



## Abstract

Residual renal function has been reported to be a major determinant of peritoneal dialysis technique survival for patients with end stage kidney disease. Anuria, leads to increases in peritoneal dialysis (PD) prescriptions designed to maintain small solute clearances and ultrafiltration volumes, resulting in greater exposure to hypertonic glucose dialysates. We reviewed the effect of developing anuria in a cohort of 136 PD patients followed for a median of 12 months, to determine whether increasing exposure to higher glucose dialysates affected body composition by increasing body fat and reducing muscle mass. Despite increasing prescription of 22.7 g/l and 38.6 g/l glucose dialysates there was no increase in body fat ( $31.1 \pm 15.4$  vs  $30.9 \pm 16.3$  kg) or loss of fat free weight ( $36.4 \pm 12.1$  vs  $35.8 \pm 12.3$  kg).

Changing PD prescriptions to maintain small solute clearances and ultrafiltration volumes did not lead to detrimental changes in body composition in the short term.

## Introduction

More than three hundred thousand patients with end stage kidney failure are treated by peritoneal dialysis worldwide. After peritonitis [1] loss of residual renal function and reliance on peritoneal dialysis to achieve adequate ultrafiltration is the next most common cause of technique failure and transfer to haemodialysis [2].

Ultrafiltration in peritoneal dialysis is achieved through an osmotic gradient created by using higher dextrose dialysate concentrations or an oncotic gradient using isomaltose (icodextrin) containing dialysate. As such anuric peritoneal dialysate patients are typically prescribed more glucose containing dialysates once residual renal function has been lost. It has been suggested that the increased mortality associated with loss of residual renal function may be due to protein energy wasting (PEW), secondary to increased glucose absorption from the peritoneal dialysates with loss of appetite and reduced protein intake [3].

To determine whether anuric peritoneal dialysis patients develop PEW we determined changes in body composition in a cohort of patients using multi-frequency bioelectrical impedance assessments (MFBIAs).

## Patients and methods

We compared the first MFBIAs after patients were documented to have become anuric (urine output < 100 ml/day) with a follow up assessment. 136 adult patients treated by peritoneal dialysis under the care of two tertiary university hospitals at clinical dry weight between Aug 2008 and Jan 2012 were reviewed. All patients had MFBIAs performed in a standardised manner (BCM Fresenius, Bad Homburg, Germany, InBody 720, Seoul South Korea), as part of established routine clinical care [4,5]. We have previously derived equations comparing these

devices [5,6], and assessed reproducibility of measuring fat mass (Bland Altman mean bias 0.04 kg). Although both Baxter (Baxter Health Care, Deerfield, USA) and Fresenius peritoneal dialysis systems were used, the majority were treated with Baxter peritoneal dialysis systems.

24 hour effluent peritoneal dialysate and urine collections were analysed to determine urine volume and both peritoneal clearances and residual renal function, and normalised nitrogen appearance (nPNA) to assess dietary protein intake calculated by standard methods, and all patients underwent peritoneal transport assessment.

Ethical approval was granted by the local ethical committee as audit and clinical service development.

### Statistical analysis

Statistical analysis was by single or paired analysis, students' t tests, Mann Whitney U test, or Wilcoxon pair analysis, with appropriate correction for multiple analyses, and by Chi square test with Yate's correction (GraphPad Prism version 6.0, San Diego, USA). Data are presented as mean  $\pm$  standard deviation, median (inter quartile range) or as a percentage.

### Results

136 patients, median age 59.9  $\pm$ 14.3 years, 54.4 % male, 35.3% diabetic, 31% Caucasoid, 36% South Asian and 27% African/Afro-Caribbean were studied. The median peritoneal dialysis vintage at time that anuria was documented was 11.8 months (9.0-48.8), and the median time between assessments 11.8 (10-13) months. 36% were treated by continuous ambulatory peritoneal dialysis and 64% by automated peritoneal dialysis cyclers (APD). On follow up the percentage of patients prescribed icodextrin, and higher dialysate glucose solutions increased from 44.1 to 63.9%, and for 22.7 g/l glucose (120 mmol/l) 58 to 78.2% and for  $\geq$  38.6% glucose (204 mmol/l) 29 to 46% (all  $p < 0.05$ ). Dialysis adequacy as assessed by weekly peritoneal urea clearance and ultrafiltration volumes did not differ (Table 1). Nor did dietary protein intake as assessed by nPNA, despite the increased prescription of higher glucose containing dialysates (Figure 1), body composition measured by MFBI did not change for the cohort (Table 1), or on subgroup analysis.

### Discussion

To compensate for the loss of residual renal function, peritoneal dialysis prescriptions are typically adjusted in clinical practice to increase both peritoneal small solute clearances and ultrafiltration, leading to larger infill volumes and additional cycles, with greater use of hypertonic glucose dialysates [3]. In keeping with this practice there was a greater prescription of both hypertonic glucose dialysates and icodextrin in our cohort of anuric patients maintained on peritoneal dialysis.

Previous reports have suggested that hunger profiles are blunted in peritoneal dialysis patients compared to both haemodialysis patients and normal

healthy controls [8], as appetite may be reduced by a variety of factors including abdominal distension from larger in-fill volumes, and increased glucose absorption from hypertonic glucose dialysates. As such earlier studies reported reduced nutritional intake over time in anuric patients [4], and those patients with greater malnutrition, determined by subjective global assessment scoring were more likely to die or transfer to haemodialysis [3]. Despite changes in peritoneal dialysis prescriptions and exposure to greater amounts of dialysate glucose our cohort of patients did not reduce their dietary protein intake, as assessed by nPNA. We used MFBIA to determine body composition, as previous studies have shown correlation with body composition measured by dual X-ray absorption scanning [9]. Although increased dialysate glucose exposure could potentially lead to increased absorption leading to an increase in body fat, and a reduced appetite in combination with the uraemic state lead to protein energy wasting [10], we observed no increase in body fat or reduction in muscle mass in this cohort of anuric peritoneal dialysis patients followed for a median of a year.

Our data which shows stable body composition over twelve months suggests that peritoneal dialysis can be a successful therapy for chronic kidney failure patients despite a loss of residual renal function. Previous reports have suggested that both peritoneal dialysis adequacy, in terms of small solute clearances and ultrafiltration volumes may be important in determining peritoneal dialysis technique failure [2,]. However studies have varied in small solute clearances and daily ultrafiltration volumes to be clearly able to define a minimum target for every day clinical practice. Our patients achieved acceptable targets for both small solute clearances and ultrafiltration volumes [2] but lower levels may have resulted in PEW and technique failure. Our study was too small to identify an effect of age, sex, ethnicity and diabetes, and our cohort was also potentially biased as a survivor cohort, but even so despite increasing exposure to higher glucose based dialysates we did not show any detrimental changes to body composition, with patients maintaining both fat and muscle mass despite becoming anuric.

The authors have no conflict of interest

Dr S Fan has accepted monies from Fresenius AG for speaking engagements, and Fresenius AG have provided educational grants to the Royal London & St Bart's department of Renal medicine, and Fresenius. AG have supported the UCL Centre for Nephrology Dialysis course

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Figure 1: change in peritoneal dialysis prescription of 7.5% icodextrin and 22.7 g/l and  $\geq 38.6$  g/l glucose dialysates in peritoneal dialysis who had been recorded as being anuric, median peritoneal dialysis vintage 11.8 months (9.0-48.8), and then peritoneal dialysis prescription at time of repeat bioimpedance after a median follow up of 11.8 months. \*\*\* p <0.001

Table 1. Peritoneal dialysis adequacy, daily ultrafiltration volume, assessment of protein intake by normalised nitrogen accumulation (nPNA) and body composition from multifrequency bioelectrical impedance. No significant differences.

	anuric	on follow up
weekly peritoneal Kt/Vurea	1.89 ±0.43	1.83 ±0.35
24 hr peritoneal ultrafiltration volume ml	942 (600-1371)	950 (639-1374)
nPNA g/kg/day	0.81 ±0.22	0.86 ±0.16
body mass index kg/m <sup>2</sup>	24.4 ±4.3	24.6 ±4.8
intracellular water litres	18.25±4.79	18.02 ± 4.76
fat mass kg	31.1 ±15.4	30.9 ±16.3
fat free mass kg	36.4 ±12.1	35.8 ±12.3