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A LARGE INTRAPERITONEAL RESIDUAL VOLUME HAMPERS ADEQUATE VOLUMETRIC ASSESSMENT OF OSMOTIC CONDUCTANCE TO GLUCOSE

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♦ ***Background:*** **In end-stage renal disease patients treated with peritoneal dialysis (PD), the osmotic conductance to glucose (OCG) represents the intrinsic ability of the membrane to transport water in response to a crystalloid osmotic gradient. A progressive loss of OCG in long-term PD patients indicates the development of fibrosis in the peritoneal interstitium, and helps identify patients at risk for encapsulating peritoneal sclerosis. The double mini-peritoneal equilibration test (PET) has been proposed as a simple method to assess OCG using the difference in initial ultrafiltration rates generated by 2 successive dwells using 1.36% and 3.86% glucose-based, 1-h PET. However, the presence of a large peritoneal residual volume (RV) may potentially interfere with the correct evaluation of drained volumes, limiting the reliability of OCG assessed by the double mini-PET.**

♦ ***Methods:*** **We retrospectively reviewed data from 53 peritoneal function tests in 35 consecutive PD patients starting PD at our center between March 2013 and March 2017. The test consisted of a uni-PET (double mini-PET combined with a 3.86%, 4-h PET) performed at PD start, then yearly. In addition to peritoneal solute transport rate and net ultrafiltration, the tests provided information about osmotic water transport (OCG, sodium sieving, and free-water transport) as well as the RV estimated from albumin dilution.**

♦ ***Results:*** **Contrary to sodium sieving, net ultrafiltration, and free-water transport, OCG did not correlate with any of the other parameters of osmotic water transport. In multivariate regression analyses, the RV was identified as the only determinant of OCG, while it did not alter the robust association between sodium sieving/free-water transport and their respective determinants. Considering only baseline tests or the whole series of tests, the presence of a large intraperitoneal RV was associated with discrepant values between OCG and sodium sieving, and with an artificial increase in OCG.**

♦ ***Conclusions:*** **A large RV leads to significant overestimation of OCG using the double mini-PET, potentially reducing the ability of OCG to identify patients with progressive fibrosis in the peritoneal interstitium. On the other hand, sieving of the dialysate sodium, a biochemical surrogate for OCG, is independent of the RV and may therefore be more reliable. A call for caution is warranted in patients with a large RV to avoid misinterpretation of OCG values derived from the double mini-PET.**

* Eric Goffin and Johann Morelle co-directed the study and are co-senior authors.

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Osmotic water transport across the peritoneal membrane is of primary importance to restore water balance in patients with end-stage renal disease (ESRD) treated with peritoneal dialysis (PD). Large epidemiological studies have demonstrated that fluid balance is a strong determinant of outcome in patients on PD and that a low ultrafiltration (UF) capacity is associated with an increased risk of complications, including hypertension, cardiovascular events, and death (1–3). Patients on long-term PD show a gradual decline in UF capacity, and UF failure still represents a leading cause of technique failure (2,4).

From a physiological point of view, the amount of water removed during a dwell (or net UF) is determined by the type and tonicity of osmotic agent; osmotic and hydrostatic pressure gradients; dwell duration; lymphatic/interstitial fluid absorption; and membrane-specific parameters, including the UF coefficient (the product of hydraulic permeability, Lp, and surface area, S) and the reflection coefficient (σ) (5). The osmotic conductance to glucose (OCG)—the product of the UF coefficient and the reflection coefficient ($LpS\sigma$)—is an intrinsic characteristic of the membrane which determines the effectiveness of glucose as an osmotic agent and reflects the number and size of 'pores' available for water transport in the membrane (5).

Mathematical modeling combined with data from experimental models of PD have established that water transport

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across the peritoneal microvascular endothelium induced by glucose-based solutions occurs both at the level of interendothelial junctions (*para*-cellular pathway, or 'small-pore'-mediated, solute-coupled, water transport [SPWT]) and across endothelial aquaporin water channels (*trans*-cellular pathway, or 'ultrasmall pore'-mediated, free-water transport [FWT]) (6–9). In baseline conditions, it is assumed that the peritoneal interstitium does not influence peritoneal transport (6); on the other hand, the development of a fibrotic interstitium in long-term PD patients restricts osmotic water flow across the membrane, thereby altering sieving of the sodium dialysate and OCG (10–15).

The so-called "double-mini PET" has recently been suggested as a simple method to directly calculate OCG as the ratio between the difference in initial UF rates over the difference in osmotic gradient during 2 successive 1-h dwells with 1.36% then 3.86% glucose-based dialysate (16,17). The method is easy to implement in clinical practice and potentially useful to monitor functional changes in the peritoneal membrane of long-term PD patients. However, catheter patency and a significant residual volume (RV), i.e., the amount of dialysis fluid that remains in the peritoneal cavity at the end of the drainage, may potentially influence drained volumes and therefore the estimation of OCG.

Here we retrospectively analyzed a series of peritoneal function tests in incident PD patients to investigate the potential impact of the peritoneal RV on OCG assessed by the double mini-PET.

MATERIAL AND METHODS

PATIENTS AND PERITONEAL TRANSPORT TESTING

Fifty-three peritoneal function tests, performed in 35 consecutive ESRD patients starting PD between February 2013 and March 2017 at the Cliniques universitaires Saint-Luc, Brussels, Belgium were included in this study. During this period, patients enrolled in clinical trials requiring specific functional tests were not eligible for the present study.

Peritoneal function was assessed within the first 3 months after PD start, then yearly, with the use of a uni-PET, as previously described (18,19). The uni-PET combines a double mini-PET and a modified 3.86% glucose-based modified PET in a unique test to provide not only a reliable evaluation of peritoneal solute transport rate but also several parameters of osmotic water transport, including sodium sieving, FWT, and OCG. At the time of the uni-PET, patients were in stable condition and had been peritonitis-free for at least 4 weeks before the test. One test had to be excluded from the analysis for methodological problems during the procedure. Net UF, i.e., the net difference between dialysate volume effluent and volume infused, was recorded. The bags were weighed throughout the test to rule out a potential effect of overfilling the dialysate bags and to accurately calculate the parameters of osmotic water transport. Measurements of serum urea, creatinine, and glucose were performed using routine laboratory techniques on an LX 20 analyzer (Beckman-Coulter, Fullerton, CA, USA). Dialysate sodium was determined using an indirect ion-selective electrode on a Roche Diagnostics Cobas 8000 Module ISE (Mannheim, Germany). The Jaffe's method was used for creatinine determinations, and the results were corrected for interference due to high glucose levels. Dialysate albumin was assessed by immunoturbidimetry on a Roche Diagnostics Cobas 8000 module c502 (Mannheim, Germany). Sodium sieving (ΔD/P sodium) was defined as the difference between the dialysate-over-plasma sodium ratio at the beginning of the PET and at 1 hour. All values of sodium sieving were corrected for sodium diffusion using mass transfer area coefficient (MTAC) creatinine. The PET was part of the normal procedure of care for PD patients. The study was approved by the Ethical Review Board of Cliniques universitaires Saint-Luc.

Calculations: Free-water transport was calculated during the 3.86% mini-PET as follows: FWT (mL) = total net UF (mL) – UFSP (mL), where UFSP was the small pore-mediated UF. Small pore-mediated UF was calculated as follows: UFSP (mL) = [NaR (mmol) × 1,000]/NaP, where NaR (mmol) was sodium removal, calculated as: NaR = [drained dialysate volume (L) × D_{Na} in the drained dialysate (mmol/L)] – [instilled dialysate volume (L) × D_{Na} in the instilled dialysate (mmol/L)] and NaP was the sodium concentration in the plasma (17).

Osmotic glucose conductance was assessed in μL/min/mmHg following the formula: $OCG = \{(V_{3.86} - V_{1.36})/[19.3 \times (G_{3.86} - G_{1.36}) \times t]\} \times 1.7$. $V_{3.86}$ and $V_{1.36}$ (mL) are the dialysate volumes obtained at 1 hour of the dwells using the 3.86% and the 1.36% glucose-based solutions, respectively; 19.3 (mmHg/mmol/L) is the product of the absolute temperature and the constant of gases at 37°C; $G_{3.86}$ and $G_{1.36}$ are the molar glucose concentrations (mmol/L) in the dialysate before the infusion. $G_{3.86}$ and $G_{1.36}$ are calculated as follows: G = glucose/18, where glucose is expressed in mg/dL; t was 75 min, i.e., the duration of the exchange (60 min) + half the duration of the infusion (5 min) and of the drainage (10 min); 1.7 is a correction factor (17).

The RV was calculated following the dilution method as previously described (18,20), as RV = [instilled 3.86% glucose-based dialysate volume × ($D_{Alb}3 - D_{Alb}2$)]/($D_{Alb}1 - D_{Alb}3$), where $D_{Alb}1$ = concentration of albumin in the dialysate at 60 minutes of dwell with the 1.36% glucose solution; $D_{Alb}2$ = concentration of albumin in the fresh 3.86% glucose solution; $D_{Alb}3$ = concentration of albumin in the dialysate at the end of the infusion of the 3.86% solution (t_0). No correction for the diffusive transport of solutes was applied.

Statistical methods: Data are presented as mean ± standard deviation (SD) for continuous variables and as numbers and proportions for categorical variables. Comparisons between the means from different groups were performed using unpaired *t*-tests, Fisher's exact test, or 1-way ANOVA, as appropriate. Multivariate regression was performed by ordinary least squares regression analysis. Initial selection of candidate variables for multivariate regression

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was based on univariate analysis with a threshold value of $p = 0.10$ for inclusion. Normalized values of sodium sieving were calculated to allow direct comparison as follows: normalized sodium sieving = $(x - r_{min})/(r_{max} - r_{min})$, where x is the absolute value of sodium sieving; r_{min} and r_{max} are the minimum and maximum values, respectively, of sodium sieving in the cohort. Normalized values of OCG were calculated using the same formula. All analyses were performed by GraphPad Prism (version 6.01, GraphPad Software Inc., La Jolla, CA, USA) or Stata (version 12, StataCorp, College Station, TX, USA) software.

RESULTS

PATIENTS AND PERITONEAL FUNCTION TESTING

Fifty-three peritoneal function tests, performed in 35 consecutive incident PD patients were included in this study.

Demographic and clinical features of the patients are presented in Table 1; mean age at the start of PD was 45 years, 40% were female, and 86% Caucasian. Twenty-nine percent had diabetes, 89% high blood pressure, and 66% were on automated PD. The first peritoneal function test ($n = 34$) was performed a mean (± SD) of 51 (± 29) days after the start of dialysis, and showed a mean D/P creatinine of 0.70, net UF 524 mL, sodium sieving 0.06, FWT 174 mL, and OCG of 3.9 µL/min/mmHg (Table 2). Mean peritoneal RV calculated from the dilution of albumin was 492 (± 201) mL. Subsequent tests, performed at 12 ($n = 15$) and 24 ($n = 4$) months, yielded similar values (Table 2).

Osmotic conductance to glucose does not correlate with other parameters of osmotic water transport: We first tested the relationship between the different parameters of osmotic water transport derived from the uni-PET, including net UF, sodium sieving, FWT, and OCG. Sodium sieving was estimated from both the $\Delta D/P_{Na}$ and the ΔD_{Na} during the first hour of the dwell with 3.86% glucose, and calculated with either dialysate sodium assessed on the fresh solution (stock) or at the end of instillation (t_0).

While there was a close and significant linear correlation between sodium sieving, net UF, and FWT, OCG did not correlate with any of the other parameters of osmotic water transport (correlation coefficients between -0.09 and 0.08; Table 3). The same observation was made when considering only results from the initial peritoneal test, performed at the start of PD (Supplemental Table 1), and when no systematic arbitrary correction factor was applied to calculate OCG (Supplemental Table 2). The absence of a correlation between OCG and other parameters of osmotic water transport suggested the double mini-PET may not reliably assess OCG.

Determinants of osmotic water transport parameters: Next, we tested the determinants of sodium sieving, FWT, and OCG in univariate and multivariate regression analyses (Table 4). In a first model, considering all clinical and functional parameters except the RV, peritoneal solute transport rate and residual renal function were found to be independent determinants of sodium sieving and FWT, as previously shown by others (21) and by our group (unpublished data) (Table 4). Other covariates such as gender, body mass index, age at PD start, diabetes, serum albumin, corticoids, and serum levels of C-reactive protein were not predictive of any of the parameters of osmotic water transport in univariate analysis. A second model, in which RV was added to PSTR (peritoneal solute transport rate) and residual renal function, found RV as the only determinant of OCG—strong and independent—, while it did not alter the strong association between PSTR and residual renal function on the one hand, and sodium sieving and FWT on the other

TABLE 1
Baseline Demographics

Characteristic	Value
No. of patients	35
Age at PD start, years	45±15
APD, *n* (%)	23 (66)
Ethnicity, *n* (%)	
Caucasian	30 (86)
African	2 (6)
Asian	3 (8)
Female gender, *n* (%)	14 (40)
BMI, kg/m²	24±4
Systolic BP, mmHg	140±20
Diastolic BP, mmHg	87±13
Residual urine volume, mL/day	1,567±660
Mean of renal urea and CrCl, mL/min	7±4
Charlson comorbidity index	5±3
Davies comorbidity index	1±1
Hypertension, *n* (%)	31 (89)
Diabetes, *n* (%)	10 (29)
History of CHF, *n* (%)	1 (3)
History of CHD, *n* (%)	4 (11)
Kidney transplant waiting list, *n* (%)	27 (77)
Albumin, g/L	37±4
Underlying nephropathy, *n* (%)	
Glomerulonephritis	13 (37)
Chronic interstitial nephritis	8 (23)
Polycystic kidney disease	2 (6)
Reno-vascular disease	1 (3)
Diabetic nephropathy	7 (20)
Miscellaneous nephropathy	4 (11)
Chronic treatment	
ACEi, *n* (%)	16 (46)
ARB, *n* (%)	10 (29)
Beta-blockers, *n* (%)	10 (29)
Corticosteroids, *n* (%)	8 (23)

PD = peritoneal dialysis; APD = automated PD; BMI = body mass index; BP = blood pressure; CrCl = creatinine clearance; CHF = congestive heart failure; CHD = coronary heart disease; ACEi = angiotensin-converting-enzyme inhibitor; ARB = angiotensin II receptor blockers. Continuous variables are mean±SD and categorical variables, number (*n*) and percentage (%).

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TABLE 2
Parameters of Peritoneal Transport at Baseline, 12 and 24 Months

	Baseline *n*=34	12 Months *n*=15	24 Months *n*=4
Net UF 3.86% glucose, mL/4 h	524±305	504±222	614±86
D/P_{creat} at 4 h	0.70±0.12	0.68±0.09	0.67±0.07
Dip Na 60 min, mmol/L	9±4	8±2	8±4
ΔD/P Na 60 min	0.06±0.03	0.06±0.02	0.06±0.03
FWT, mL	174±100	156±41	164±70
SPWT, mL	149±110	134±153	200±89
OCG, µL/min/mmHg	3.9±1.4	3.4±2.0	4.5±0.7
Residual volume, mL	492±201	553±160	505±113

UF = ultrafiltration; D/P_{creat} = dialysate-over-plasma creatinine ratio; FWT = free-water transport; SPWT = small pore-mediated water transport; OCG = osmotic conductance to glucose.
Data are mean±SD.

(Table 4). Again, the same results were observed when considering only baseline tests (coefficient [95% confidence interval (CI)] of RV: 2.6×10^{-6} [-4.4×10^{-5}; 4.9×10^{-5}], $p = 0.91$; 0.12 [-0.04; 0.28], $p = 0.13$; and 4.1×10^{-3} [2.0×10^{-3}; 6.3×10^{-3}], $p < 0.001$; for sodium sieving, FWT, and OCG, respectively; p = 35 tests). These data indicated that RV is the main determinant of OCG assessed using double mini-PET, while it did not affect sodium sieving nor FWT.

Influence of high intraperitoneal residual volume on OCG: To cast light on the relationship between RV and parameters of osmotic water transport, we next compared the evolution of OCG vs sodium sieving when the RV progressively increased. While the sodium sieving remained unchanged across all quintiles of RV, OCG progressively increased in patients with high RV (p for linear trend = 0.68 and 0.003, for sodium sieving and OCG, respectively) (Figure 1A). Comparison between patients in the lowest vs the highest quintile of RV showed significant differences in OCG (3.2 ± 0.9 vs 5.4 ± 1.6 µL/min/mmHg,

TABLE 3
Correlation Coefficients Between Parameters of Osmotic Water Transport

	Net UF 4 h	ΔD/P Na 60 min (stock)	ΔD/P Na 60 min (t_0)	Dip Na 60 min (stock)	Dip Na 60 min (t_0)	FWT	OCG
Net UF 4 h	1.00						
ΔD/P Na 60 min (stock)	0.41[a]	1.00					
ΔD/P Na 60 min (t_0)	0.38[a]	0.82[b]	1.00				
Dip Na 60 min (stock)	0.42[a]	0.99[b]	0.83[b]	1.00			
Dip Na 60 min (t_0)	0.40[a]	0.83[b]	1.00[b]	0.83[b]	1.00		
FWT	0.52[a]	0.94[b]	0.81[b]	0.95[b]	0.82[b]	1.00	
OCG	-0.00	-0.09	-0.09	-0.08	-0.09	0.08	1.00

UF = ultrafiltration; D/P Na = dialysate-over-plasma sodium ratio; FWT = free-water transport; OCG = osmotic conductance to glucose.
[a] p<0.01.
[b] p<0.001.

TABLE 4
Multivariate Regression Analysis of Parameters of Osmotic Water Transport

	Model 1			Model 2		
	Coeff.	95% CI	*P*	Coeff.	95% CI	*P*
Sodium sieving						
D/P_{creat} at 4 h	-0.09	-0.16 – -0.03	0.006	-0.09	-0.16 – -0.02	0.009
RRF	-0.003	-0.005 – -0.001	0.002	-0.003	-0.005 – -0.001	0.002
RV	—	—	—	-7.2×10^{-6}	-4.3×10^{-5} – 2.9×10^{-5}	0.691
Free-water transport						
D/P_{creat} at 4 h	-299.2	-485.0 – -113.4	0.002	-303.6	-495.0 – -112.7	0.002
RRF	-7.4	-12.6 – -2.2	0.006	-7.4	-12.7 – -2.2	0.006
RV	—	—	—	1.3×10^{-2}	-0.1 – 0.1	0.799
Osmotic conductance						
D/P_{creat} at 4 h	-0.1	-4.5 – 4.3	0.963	-1.8	-5.9 – 2.4	0.395
RRF	0.0	-0.1 – 0.1	0.767	-0.02	-0.13 – 0.10	0.753
RV	—	—	—	4.1×10^{-3}	1.6×10^{-3} – 6.6×10^{-3}	0.002

Coeff. = coefficient; 95% CI = 95% confidence interval; D/P_{creat} = dialysate-over-plasma creatinine ratio; RRF = residual renal function; RV = residual volume.

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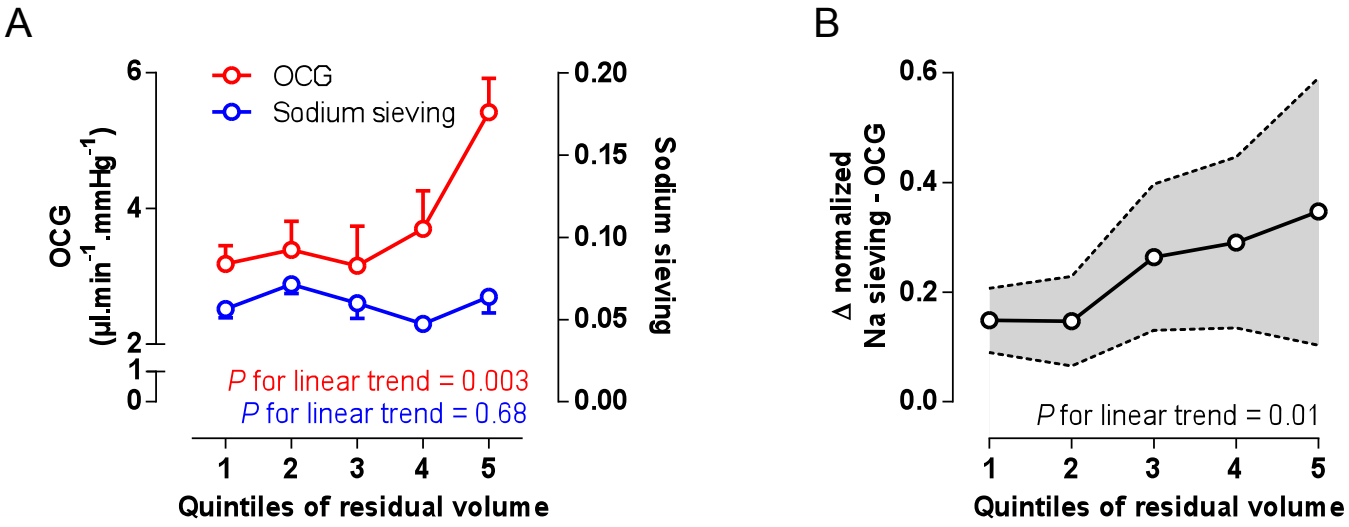

Figure 1 — Relationship between the peritoneal residual volume (RV) and parameters of osmotic water transport during the double mini-PET. A) Relationship between the RV and osmotic conductance to glucose (OCG), and the RV and sodium sieving. Data are mean ± standard error of the mean (SEM). B) Relationship between the RV and the absolute difference between normalized sodium sieving and OCG. Data are mean ± 95% confidence interval (CI). Breusch-Pagan/Cook Weisberg test for heteroskedasticity, $p<0.0001$.

respectively, $p < 0.001$) but not in sodium sieving (0.056 ± 0.017 vs 0.041 ± 0.086, respectively, $p = 0.51$).

To allow a more direct comparison between sodium sieving and OCG, we normalized these values and calculated the absolute difference between them for every patient. As shown in Figure 1B, the absolute difference between normalized values of sodium sieving and OCG progressively and significantly increased with increasing RV (p for linear trend = 0.01; Breusch-Pagan/Cook Weisberg test for heteroskedasticity, $p < 0.0001$). A similar increase in the absolute difference between normalized values of sodium sieving and OCG was observed when considering only baseline tests (p for linear trend = 0.04).

Altogether, these data showed that large RVs are associated with an artificial increase in OCG, which is not paralleled by any change in sodium sieving.

DISCUSSION

In this study, we analyzed a series of incident PD patients with systematic and exhaustive peritoneal function testing to investigate the reliability of the double mini-PET, which has been proposed as a simple method to assess OCG. In our cohort, OCG failed to correlate with any of the other parameters of osmotic water transport, and RV was identified as the main determinant of OCG, suggesting that the double mini-PET has a limited reliability to assess OCG in patients with a large RV.

Osmotic conductance to glucose characterizes every individual membrane and reflects its intrinsic ability to transport water in response to the crystalloid osmotic gradient induced by glucose. Recent data from mathematical modeling and structure-function correlations in patients on long-term PD have highlighted the importance of monitoring water transport to detect progressive fibrosis in the peritoneal interstitium and identify those at risk of encapsulating peritoneal sclerosis (EPS) (10–15). Here, we found that a large RV leads to significant overestimation of OCG using the double mini-PET, potentially reducing the ability of OCG to identify patients at risk for EPS. On the other hand, we confirm that the sieving of the dialysate sodium, a biochemical surrogate for OCG, is independent of the RV and may therefore be more reliable than volumetric assessment of OCG (22).

In the initial description of the test, the use of a correction factor of 1.7 was derived from mathematical modeling and proposed to correct for the influence of the RV and the underestimation of the initial UF rate, when water removal is assessed after 60 minutes (16,17). However, the systematic use of a correction factor does not consider the important inter- and intra-individual variability in the amount of peritoneal RV, as previously demonstrated (20,23).

In clinical practice, the RV can be calculated from indicator dilution techniques as the difference between the intraperitoneal volume at the end of a dwell period and the drained volume. In our cohort, RV was estimated from the dilution of albumin, with values similar to those from previous studies (20). Although albumin dilution is the most reliable endogenous volume indicator, it lacks accuracy as compared with the gold-standard method using dextran 70 or inulin (20). The presence of a large peritoneal RV may theoretically affect the volumetric assessment of OCG either by underestimating net UF during the dwell preceding the measure of the RV or by reducing the transcapillary UF rate (due to dilution of the osmotic gradient) and increasing the peritoneal fluid absorption rate (through increased intraperitoneal hydrostatic pressure) in the subsequent dwell, as demonstrated in experimental models of PD (24). In the present studies, in which the RV was estimated at the transition between the 1.36% and the

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3.86% glucose-based dwells, several observations support the hypothesis that underestimation of the drained volume in the 1.36% glucose-based dwell primarily affected OCG, including: the observation of higher OCG for high peritoneal RV; the absence of an impact of RV on sodium sieving; and the negative correlation between RV and net UF at the end of the 1.36% glucose-based 1-h dwell (Pearson correlation coefficient, $r = -0.33$, $p = 0.02$). These data support the conclusion that a large RV and underestimation of net UF during the 1.36% glucose-based dwell are responsible for the overestimation of OCG during the double mini-PET.

A patent peritoneal catheter is a prerequisite to correctly assess net UF and derived parameters such as OCG. In this cohort, 3 out of the 35 incident patients (9%) presented with catheter dysfunction within the first year on PD, including 2 who required early catheter replacement (7 and 41 days after PD start, before baseline peritoneal function testing) and 1 who opted to be transferred to hemodialysis because of catheter problems after 9 months on PD. In the latter, peritoneal function tests at baseline were normal, and RV < 400 mL. Thus, in our cohort, the proportion of patients experiencing PD catheter problems—requiring replacement or leading to technique failure—within the first year was below 20%, and catheter patency above 80%, in line with international recommendations (25).

The calculation of FWT also requires an accurate assessment of net UF at the end of the 1-h dwell with hypertonic glucose and may therefore theoretically be influenced by the presence of a large RV. However, contrary to OCG, we failed to observe any significant influence of the residual volume on FWT. This may potentially be explained by (i) a large inter-individual variability in FWT, limiting the power of the study to detect any relationship with the residual volume; and (ii) by the fact that calculation of FWT only requires a single assessment of net UF, whereas OCG requires the evaluation of 2 successive drained volumes, potentially increasing the risk of error.

From a clinical standpoint, it will be important to determine specific criteria, including the amount of RV, to allow a correct interpretation of volumetrically-assessed OCG. Due to the monocentric design of the study and the current lack of standardization of peritoneal function tests, it is not possible to propose such a specific cut-off of RV to validate a test. In our cohort, a discrepancy between sodium sieving and OCG became evident for tests with RV in the fourth and fifth quintiles, suggesting that a RV > 510 mL may be associated with incorrect assessment of OCG. However, future multicenter studies will need to further standardize procedures and calculations and to prospectively validate this cut-off.

CONCLUSIONS

In conclusion, the present study confirms the hypothesis that large peritoneal RVs affect volumetrically-assessed OCG, and supports the systematic evaluation of RV when performing a double mini-PET. In addition, any discrepancy between OCG and sodium sieving during the same test requires the critical appraisal of parameters obtained during the test. Future collaborative studies, ideally including direct measurement of RV and OCG with exogenous volume tracers, will need to validate the conclusions of the present work and determine criteria for a correct interpretation of OCG in daily clinical practice. In the meantime, a call for caution is warranted to avoid misinterpretation of OCG values derived from the double mini-PET, especially in long-term PD patients who are potentially at risk of EPS.

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DISCLOSURE

The authors have no financial conflicts of interest to declare.

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