# Perfusion Parameters of MR Renography are Associated with Cardiovascular Disease Risk Factors and Clinical Indices of Kidney Function

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## Introduction and Aims

Contrast enhanced MR Renography (CE-MRR) is a technique by which it is possible to monitor renal cortical perfusion, and hence obtain an understanding of kidney function [1]. Indices of perfusion can be obtained by measuring the magnitude and timecourse of cortical contrast enhancement through a 3D dynamic post-contrast MR dataset, and such measurements have been shown to correlate with degree of renal artery stenosis as measured by MRI [2, 3]. The objective of this work was to establish whether renal perfusion measurements from MRI mirrored expected trends associated with previous history of cardiovascular disease, clinical measurements of renal function, and associated cardiovascular risk factors in a cohort of patients with renovascular disease.

## Methods

Fifty-five consenting patients were recruited for MR imaging. CE-MRR was performed on a 1.5T Symphony scanner (Siemens Medical, Erlangen, Germany), using a 3D gradient-echo volume interpolated breath-hold examination (VIBE) sequence. A 2ml test bolus of gadoteridol (Prohance$^{TM}$, Bracco, Italy) was delivered into an antecubital vein in the arm, and nine sequential VIBE measurements were acquired, at baseline, 7, 14, 21, 45, 60, 120, 180 and 240 seconds. The imaging parameters were TR 4.20ms, TE 1.88ms, flip angle 15$^{o}$, and 32 axial slices over a 100mm block. The image matrix was 74x256, across a 240x480mm field of view. Image analysis was performed on a Siemens Virtuoso workstation, where signal intensity measurements were made on the central axial slice through each kidney for each VIBE dataset. Regions of interest were placed over the aorta and the posterior aspect of the renal cortex, taking care to allow for potential misregistration due to breathing/motion artefact.

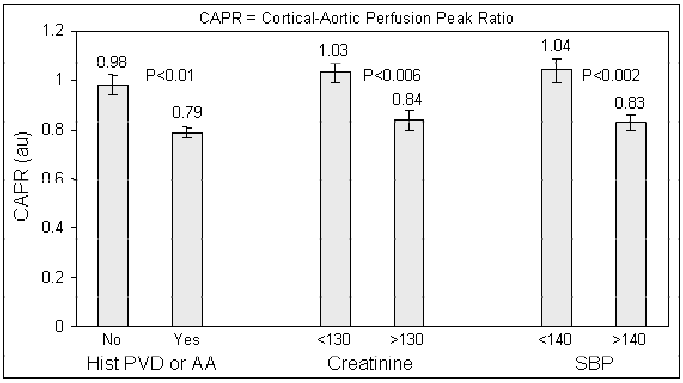
Signal intensity versus time curves were plotted for aortic and cortical enhancement. The ratio of the peak cortical signal to peak aortic signal was measured and defined as the cortical-aortic perfusion peak ratio (CAPR), and the time delay between aortic and cortical perfusion peaks was also measured and defined as the cortical-aortic delay time (CATD). Additionally, clinical information describing the history of cardiovascular disease (including history of angina, myocardial infarction, cerebrovascular accident, and peripheral vascular disease or aortic aneurysm) was collected for each patient. Clinical renal function parameters of serum creatinine and proteinuria were also identified for each patient, along with cardiovascular risk factor assessments of systolic blood pressure (SBP) and cholesterolaemia.

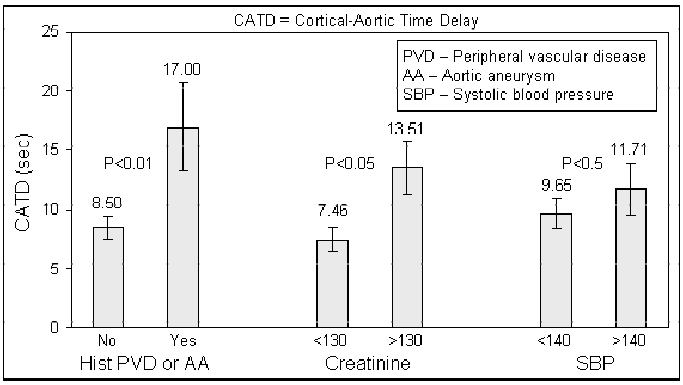
## Results and Discussion

*Previous Cardiovascular Disease:* When history of previous cardiovascular disease was investigated, patients with a history of peripheral vascular disease (PVD) or aortic aneurysm (AA) all had significantly reduced CAPR perfusion values and longer CATD values than those patients without PVD or AA history ($p<0.01$ for both cases, see figure). The CAPR value was also reduced in those patients with a history of myocardial infarction, and the CATD value was longer in those patients with a history of cardiovascular accident ($p<0.02$). However, there was no clear association between the MR renal cortical perfusion values and history of angina.

*Clinical Indices of Kidney Function:* When kidney function was assessed by comparing MR cortical perfusion values with serum creatinine and proteinuria, the mean CAPR value was significantly lower for patients with elevated serum levels ($p<0.001$ for proteinuria, and $p<0.01$ for creatine – see figure). Additionally, the CATD value was significantly longer for patients with high serum creatinine ($p<0.05$ – see figure).

*Cardiovascular Risk Factors:* When SBP was investigated, the mean CAPR perfusion value was reduced in patients with high SBP relative to those with low SBP, whilst the mean CATD value was longer. This was statistically significant for the CAPR value (1.04 +/- 0.05 au for high SBP relative to 0.83 +/- 0.03 au for low SBP, $p<0.002$). The same MR perfusion pattern was observed when patients were stratified on the basis of history of cholesterolaemia, although this did not quite reach statistical significance.




## Conclusion

In most cases, both MRI measurements of reduced renal cortical perfusion follow clinical parameters associated with cardiovascular disease history, kidney function and cardiovascular risk factors. This experiment has validated these MR perfusion measurements in the clinical context of renovascular disease.

## References

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