Optimising filter lifespan in critically ill patients with SARS-COV-2 receiving renal replacement therapy: an observational study in a UK district general hospital

Dr C Evans, Dr R Sundaram, SN J Hunter, Dr L Gemmell

Intensive Care Unit, Royal Alexandra Hospital, Paisley

Aim

To prolong the life of renal replacement therapy (RRT) filters in critically unwell patients with SARS-Coronavirus-2 (SARS-CoV-2).

Background

Critically unwell patients with SARS-CoV-2 are at risk of acute kidney injury (AKI).

- The mechanism is likely multifactorial including hypoperfusion, endothelial dysfunction, coagulopathy and complement activation.

When requiring RRT evidence showed these patients had an increased risk of early filter failure

- The lifespan of a filter is 72 hours and some centres reported issues after 6-10 hours.
- Failure is likely due to the prothrombotic nature of these patients and or the inflammatory cytokines causing raised transmembrane pressure.

Why is this important?

- Blood is commonly lost in the filter when it fails which can lead to anaemia and the risks then associated with transfusions.
- Frequent filter failure means patients are not receiving their RRT for periods of the day and therefore we are not delivering the treatment.
- Frequent filter changes require more work for the nurses.
- Every change of filter costs us money in filter cartridges and filtrate.

Methods and Materials

We performed a retrospective observational study looking at all patients admitted to our ICU since the pandemic in March 2020. We introduced a modified RRT prescription for continuous venovenous haemodiafiltration (CVVHDF) with an increased citrate dose of 4mmol/l from 3mmol/l.

Figure 1. Prismaflex RRT system.

We also primed the circuit with heparin but did not use further heparin during treatment and we reduced the intensity of prescription to that of a 50kg patient to place less demand on the filter.

Data was collected from Ward Watcher, a Scottish Intensive Care Society Audit Group (SICSAG) database and the CAREVUE electronic patient records.

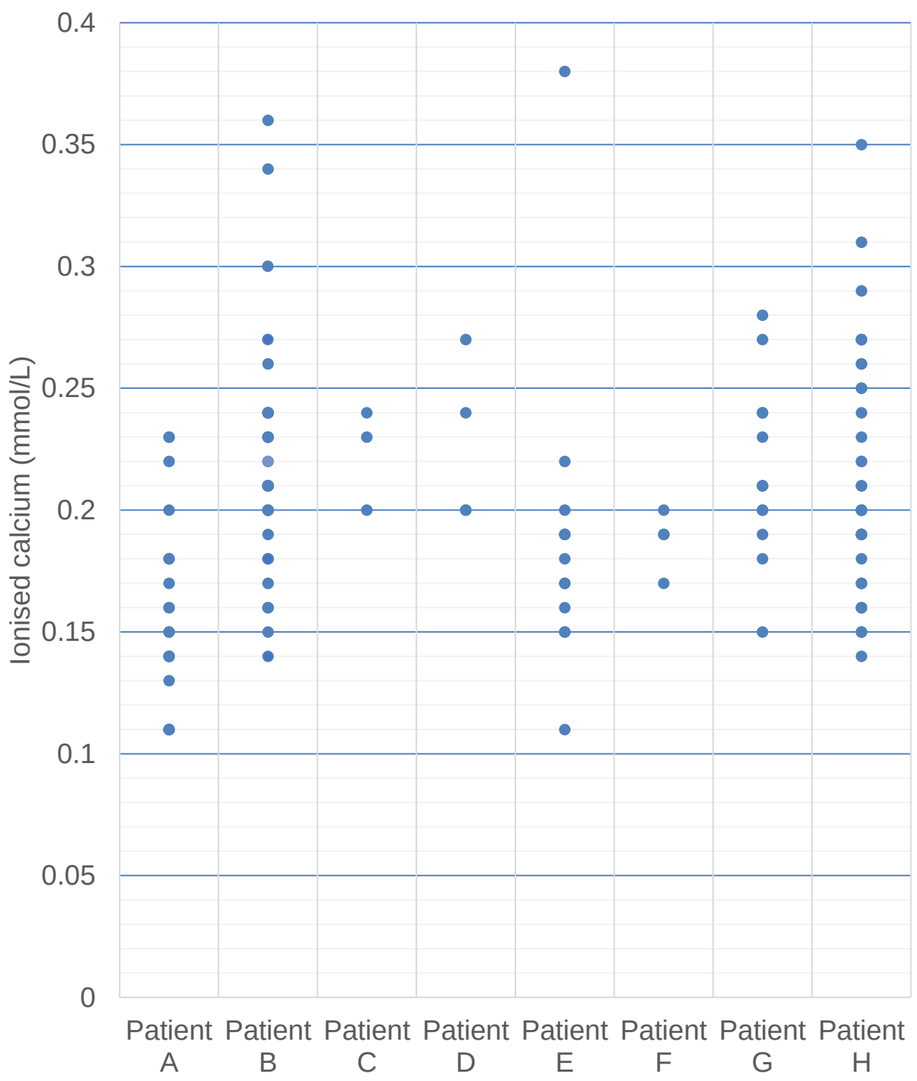

Chart 1. Measured ionised calcium in filter draw for each patient.

Results

Patient numbers

106 SARS-CoV 2 patients in ITU during data collection → 15 of whom required RRT → 8 treated on increased citrate protocol

- The median duration of time on RRT per patient was 188 hours (range 24-677 hours).
- This protocol improved the average lifespan in the covid patients from 37 hours to 45 hours (range 6-70 hours).
- This allowed us to provide RRT almost 19 hours a day (79%). which was similar to that of data prior to covid.

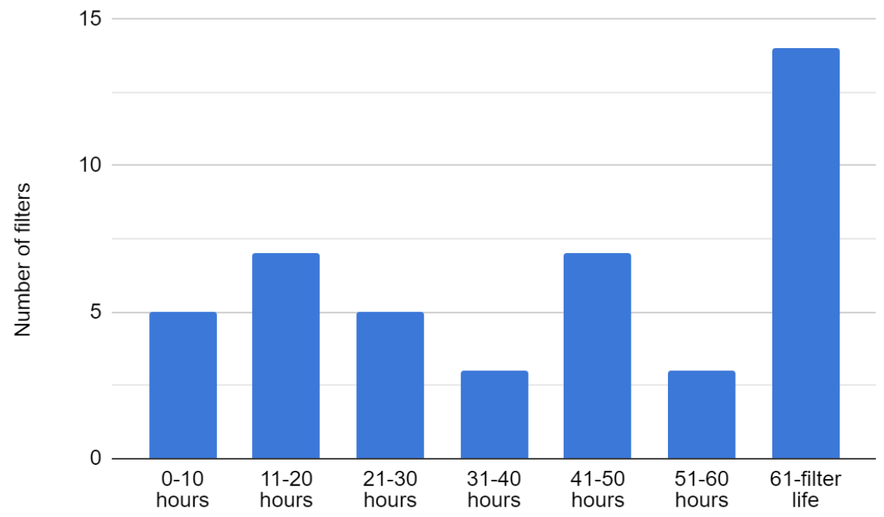

Chart 2. Filter duration.

- We had no adverse bleeding episodes.
- There was no evidence of citrate toxicity based on monitoring of calcium ratios and acid base disturbance.

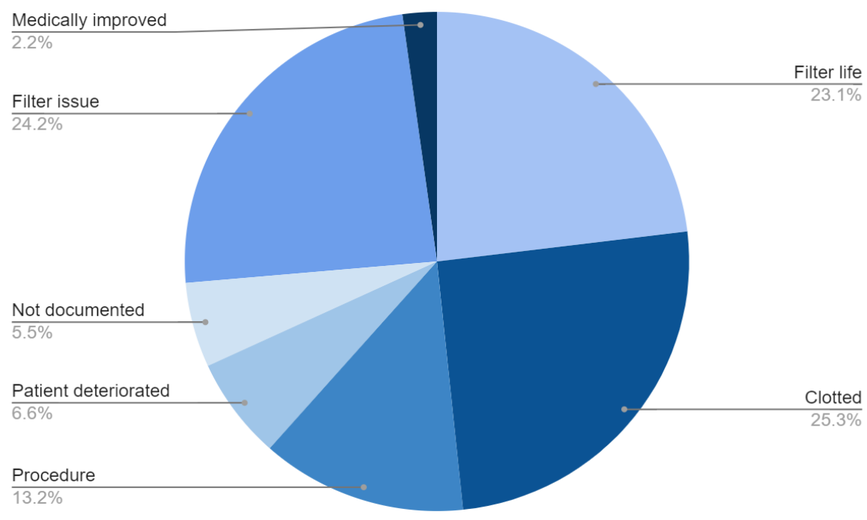

Chart 3. Reasons for stopping RRT filter.

Discussion

Some centres returned to using heparin based anticoagulation protocols to manage the high number of early filter failures in the SARS-CoV-2 cohort. However this is associated with higher bleeding risk and this is associated with significant morbidity and mortality as well as increased cost to a patients stay. Our increased citrate protocol improved filter life without any recorded adverse outcomes.

The cost savings are complex to calculate because nursing time and patients' length of stay in the ITU also affect cost. However using the increase in RRT filter life of 8 hours in 8 patients saved us a minimum of £700 in filter costs alone.

We were not able to comment on the affect this had on the need for blood product transfusion because of confounding factors.

One concern is that the increased citrate load may be causing hypocalcaemia and the ionised calcium monitored from filter draw blood is shown in chart 1. We had no recorded abnormal calcium ratios or acid base disturbance but this should be monitored closely.

The numbers of patients were low and further research is required but it is promising and unfortunately SARS-CoV-2 continues to be a common cause of ITU admission.

Conclusions

This small study showed an increase in filter life for patients on an increased citrate dose protocol of CVVHDF without any adverse outcomes. This results in cost savings and more appropriate resource usage during a pandemic without increased bleeding risk.

References

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