

ORIGINAL ARTICLES

FREE WATER TRANSPORT AND ITS ASSOCIATION WITH CARDIOVASCULAR STATUS
IN CHILDREN ON PERITONEAL DIALYSISLilian Bolte,¹ Maria Jose Ibacache,¹ Iris Delgado,² and Francisco Cano¹*Division of Pediatric Nephrology,¹ Hospital Luis Calvo Mackenna, Universidad de Chile, Santiago, Chile; and
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◆ **Background:** Volume overload is one of the most important factors associated with left ventricular hypertrophy (LVH) and cardiovascular disease in chronic peritoneal dialysis (PD) patients. MiniPET is a reliable tool to evaluate free water transport (FWT). In a clinical setting, the significance of FWT has not been evaluated in terms of outcome in children on PD. The objective was to define a FWT value of clinical significance in children on PD, fixing its relationship to left ventricular mass index (LVMI) as a well-known outcome parameter.

◆ **Methods:** MiniPET was performed with 3.86% glucose, 1-h long, to measure FWT in PD patients > 6 years old. An echocardiogram (ECG) was performed within 2 months of the MiniPET. Left ventricular hypertrophy was defined as LVMI ≥ 38.6 g/height^{2.7} (95th percentile). Receiver operating characteristic curve (ROC) analysis was used to determine the cut-off value of FWT searching the highest sensitivity and specificity to differentiate patients with normal/abnormal LVMI. A $p < 0.05$ was considered significant.

◆ **Results:** Forty-six studies were performed on 32 patients, 16 males; mean age 11.59 ± 3.07 years. Mean normalized FWT (nFWT) was 144.4 ± 84.8 mL/m², corresponding to 46.7% of total ultrafiltration. Mean LVMI was 42 ± 11.3 g/m^{2.7} with a negative correlation to nFWT ($p < 0.01$). Eighteen out of 32 patients had LVH. The ROC analysis (nFWT vs LVMI) showed an area under the curve of 0.71 (95% confidence interval [CI], 0.53 – 0.89; $p = 0.04$), allowing a cut-off nFWT value of 110 mL/m² to be defined, dividing the population into 2 groups of patients according to the LVMI cut-off value of 38.6 g/m^{2.7}.

◆ **Conclusions:** The nFWT showed an inverse correlation to LVMI. A nFWT value < 110 mL/m² was significantly associated with LVH. The negative relationship observed between nFWT and LVMI, and the cut-off level for nFWT according to the 95th percentile of LVMI, suggest that the regular evaluation of nFWT could become a useful tool in assessing the capacity of PD treatment to keep patients' volume status under control, avoiding cardiovascular impairment.

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In chronic kidney disease (CKD) children on peritoneal dialysis (PD), cardiovascular disease remains the leading cause of morbidity and mortality (1–3). Left ventricular hypertrophy (LVH) is the most prominent evidence of cardiovascular impairment, reflecting target-organ damage in these patients. The most important factors associated with the development of LVH are chronic volume overload, hypertension, and loss of residual renal function (4–7).

The progressive loss of ultrafiltration (UF) capacity in PD has been recognized as a main factor of treatment failure, cardiovascular stress, and poor survival. Both total sodium and fluid removal were shown to be independent factors affecting survival in a large cohort of adult PD patients (8). Therefore, a close follow-up of sodium and water peritoneal transport is critical for the success of the therapy in dialyzed children.

The peritoneal equilibration test (PET) has been shown to be a reliable tool to evaluate peritoneal transport, adjusting PD prescription to peritoneal transport capacity (9). However, PET is mainly focused on solute transport and not on UF capacity nor free water transport (FWT). In the 3-pore model of peritoneal transport (10–13), it has been suggested that ultras-small pores (USP) are the main contributors to FWT (14). Loss of this mechanism could lead to net UF failure (UFF) and could be linked to a functional deterioration of water transport capacity. Free water transport through aquaporins has not been part of a routine clinical follow-up in children on PD, a bias that could explain why adjusting PD therapy only based on PET has not resulted in a decrease in cardiovascular mortality.

The existence of a relationship between FWT and cardiovascular status has been suggested by a recent study of children on PD (15), where a direct association between left ventricular mass index (LVMI) and FWT was found. However, in a clinical

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setting, the significance of FWT has not been evaluated in terms of outcome for CKD patients, and most PD centers do not include this test in the routine follow-up of patients.

To define the clinical utility and prognostic value of any parameter, it needs to be validated with regard to a gold standard variable. In this sense, the clinical significance of FWT must be evaluated based on a well-known outcome variable, such as LVMI. The aim of this study was to define a FWT value of clinical significance for children on PD, fixing its relationship to LVMI as a well-known outcome parameter.

PATIENTS AND METHODS

Between November 2012 and September 2018, CKD patients from the Division of Pediatric Nephrology, Luis Calvo Mackenna Children's Hospital, were evaluated in a prospective/cross-sectional design study. Adequacy studies, MiniPET, and short PET were performed on CKD children under chronic PD therapy. Inclusion criteria were patients ≥ 6 years old and stable on chronic PD for more than 3 months. Exclusion criteria were a peritonitis episode up to 2 months before, known cardiac disease, active nephrotic syndrome, age ≤ 6 years, and biochemical values out of Disease Outcomes Quality Initiative (DOQI) recommended ranges.

PERITONEAL FWT EVALUATION

MiniPET was performed for 1 hour with 3.86% glucose, as previously published (14,15). Patients had a standard dialysis prescription the night before the test (9). The day of the test, the last dwell from the previous night was drained, and 3.86% glucose solution was infused (1,100 mL/m²). Plasma sodium was measured at the start of the test. Peritoneal dialysis fluid samples for sodium were obtained at the end of the glucose dwell infusion (minute 1) and at the end of the 1-hour dwell (minute 60). After that, the hypertonic dwell was drained. Both the infused and drained volume were registered. Dialysate sodium was measured through an indirect electrode method using pre-dilution of the sample to minimize the influence of sodium binding to protein and inorganic ions.

Normalized FWT (nFWT) was calculated as follows:

Absolute dip of dialysate sodium concentration:

$$\text{Dip Na}_D (\text{mEq/L}) = \text{Na dialysate min 60 (mEq/L)} - \text{Na dialysate min 1 (mEq/L)}, \text{ where Na}_D \text{ is sodium in dialysate.}$$

Dip of sodium D/P relationship:

$$\text{Dip D/PNa} = \text{D/PNa}_{60} - \text{D/PNa}_1, \text{ where D/PNa is dialysate/plasma ratio of sodium at minute 60 and minute 1 of the test.}$$

Sodium removal during the first hour of the test:

$$\text{Na removal} = [\text{total sodium in dialysate min 60 (out)} - \text{total sodium in dialysate min 1 (in)}]$$

$$\text{Na removal} = [\text{volume dialysate out (L)} \times \text{Na dialysate min 60 (out) (mEq/L)}] - [\text{volume dialysate in (L)} \times \text{Na dialysate min 1 (in) (mEq/L)}]$$

Convective UF through small pores (UFSP):

$$\text{UFSP (mL)} = [\text{Na}_R (\text{mEq}) \times 1,000] / \text{Na}_P, \text{ where Na}_R \text{ is sodium removal, and Na}_P \text{ is plasma sodium}$$

$$\text{Free water transport (FWT)} = \text{total UF (mL)} - \text{UFSP (mL)}$$

$$\text{nFWT} = \text{FWT normalized to BSA, where BSA is body surface area (m}^2\text{)} = \sqrt{[\text{height (cm)} \times \text{weight (kg)}] / 3,600}$$

UF and FWT were normalized by BSA (nUF and nFWT, respectively).

CARDIOVASCULAR EVALUATION

Blood Pressure (BP) was measured according to the Clinical Practice Guidelines for Screening and Management of High Blood Pressure in Children and Adolescents (16). Hypertension (HTN) was diagnosed with BP > 95 th percentile.

An echocardiogram was performed within 2 months of PET studies by 2 pediatric cardiologists at the Division of Cardiology at the same hospital. Measurements of interventricular septal diastolic width (IVSd), left ventricular end diastolic diameter (LVEDD) and posterior wall thickness (LVPWd) were taken on M-mode using a Vivid E9 cardiac ultrasound machine (Providian Medical Equipment, Highland Heights, OH, USA). Left ventricular mass index was calculated using IPPN software (www.pedpd.org). The LVM was calculated according to the Devereux formula:

$$\text{LVM (g)} = 0.8 \{1.04 [(\text{LVEDD} + \text{PWT} + \text{IVST})^3 - (\text{LVEDD})^3] + 0.6\}.$$

Left ventricular hypertrophy (LVH) was defined as LVMI ≥ 38.6 g/m^{2.7} for boys and girls, which represents the 95th percentile obtained from a cohort of healthy children, corresponding to the classic cut-off value for LVH (16–19). Severe cardiac hypertrophy was defined as LVMI > 51 g/m^{2.7} (4).

CORRELATION STUDIES

Dialytical variables, blood pressure, and daily UF were registered to establish their relationship to LVH. Ultrafiltration failure was defined as < 150 mL/m², as published (17), and anuria was defined as a residual Kt/V < 0.1 .

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS software, version 24.0 (SPSS Inc., Chicago, IL, USA). Descriptive analysis was performed using mean and standard deviation for numerical variables, median values when a non-normal distribution was confirmed. The Shapiro-Wilk test was used to verify if the distribution of variables was normal. Pearson's correlation coefficient was used to evaluate the association between variables. The Mann-Whitney test was used to analyze variables without a normal distribution. Receiver operating characteristic curve (ROC) analysis was used to determine the cut-off value of nFWT, searching the highest sensitivity and specificity differentiating between patients with LVMI < 38.6 g/m^{2.7} and those with LVMI ≥ 38.6 g/m^{2.7} to evaluate the discriminative

TABLE 1
Demographic, Dialytic, and Cardiovascular Characterization of Study Population ($n = 32$)

Variable	Mean	SD	Median	Minimum	Maximum
Age ^a (years)	11.59	3.13	12.85	6	16.1
Age at PD start ^a (years)	8.46	4.61	9.9	0.3	14.8
Height ^a (cm)	136.47	17.99	140.5	94	164
Weight (kg)	33.23	11.48	33.5	13	58
BSA (m ²)	1.11	0.26	1.16	0.58	1.63
Daily UF/BSA ^a (mL)	919.17	640.37	843.01	112.63	3,383.33
UFSP+FWT ^a (mL)	310.4	262.48	320	-600	890
nFWT (mL)	144.43	84.88	125.07	17.39	400.09
Urine output ^a (ml/day)	810	774	600	0	3300
pKt/V	1.73	0.58	1.66	0.66	3.2
rKt/V ^a	1.10	1.18	0.90	0	4.8
Creatinine D/P ^a	0.38	0.15	0.35	0.01	0.81
Glucose D/D ₀	0.61	0.13	0.62	0.25	1
LVMi (g/m ^{2.7})	42	11.3	39.3	25	78.3
Systolic BP	116.3	5.88	116	106	130
Dyastolic BP ^a	75.33	4.11	77	61	80

SD = standard deviation; PD = peritoneal dialysis; BSA = body surface area; UF = ultrafiltration; UFSP = UF through small pores; FWT = free water transport; nFWT = normalized FWT; pKt/V = peritoneal Kt/V; rKt/V = residual Kt/V; D/P = dialysate/plasma; LVMi = left ventricular mass index; BP = blood pressure.

^a Variables with a non-normal distribution.

capacity of the diagnostic test. For this purpose, LVMi was used as a dicotomic variable, with a normal value $< 38.6 \text{ g/m}^{2.7}$ and an abnormal value $\geq 38.6 \text{ g/m}^{2.7}$. Ethical committee approval and informed consent were obtained as requested for research studies at the Luis Calvo Mackenna Children's Hospital and Faculty of Medicine, University of Chile.

RESULTS

Forty-six studies were performed on 32 patients, 16 males, mean age 11.59 ± 3.13 years (median value 12.8 years). Eight patients had repeated short PET and echocardiogram (1 patient had 4 evaluations, 4 patients had 3, and 3 patients had 2 evaluations). Chronic kidney disease etiologies were congenital anomaly of the kidney and urinary tract (CAKUT), chronic glomerulonephritis, renal dysplasia, hemolytic uremic syndrome, and Alport syndrome. Mean height and weight were 136.5 ± 17.9 cm (median value, 140.5 cm) and 33.2 ± 11.5 kg, respectively. All patients were on automated PD (APD). The mean time in dialysis was 34.6 ± 46.6 months. The mean dextrose concentration was 1.9 ± 0.39 g/dL. Residual Kt/V (rKt/V) was 1.1 ± 1.18 (median value, 0.9) and peritoneal Kt/V (pKt/V) was 1.7 ± 0.58 . Demographic, dialysis, and cardiovascular data are shown in Table 1 as mean and median values.

CARDIOVASCULAR EVALUATION

The mean LVMi value was $42 \pm 11.3 \text{ g/m}^{2.7}$. Eighteen of the 32 patients had LVH (LVMi $\geq 38.6 \text{ g/m}^{2.7}$). Among them, 9 showed severe cardiac hypertrophy ($> 51 \text{ g/m}^{2.7}$). In anuric

patients ($n = 8$), the mean LVMi was $49.3 \pm 12.3 \text{ g/m}^{2.7}$, vs $39.5 \pm 9.9 \text{ g/m}^{2.7}$ for those children with residual renal function (RRF) ($p < 0.05$). Systolic and diastolic blood pressure did not show a significant correlation to LVMi in the univariate analysis when analyzed as continuous variables. When patients were categorized by 95th percentile for blood pressure (BP), 11 patients were diagnosed as BP > 95 th percentile. The hypertensive group showed a significant correlation to LVH (LVMi $> 38.6 \text{ g/m}^{2.7}$, $p < 0.05$). Hypertension and anuria showed a significant association ($p < 0.01$); however, anuric patients did not show an increased risk of having LVH (odds ratio [OR] 3.38, 95% confidence interval [CI] 0.78 – 14.69).

To evaluate the association between LVMi and nFWT, a ROC analysis was performed, described below. A higher nFWT value was associated with a significantly lower probability of having LVH.

DIALYTICAL EVALUATION

Analysis of MiniPET showed nFWT of $144.4 \pm 84.9 \text{ mL/m}^2$, corresponding to 46.7% of the UF obtained during the test (UFSP + FWT, Table 1). Daily UF was 919 ± 640 mL, median value, 843 mL. A negative correlation was found between nFWT and LVMi (Pearson's correlation coefficient, $r = -0.41$, $p < 0.01$), showing that for each unit of decrease in nFWT, the LVMi value increased 0.055 units (CI 95%, -0.093 – 0.017). Normalized FWT also showed a direct correlation to age, height, weight, BSA, age at PD start, drained volume at 1 hour, and an inverse correlation to DipNa in the dialysate, D/P Na₆₀ and Dip D/P Na. No correlation was found between nFWT and both peritoneal Kt/V and residual Kt/V, nor with transporter status (high,

high-average, low-average, or low, short PET evaluation). Anuric vs non-anuric patients did not differ in terms of nFWT nor daily UF.

Regarding short PET results, creatinine D/P and glucose D/D₀ were 0.38 ± 0.15 (median value, 0.35) and 0.61 ± 0.13 , respectively. Eight patients were categorized as high transporters, 6 patients as low transporters, and 18 patients were classified as medium transporters. No correlation was found between creatinine D/P and glucose D/D₀ vs LVMI, nFWT, or normalized UF (nUF).

RECEIVER OPERATING CHARACTERISTIC CURVE ANALYSIS

Receiver operating characteristic curve analysis was performed to determine the discriminative capacity of nFWT to discern between LVMI below or above $38.6 \text{ g/m}^{2.7}$. The ROC analysis showed an area under the curve of 0.71 (95% CI 0.53 – 0.89; $p = 0.04$). According to this, a cut-off value of 110 mL/m^2 was defined for nFWT, dividing the population into 2 groups. Patients above a LVMI of $38.6 \text{ g/m}^{2.7}$ correspond to a nFWT less than 110 mL/m^2 , and patients with a LVMI under $38.6 \text{ g/m}^{2.7}$ correspond to a nFWT more than 110 mL/m^2 . Mean LVMI was $46.8 \pm 11.5 \text{ g/m}^{2.7}$ in patients with nFWT less than 110 mL/m^2 , and 39.2 ± 10.45 in those with nFWT $> 110 \text{ mL/m}^2$ (Figures 1 and 2). The association between nFWT $< 110 \text{ mL}$ and hypertension was found to be statistically significant (chi-squared test, $p < 0.05$)

DISCUSSION

As previously published, in this study, the significant inverse correlation between nFWT and LVMI in children on PD was confirmed (15). Furthermore, we were able for the first time to define nFWT categories for children on chronic PD. In the first category, nFWT less than 110 mL/m^2 was significantly associated with LVMI $> 95\text{p}$, while the second category corresponded to patients with nFWT $> 111 \text{ mL/m}^2$ and a normal ventricular mass.

Free water transport is a critical issue in terms of UF and volume overload, with a direct impact on cardiovascular status. Aquaporins account for a small fraction of the UF coefficient, only 2% (13,14), given that this coefficient represents the product of the hydraulic permeability to water and the vascular surface area available for transport. However, they contribute to a large portion of the total UF, reported at approximately 40% in adult studies (14), because they have a high reflection coefficient for glucose, meaning that 100% of the glucose osmotic effect acts across them (13). Besides FWT through USP, a large proportion of water removal is coupled to sodium transport and dialyzed by convective forces through small pores (SP), a process that requires longer dwells and adequate dwell volumes to reach its optimal level of transport (18,19). Sodium is basically transported through SP by convection, and quantitatively less by diffusion, and dwell volume and dwell time are basic conditions to obtain an adequate removal of coupled water and sodium via SP. Free water transport in PD

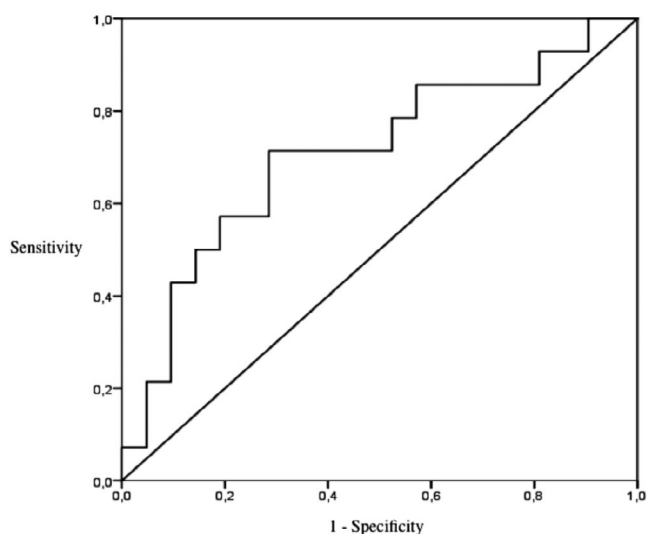


Figure 1 — Receiver operating characteristic curve study. Area under the curve showing specificity and sensitivity for nFWT adjusted to LVMI as a dicotomic variable. nFWT = normalized free water transport; LVMI = left ventricular mass index.

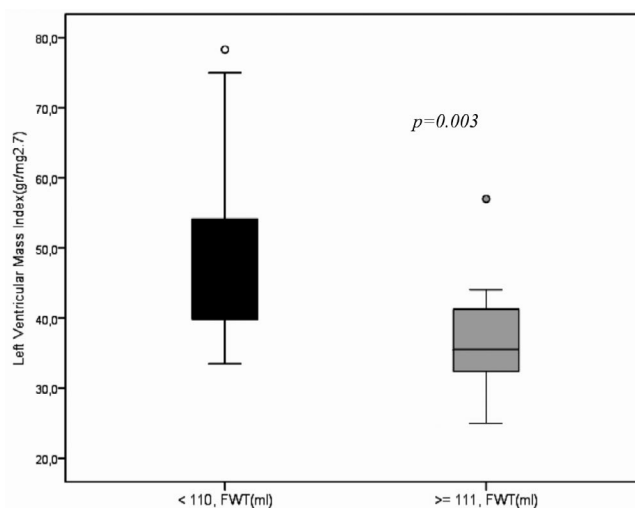


Figure 2 — Normalized FWT groups according to LVMI with a cut off value of $38.6 \text{ g/m}^{2.7}$. LVMI = left ventricular mass index ($\text{g/m}^{2.7}$); FWT = free water transport (mL/m^2).

patients was assessed by La Milia with a modified PET, called “MiniPET” based on the 3-pore model, a method validated by computer simulations (14). According to this model, fluid and solute transport across the peritoneum is determined by hydraulic and osmotic forces acting on 3 types of pores in the capillary wall: large, small, and ultrasmall pores. Ultrasmall pores correspond to aquaporin 1 (AQP1), and account for the movement of free water through the peritoneal membrane. In adults, during a hypertonic dwell, it has been estimated that approximately 40% – 50% of UF occurs through the ultrasmall pores as free water without solutes (20). In this study, aquaporin-FWT corresponds to 46.7% of the UF obtained during the test (UFSP + FWT, Table 1), a similar value compared with results from adults. It is very important that the duration of the

exchanges and the fill volume preceding MiniPET are standardized to compare results between different studies (9,14–23). The FWT will be maximized in the first hour of a hypertonic dwell because at that time the glucose osmotic gradient is at its highest. At that moment, sodium transport by diffusion is very low, due to a low plasma to dialysate sodium gradient. Therefore, the dip in the dialysate sodium concentration in the first hour of a hypertonic dwell—also known as sodium sieving—is caused by the dilution of the dialysate sodium. The functional loss of AQP1 and the loss of sodium sieving have been confirmed by Ni *et al.* (13), who have shown that the deletion of AQP1 in aquaporin-null rats causes a loss of sodium sieving, with a close relationship between the initial solute-free UF rate and the level of AQP1 expression.

In a clinical setting, the significance of FWT has not been evaluated in terms of outcome for CKD patients. In different studies, a high proportion of dialyzed children show cardiovascular damage (2,3,18,24–26). Left ventricular hypertrophy was found in 52% of 21 pediatric patients on chronic PD, corresponding to severe LVH in 91% of cases (27). We found a mean LVMI value of $42 \pm 11.3 \text{ g/m}^{2.7}$, slightly higher than that reported in other studies (24,28), but close to results published in large series of dialyzed children (4,7). In CKD patients, LVH is the most prominent evidence of cardiovascular impairment, reflecting target-organ damage secondary to hypertension and volume overload in the dialyzed population. Blood pressure did not show a significant correlation to LVMI when analyzed as a continuous variable, which does not consider the 95th percentile for each patient. When analyzed as a categorical variable, hypertension was significantly correlated to LVH and anuria. However, a direct correlation between anuria and LVH was not found, a lack of correlation which needs to be analyzed in a larger number of patients. The small number of patients involved in pediatric CKD studies is a weakness and future multicentric studies are required to confirm these preliminary results.

The definition of LVH has been a matter of discussion, currently based by convention upon the distribution of LVMI in healthy children, defined by the fixed LVMI partition value of 35.7 and $38.6 \text{ g/m}^{2.7}$, which defines the 90th and 95th percentiles, respectively, in children and adolescents from 6 to 17 years of age (29,30). This definition has been adopted by most of the pediatric studies (4,7,24,28–31). However, because of the small number of children on PD in individual centers, the short PD time before transplantation, and the small number of children dying of cardiovascular causes, the outcome in terms of LVH has been elusive, and intermediate end points need to be found.

In this sense, blood pressure and volume overload preceding cardiovascular events should be logical candidates. As previously published, the classic PET and the short PET are reliable methods to evaluate the peritoneal transport capacity regarding solute transport, but they do not give accurate information about UF capacity and volume overload. The classic PET shows a variability coefficient of < 10% when assessing the transport of small solutes, but this coefficient increases to 50% when it comes to evaluating UF (32). In this

study, PET showed that most of the patients were medium or high transporters, and only 6 patients were low transporters. As expected, and as shown by La Milia *et al.* (14,32), no correlation between 2-h creatinine D/P or glucose D/D₀ with FWT and UF was found, nor with LVMI. In contrast, the association of FWT, as evaluated by means of MiniPET, and cardiovascular impairment (LVMI), showed a significant inverse association between these 2 parameters, as previously shown (15).

Receiver operating characteristic curve analysis provides a statistical method for the assessment of the diagnostic accuracy of some parameters, in this case, nFWT. The ROC analysis allowed us to determine a previously unknown cut-off value for nFWT, with the highest sensitivity and specificity, based on the well-known outcome parameter LVMI. The ability of this statistical approach to differentiate individuals on both sides of a continuous variable, a “safe” group versus a “risk” group, allowed us to define a cut-off point for nFWT in a clinical setting. The area under the curve (AUC) for the ROC analysis showed a value of 0.71, with statistical significance, showing a high sensitivity and specificity in terms of defining 2 groups for FWT. As shown in Figure 2, using LVMI as a dicotomic variable with a cut-off value of $38.6 \text{ g/m}^{2.7}$, 2 groups of patients were identified. The first group, corresponding to patients with a nFWT < 110 mL, was composed of children with an abnormal LVMI, and a second group of children with nFWT > 111 mL, was associated with patients showing a normal LVMI. In accordance with ROC analysis, the association between HTN and nFWT < 110 mL was also found to be statistically significant.

Patients showing aquaporin dysfunction, according to Fischbach *et al.* (33), do not benefit from the use of a higher dialysate glucose concentration because ultras-small pores are not able to generate a dip in sodium D/P after a 1- to 2-h dwell. When a patient is suspected of losing FWT capacity, peritoneal membrane function should always be evaluated using a 3.86% glucose dialysis solution, because glucose acts as a driving osmotic force for maximal water aquaporin-transport at this high glucose concentration. It is not possible to draw conclusions about FWT capacity using lower glucose concentrations, and particularly, after a 1- to 2-h dwell time, when diffusive and convective transport take place together. After the first 1 – 2 hours of dwell time, the osmotic force of glucose has decreased secondary to reabsorption through the peritoneal membrane, degradation, and dilution. Brimble *et al.* (34) in a large meta-analysis, showed that adult patients with a higher creatinine D/P (fast transporters) were at a high mortality risk, associated with a higher dialysis fluid overload as a consequence of a more rapid reabsorption of glucose from the dialysate and subsequent UF dysfunction. A progressively increasing mortality risk of 21.9%, 45.7%, and 77.3% in low-average, high-average, and high transporters, respectively was found, as compared with low transporter patients.

In patients with an impairment of aquaporin water channels, and in whom shortening dwell time is not useful to improve UF even using hypertonic glucose solutions, the use of icodextrin, which exerts its colloid (rather than crystalloid) osmotic effect mainly through the small pores, could be considered.

In previous reports, it has been proposed that shorter dialysis dwells minimize the negative impact of glucose reabsorption on UF, allowing better aquaporin function (18,19,34,35). Those patients are known to benefit from a shortened dwell time during APD. However, if aquaporin water channels show poor water transport during the MiniPET, shortening dwell time might not be enough to improve UF.

CONCLUSIONS

In PD, assessing UF capacity is important, not only because volume overload has been recognized as a cause of LVH, but also because loss of UF is one of the principal causes of PD failure. Free water transport shows a significant correlation to UF, and MiniPET has been proven to be a valuable tool to estimate USP function based on the 3-pore model. In contrast, the classic PETs are less useful for quantifying FWT and UF.

In the present study, a clinical approach to this test was obtained using the well-known outcome parameter LVMI. The negative relationship observed between nFWT and LVMI, and the cut-off level for nFWT according to the 95th percentile of LVMI, suggest that the evaluation of nFWT could become a useful tool in assessing the capacity of PD treatment to keep patients' volume status under control.

The main limitation of this study is the small patient sample size. Pediatric studies in CKD children on dialysis are limited by the small number of patients compared with adults, and their short time on PD before kidney transplantation. The nFWT cut-off value obtained in this study needs to be confirmed with further studies on a larger sample of patients, highlighting the importance of multicentric studies on CKD children.

DISCLOSURES

The authors have no financial conflicts of interest to declare.

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