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## Background

### Bioimpedance

- Reflects body composition
- Is easy, inexpensive and non-invasive to perform
- Some measures of bioimpedance have been shown to predict death<sup>1</sup>

### Volume status

- Is difficult to assess clinically
- Hypervolaemia may predispose patients with chronic kidney disease (CKD) to congestive heart failure (CHF) in the short term and in the longer term cause arterial changes and cardiac remodelling that lead to myocardial infarction (MI), stroke, and sudden death
- Can be manipulated
- Is a potential therapeutic target
- Data on volume status in patients with CKD not on dialysis are sparse

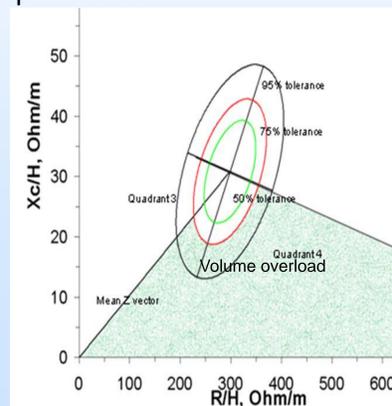
## Hypotheses

- Volume overload is prevalent in patients with CKD not on dialysis
- Bioimpedance measurements can be interpreted to assess volume status
- The resistance (R) – Reactance (Xc) graph method described by Piccoli and colleagues<sup>2</sup> can be operationalized as a dichotomous assessment of volume overload (Figure 1)
- 50% of participants in the CANPREDDICT study will consent to the bioimpedance substudy

## Methods

- Nested in the multi-centre CANPREDDICT study, we conducted a single-centre pilot to examine the feasibility of conducting a substudy measuring bioimpedance in prevalent patients with CKD who were already participating in CANPREDDICT
- Bioimpedance was measured according to the methods outlined below
- Data was analyzed according to the method of Piccoli, classifying patients based on the RXc graph method
- Primary outcomes for the pilot were the proportion of CANPREDDICT participants who were eligible and consenting to the substudy, and the proportion of substudy participants who were volume overloaded
- For the main study
  - We plan to recruit 500 of 1136 CANPREDDICT participants in 7 to 9 centres
  - Examine whether volume overload, assessed by bioimpedance predicts a primary outcome composite of stroke, MI, amputation for peripheral vascular disease, CHF or vascular death

**Figure 1.** Operationalization of the Piccoli RXc graph method



## Methods

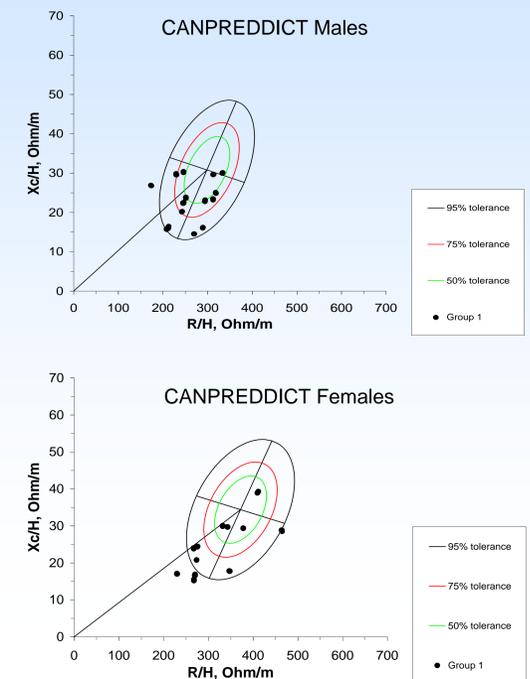
### Bioimpedance methods

- Quadscan 4000, Bodystat Inc
- Whole body impedance at 5, 50, 100, 200
- Measurements performed in triplicate
- Supine, tetrapolar lead placement
- Proprietary software to calculate phase angle, resistance and reactance
- Correct resistance and reactance for height
- Calculate vector length corrected for height from resistance and reactance
- Piccoli software to plot resistance and reactance<sup>3</sup>
- Interpret each graph in duplicate
- Resolve differences by consensus

## Results

- Participants
  - 43% women
  - Mean age 66 years
- 34 consecutive CANPREDDICT participants were approached at their first return visit between 2009 December 09 and 2010 April 20
- 28 (82%) participated, 4 declined and 2 deferred their decision to their next visit
- 43% patients volume overloaded by the RXc graph method (Figure 2)
- Kappa was 1.0 for inter-observer agreement in graph interpretation

**Figure 2.** Plots of height-corrected resistance against reactance for X patients with CKD not on dialysis, stratified by gender



## Conclusion

- The RXc graph method described by Piccoli and colleagues can be reliably operationalized into a dichotomous assessment
- Volume overload according to the RXc method is prevalent in patients with CKD not on dialysis
- The study appears to be feasible

## References

1. Pillon L, Piccoli A, Lowrie EG, Lazarus JM, Chertow GM. Vector length as a proxy for the adequacy of ultrafiltration in hemodialysis. *Kidney Int.* 2004;66:1266-71
2. Piccoli A, Rossi B, Pillon L, Bucciantie G. A new method for monitoring body fluid variation by bioimpedance analysis: the RXc graph. *Kidney Int.* 1994;46:534-9
3. Piccoli A, Pastori G. BIVA Software 2002. Department of Medical and Surgical Sciences, University of Padova, Padova Italy 2002. Il vettore di impedenza: le formule del Prof Piccoli 2002 Available from: URL: [http://www.renalgate.it/formule\\_calcolatori/bioimpedenza.htm](http://www.renalgate.it/formule_calcolatori/bioimpedenza.htm) (last accessed 2009-10-10)