Photopenic region in place of kidney
- 1 - Maximal kidney intensity equal to background
- 2 - Maximal kidney intensity between background and liver

- 3 - Maximal kidney intensity same as maximal liver perfusion
- 4 - Maximal kidney intensity better than maximal liver perfusion

Iliac vessels score:

- 0 - Photopenic region in place of the kidney
- 1 - Tracer bolus reaches kidney after it reaches iliac vessels
- 2 - Tracer bolus reaches kidney before it reaches iliac vessels

Liver score:

- 0 - Photopenic region in place of the kidney
- 1 - Maximal kidney perfusion after maximal venous liver perfusion
- 2 - Maximal kidney perfusion before maximal venous liver perfusion

Maximum perfusion score:

$$4 + 2 + 2 = 8$$

Function criteria (phase 2) included:

Background score:

- 0 - Photopenic region in place of kidney
- 1 - Maximal kidney uptake equal to background
- 2 - Maximal kidney uptake with prominent background
- 3 - Maximal kidney uptake with minimal background

Renogram score:

- 0 - No peak on renogram
- 1 - Peak after 4 minutes
- 2 - Peak before 4 minutes

Homogeneity score:

- 0 - No kidney seen on delayed image
- 1 - Inhomogenous tracer uptake on delayed image
- 2 - Homogenous tracer uptake on delayed image

Size score:

- 0 - No kidney seen
- 1 - Small kidney

- 2 - Normally sized kidney

Elimination score:

- 0 - No kidney seen

- 1 - Elimination half life from region of interest over the heart > 100 min

- 2 - Elimination half life from region of interest over the heart of 50-100 min

- 3 - Elimination half life from region of interest over the heart < 50 min

Maximum function score:

$$3 + 2 + 2 + 2 + 3 = 12$$

Results

Table I shows the perfusion scores for the various patients. Table II shows the function scores for the same group of patients. Perfusion and uptake of tracer in acute and hyper-acute transplant rejection are seen in Figures 1



Figure 1a: Fifteen frames of 4 seconds showing the perfusion of a renal transplant undergoing acute rejection.

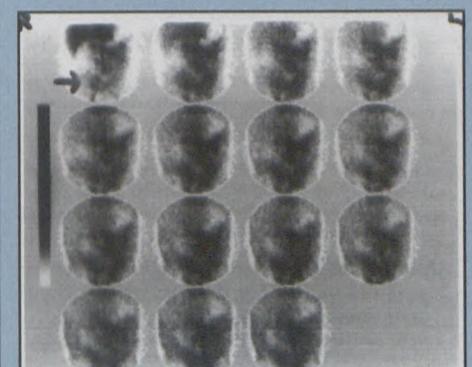


Figure 1b: Fifteen frames of 2 minutes showing the function of a renal transplant undergoing acute rejection.

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Table I: Perfusion scores of patients with various transplant pathologies

Name	EM	AK	JT	PM	JM	BS	MS	AM
Background	2	2	2	2	1	3	0	2
Iliac	1	1	2	1	1	2	0	1
Liver	2	1	2	1	1	2	0	1
Total	5/8	4/8	6/8	4/8	3/8	7/8	0	4/8
% Total	63%	50%	75%	50%	38%	88%	0%	50%
Diagnosis	cr	cr	cr	cr	ar	norm	har	ct

cr - chronic rejection norm - normal
 ar - acute rejection ct - cyclosporin toxicity
 har - hyper-acute rejection

Table II: Function scores of patients with various transplant pathologies

Name	EM	AK	JT	PM	JM	BS	MS	AM
Background	2	2	2	2	1	2	0	2
Peak	1	2	2	2	0	2	0	2
Homogeneity	1	1	2	1	1	1	0	2
Size	2	2	1	1	2	2	0	2
Elimination	1	1	1	1	2	2	0	2
Total	7/12	8/12	8/12	7/12	6/12	9/12	0/12	10/12
Percentage	58%	67%	67%	58%	50%	75%	0%	83%
Diagnosis	cr	cr	cr	cr	ar	norm	har	ct

cr - chronic rejection norm - normal
 ar - acute rejection ct - cyclosporin toxicity
 har - hyper-acute rejection

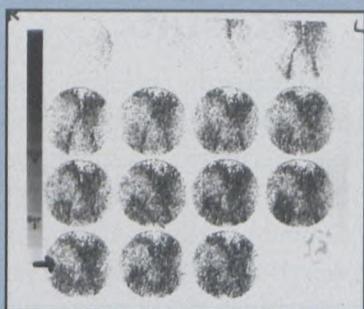


Figure 2a: Fifteen frames of 4 seconds showing the perfusion of a renal transplant undergoing hyper-acute rejection.

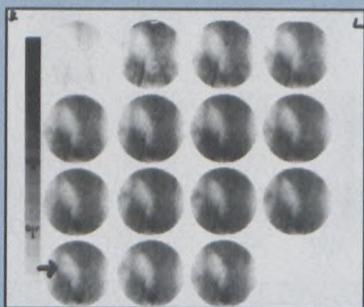


Figure 2b: Fifteen frames of 2 minutes showing the function of a renal transplant undergoing hyper-acute rejection.

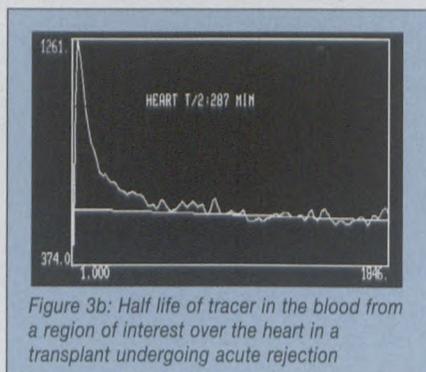


Figure 3b: Half life of tracer in the blood from a region of interest over the heart in a transplant undergoing acute rejection

in a patient with acute rejection. Figure 4 is a bar diagram that compares perfusion and function scores (converted to percent) for various transplant pathologies.

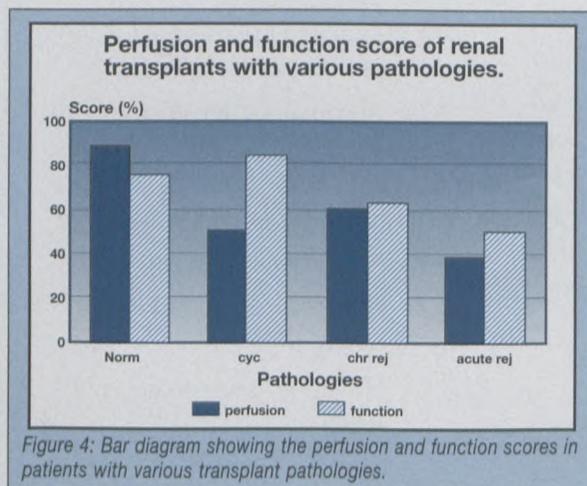


Figure 4: Bar diagram showing the perfusion and function scores in patients with various transplant pathologies.

Discussion

Perfusion scintigraphy is a good indicator for acute rejection in renal transplants. This has often been

reported^{5,6,7,8} and can be seen in our study. The perfusion score as estimated in our patient group showed a clear difference between the normal transplant, acute and chronic rejection. Attempts have been made previously to use sulphur colloid to predict transplant rejection. These were however unsuccessful.⁹

It has been shown previously that cyclosporin toxicity causes parenchymal tracer retention but does not impair perfusion.¹⁰ Such patient presented with a moderate perfusion but good function score in our study.

In hyper-acute rejection there was no perfusion or uptake of the tracer.

Conclusion

Our pilot study suggests that a renal transplant score may be a way to distinguish renal transplant pathology. Further evaluation of score criteria and exploration of the method with different tracers is necessary.

References

1. Anaise D, Oster ZH, Atkins HL, Arnold AN, Weis S, Waltzer WC, Rapaport FT. Cortex Perfusion Index: A sensitive detector of acute rejection crisis in transplanted kidneys. *J Nucl Med* 1986; 27: 1697-1701.

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