Cystatin C Has the Potential to Enhance the Practicality of the Kidney Functional Reserve Test in Real-Life Scenarios

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Abstract

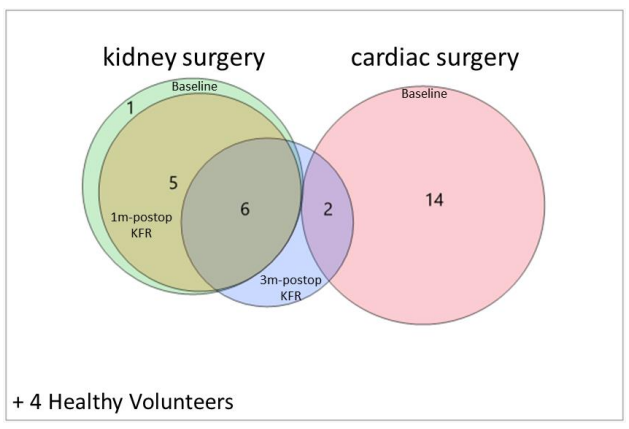
The Kidney Functional Reserve (KFR) test can be used to predict AKI. In this study we compare the traditional method of measuring KFR, by unstimulated and stimulated creatinine clearance (CrCl), with a new method using plasma cystatin C (CysC) to estimate glomerular filtration rates (GFR) before and after a protein meal, with no need for urine collection.
We measured CrCl and CysC-eGFR-based KFR in 16 participants undergoing cardiac surgery, 12 participants undergoing nephrectomy and 4 healthy volunteers. Tests were performed at baseline and at 1 and 3 months after the surgery for some participants. Different tests were conducted with or without a low protein diet before the test and with low (3h) or high (12h) fasting time before the test.
CysC-eGFR increases after protein loading, regardless of the diet and the fasting time. Protein load failed to increase CysC-eGFR after surgery, suggesting lost of KFR.
There is no correlation between baseline eGFR and KFR.

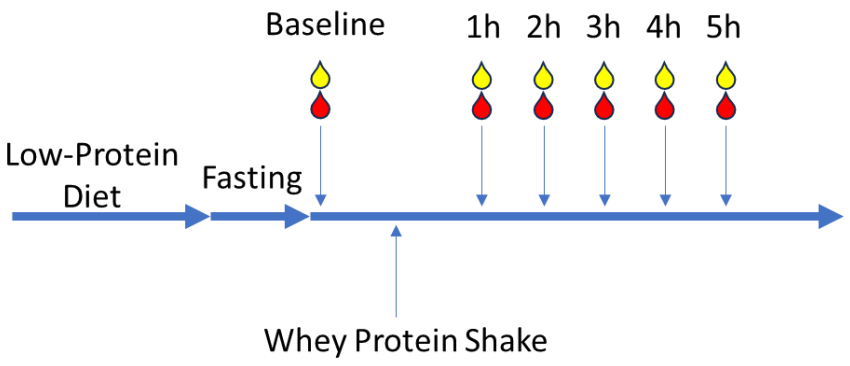
Introduction

- The KFR test quantifies the kidney's increase filtration in response to stress.
- The standard measure of KFR is the difference between the unstimulated baseline CrCl and the CrCl after a protein meal.
- KFR measured by CrCl identifies individuals at risk of Acute Kidney Injury (AKI) after cardiac surgery.
- However, clearance measurement is cumbersome and limits clinical utility. Precise and reliable urine sample collection to measure hourly CrCl is difficult.
- Recent data suggest that CrCl correlates poorly with measured GFR.
- We suggest Cystatin C estimated GFR (CysC-eGFR) can measure KFR using only plasma samples. The shorter half-life of Cystatin C (compared to creatinine) detects peak GFR earlier and shortens duration of the test.

Methods and Materials

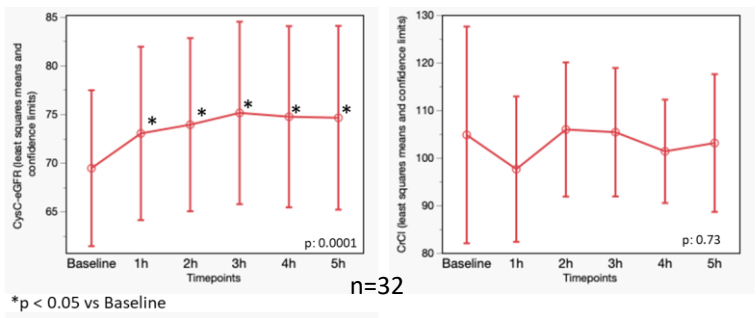
Participants undergoing cardiac surgery (n=16), nephrectomy (n=12) and healthy volunteers (n=4) performed a KFR test with the measurement of CrCl and plasma CysC levels before and after the ingestion of a shake containing 1.5g/kg powdered whey protein. Twelve tests were conducted after one day of low-protein diet and 12h fasting, 10 tests after normal diet and 12h fasting and 10 tests after normal diet and 3 hours fasting. Stimulated GFR was assessed hourly for 5 hours after the protein meal. Creatinine and cystatin C levels were performed using a clinical chemistry analyser (Konelab, Thermo™). Mixed models with repeated measures were used to assess GFR over the time.





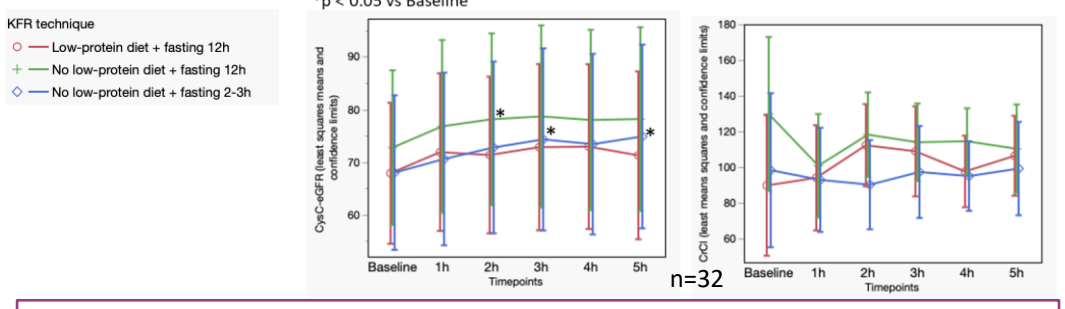
Results

CysC e-GFR increased by the first hour after protein ingestion, earlier than the 2-3h usually reported for CrCl. CrCl did not show a sustained increase in GFR after protein in these patients. Our different KFR measurement techniques had no influence on the trajectory of CysC-eGFR or CrCl.



n=32

*p < 0.05 vs Baseline



n=32

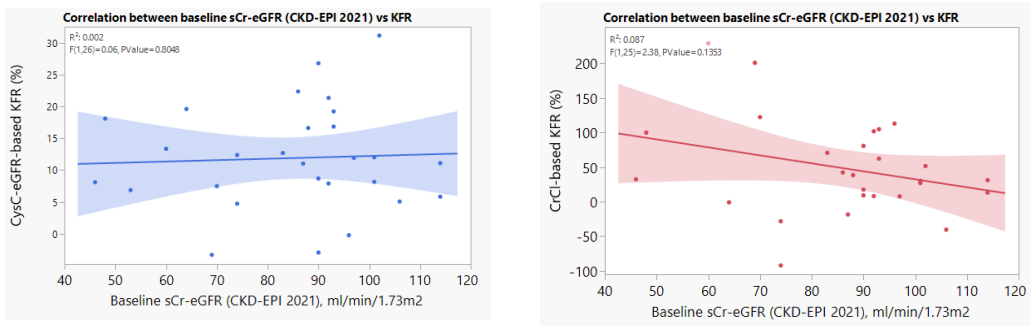
KFR as well as GFR decrease after surgery.

n=11

*p < 0.05 vs Baseline

n=8

There is no correlation between baseline eGFR and KFR, therefore KFR must be measured.



Discussion

CrCl and CysC-eGFR have different patterns after protein stimulation. CysC-eGFR-based KFR is simpler and may have clinical utility.

Conclusions

CysC-eGFR based KFR measurement is easier than clearance methods and seems to be feasible in real-life scenarios even in the absence of dietary modification or fasting.

Supported by the Prince of Wales Hospital Foundation, Lewis Foundation and FAPESP