A COMPARISON OF EXCESS FLUID TO BE REMOVED IN HAEMODIALYSIS PATIENTS, AS ESTIMATED BY HD STAFF VERSUS MULTIPLE FREQUENCY BIA.

Jane H Downs[1,2], F Veldman[2], S Kassier[2]

King Edward VIII Hospital (KEH)[1], & University of KwaZulu-Natal (UKZN)[2]

jane.downs3@gmail.com

Background

Once 90% or more of kidney function is lost, either kidney transplantation or dialysis is required to sustain life.[1] Fluid management is central to the management of end stage renal disease.

Persistent **fluid overload damages** the cardiovascular system, and leads to hypertension, left ventricular hypertrophy, congestive heart failure, pulmonary oedema, peripheral oedema and other adverse cardiovascular sequelae.[2,3] Mortality risk increases with a pre-dialysis fluid overload of 2.5L.[2]

Conversely, **dehydration or excess fluid removal** or excessive ultrafiltration, may result in intradialytic symptoms of hypotension such as acute ischaemic events with recurrent episodes, potentially causing functional impairment and organ damage.[4]

Controlling fluid status in an optimal range is crucial, to improve cardiovascular tolerance, quality of life and survival of haemodialysis (HD) patients.[2]

Currently, in most haemodialysis units in South Africa, the excess fluid to be removed in HD, is estimated by the HD staff, who compare the previous post HD versus the subsequent pre-HD body weight (wt).

Bioelectrical impedance analysis (BIA) has been shown to have clinical value, and may potentially protect the HD patients from risks associated with under and over-hydration[2]. Bioelectrical impedance analysis is a relatively inexpensive, safe, and portable tool, and easily performed without extensive training, **to assess both fluid and nutritional status.**[5]

Objective

To compare excess fluid to be removed in HD as estimated by the HD staff versus the volume measured per multiple frequency BIA.

Methods

- A prospective, non-randomized observational study was conducted.
- Repeated measures of 24 BIA pre- and post HD measurements were conducted over 3 months on 20 chronic HD subjects (50% male; ages 21 to 63 yrs) at the KEH HD unit. A total of 960 pre-and post BIA measurements were measured.
- The Quadscan 4000® (Bodystat) multiple frequency (5 to 200Hz) BIA machine was used to measure BIA.
- Ethics approval was obtained from the UKZN Ethic's Committee; Ethics no.: BE041/14
- Data were analysed using **repeated measures ANOVA**(Statistica v7).

Results

- There was no significant difference when combined effects including days were considered, but there was a **clinically significant difference** (1.29L) between the **excess fluid measured per BIA vs the HD staff estimate**. This difference was more pronounced in subjects with a body fat % (BF) ≥30% and a BMI ≥28 kg/m^2 vs their leaner counterparts, (the combined effect accounting for days was p= 0.780; but the difference between the 2 groups was p=0.00*; Fig. 1a, b).
- Subjects with a body fat % ≥30% and a BMI >28 kg/m^2, had a **negative 3rd water space** vs those with lower BF % and BMI's. There was no significant difference when combined effects including days were considered but there was a significant difference between the two groups(p=0.000*; Fig. 1c).
- All subjects' **intracellular fluid was below the normal range** despite their hydration status. There was no significant difference when combined effects including days were considered but there was a significant difference between pre and norm(p=0.003*).
- The **prediction (illness) marker** showed a post dialysis improved trend.

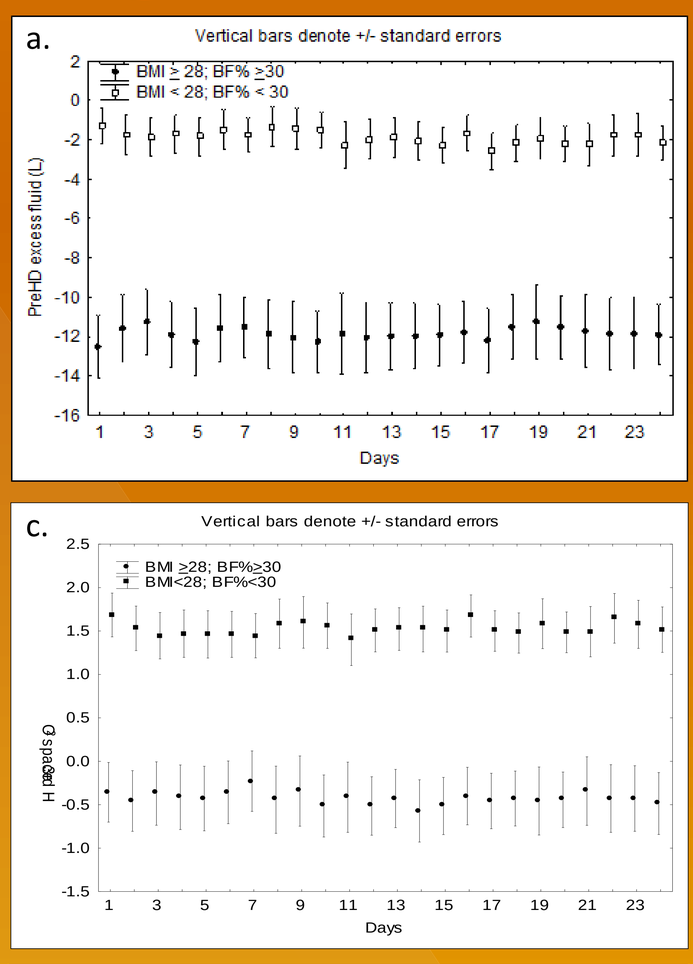

Fig. 1. Changes with time (days) of a.) pre-HD excess fluid, b.) fluid to be removed and c.) 3rd water space.

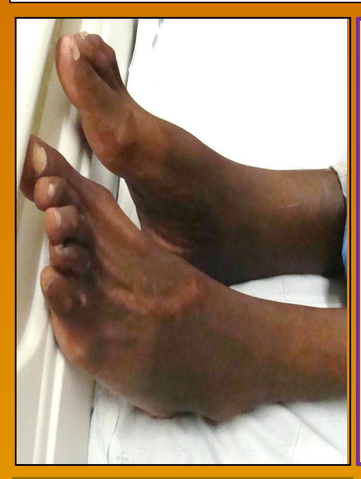

Fig. 2. This patient had no visible signs of pedal oedema, despite being severely fluid overloaded and having an average pre-HD 3rd water space of +2L. BIA allows for earlier detection of fluid overload than usual clinical signs.

Conclusions

- There was a **clinically significant** difference between the excess fluid measured per BIA vs the HD staff estimate.
- All the subjects irrespective of whether they were overhydrated or dehydrated, had an **intracellular fluid % below the normal range**. We postulate that this patient group has an excessive sodium intake, resulting in fluid shifts from the intra- to the extracellular space.
- The reason for a **survival benefit of a higher body fat % & BMI in HD patients** has alluded scientists for the past 20 years. Subjects with a body fat percentage ≥30% and a BMI >28 kg/m2, had **a negative 3rd water space** vs those with lower BF % and BMI's. We postulate that this is an important factor in improving this sub-groups better survival amongst HD patients, and that it is due to greater perspiration, and consequent higher water and sodium losses in this group versus their leaner counterparts.
- **BIA is an invaluable tool for guiding both HD staff and patients** towards an optimal fluid status in HD patients, as both extracellular and 3rd water space can be accurately measured and monitored.

References:

1. FHN Trial Group. In-center hemodialysis six times per week versus three times per week. N Engl J Med 2010; 363 (24):2287-2300.
2. Moissl U *et al*. Bioimpedance-guided fluid management in hemodialysis patients. Clin J Am Soc Nephrol 2013; 8:1575-1582.
3. Tsai Y *et al*. Association of fluid overload with kidney disease progression in advanced CKD: a prospective cohort study. Am J Kidney Dis 2014; 63 (1):68-75.
4. Vasko R *et al*. Clinical judgement is the most important element in over hydration assessment of chronic hemodialysis patients. Clin Exp Nephrol 2013; 17:563-568.
5. Oei EL & Fan SL. Practical aspects of volume control in chronic kidney disease using whole body bioimpedance. Blood Purif 2015; 39:32-36.

Acknowledgements:
We wish to acknowledge and sincerely thank the KEH HD staff and patients who participated in this study, and CT Downs (UKZN) for assisting with the data analyses.