



RESEARCH

INFORMATION

The TICKER study: investigating the cardiovascular changes associated with kidney failure



AIMS

The aim of this study was to better understand the cardiovascular changes that can be detected on CT and MRI scans in patients with kidney failure. We focused on 4 questions: 1) Can cardiac MRI scans be used to predict survival in patients with kidney failure? 2) Do cardiac MRI findings change before and after dialysis? 3) Can a new type of CT scan detect scarring in the heart muscle? 4) Can a new MRI technique detect hardening of the arteries?



KEY FINDINGS

- A newer measure of heart function on MRI scans, called 'Global Longitudinal Strain', is better than existing measures of heart function at predicting survival in patients with kidney failure
- An MRI technique called 'T1 mapping' is thought to detect scarring in the hearts of patients on dialysis. However, in our study we found that T1 mapping changed before and after dialysis. This change happens too fast to represent scarring and so it is likely that T1 mapping is affected by fluid in the heart muscle in patients on dialysis.
- An alternative way to measure scarring in the heart is to use a new type of CT scan. In our study we found this CT technique is possible in patients on dialysis but further studies are needed to prove its significance.
- A new MRI technique can be used to detect calcium in blood vessels. This allows us to study hardening of the arteries without needing to expose patients to the radiation associated with CT scanning.





WHAT DID THE STUDY INVOLVE?

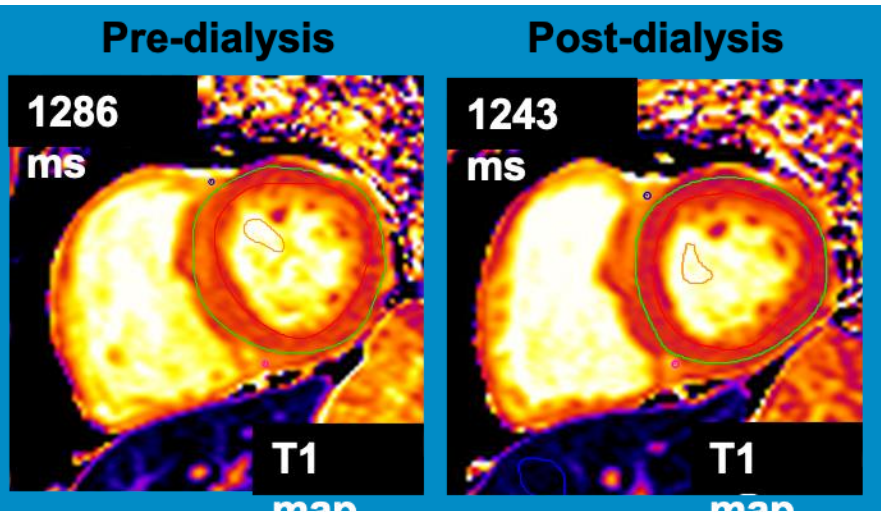
The first question in this study was addressed by re-analysing 215 previously acquired research MRI scans. The second, third and fourth questions were addressed in a small, prospective study in which 26 participants underwent scans of their heart before and after dialysis. Additional measurements including blood tests, weight and fluid intake were recorded.



WHAT WERE THE RESULTS AND WHAT DO THEY MEAN?

- 1) **Global longitudinal strain (GLS)**, a newer technique to assess heart function on an MRI scan, is better than existing measures at predicting survival in patients with kidney failure. This is true despite the majority of the cohort having normal heart function by standard parameters. In the future GLS may become the standard method of reporting heart function. However, the benefits of transplantation were present even in the group with the worst GLS suggesting it will not help in assessing patients' suitability for transplant.
- 2) **T1 measurements on MRI change before and after dialysis**. This means that the abnormal T1 results observed in patients with kidney failure is not entirely due to scarring. Unfortunately, this means that T1 might not be as useful a test in kidney failure as we had hoped it would be. It does highlight that every single dialysis session has effects on patients' hearts and further studies are needed to try to work out if this is harmful and how it can be best managed.
- 3) **CT scans to detect scarring in the heart**. Our study has shown this is possible in patients with kidney failure but further studies are needed before it can be used clinically. CT scans are much faster and more readily available than MRI, so if proven to work, would make it easier to study the cardiovascular changes that occur in kidney failure.
- 4) **A new type of MRI scan can detect calcium in blood vessels**. Our study revealed that although some improvements in image quality are still needed, this new MRI sequences is a promising technique that let's us study hardening of the arteries without needing to expose patients to radiation.

The Figure shows the T1 map on MRI for a participant before and after dialysis. Small, but consistent, reductions in T1 time were observed after dialysis. This suggests that some of the abnormal T1 signal that is present in patients on dialysis is due to fluid, rather than scarring.





WHAT IMPACT COULD THE FINDINGS HAVE?

- **Patients.** The results of this study have identified more reliable measures to assess heart function in patients on dialysis. This study has allowed us to better understand the cardiovascular changes that can be detected on MRI and CT scans in patients on dialysis in the hope that one day better treatments can be developed.
- **Practice.** This study is further evidence that we should change the way we assess heart function in patients with kidney failure. Unfortunately, T1 mapping, which was a promising new marker for diagnosing scarring of the heart muscle, looks to be affected by the dialysis process which might make it less useful than we had hoped.



HOW WILL THE OUTCOMES BE DISSEMINATED?

The results will be published in scientific journals and presented at scientific meetings. Some of the results from this study have already been published. Additional results are being prepared for publication currently. A newsletter is being prepared to inform all participants what the study has shown.



CONCLUSION

Patients with kidney failure continue to experience a greatly increased risk of cardiovascular disease. There are significant challenges in diagnosing and treating cardiovascular disease in this population. This study has examined 4 different methods of assessing the cardiovascular system in patients with kidney failure in an attempt to improve diagnosis and to better understand the processes of disease driving the increased cardiovascular risk.



RESEARCH TEAM & CONTACT

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Additional Information

This research was completed between August 2017 and December 2020, with a brief hiatus to allow Dr Rankin to return to full-time clinical duties during the first wave of the COVID-19 pandemic. The research was made possible by a grant from CSO for £144,252.