

INTRODUCTION

Preservation of residual renal function (RRF) is important to improve clinical outcomes in patients undergoing peritoneal dialysis (PD). Although icodextrin solution has been highlighted in many aspects compared to glucose-based solution, proof of a beneficial effect of icodextrin solution on RRF is lacking.

PATIENTS AND METHODS

We conducted a multicenter prospective randomized controlled open-label trial (ClinicalTrials.gov Identifier: NCT01170858) to investigate whether icodextrin solution can preserve RRF. Of the 796 PD patients who underwent screening at 8 centers in Korea, 100 patients who met inclusion criteria (66 incident and 34 prevalent) were randomly assigned to receive one exchange of icodextrin solution for ≥ 8 hour-dwell and two exchanges of 1.5% glucose-based biocompatible neutral pH solutions or one exchange of $\geq 2.5\%$ and two exchanges of 1.5% glucose-based biocompatible solutions. These patients had daily urine output ≥ 750 ml at enrolment. The primary outcome was changes in RRF including residual glomerular filtration rate (GFR) and daily urine output at 1 year. These were analyzed according to intention-to-treat principle using mixed-effects general linear models.

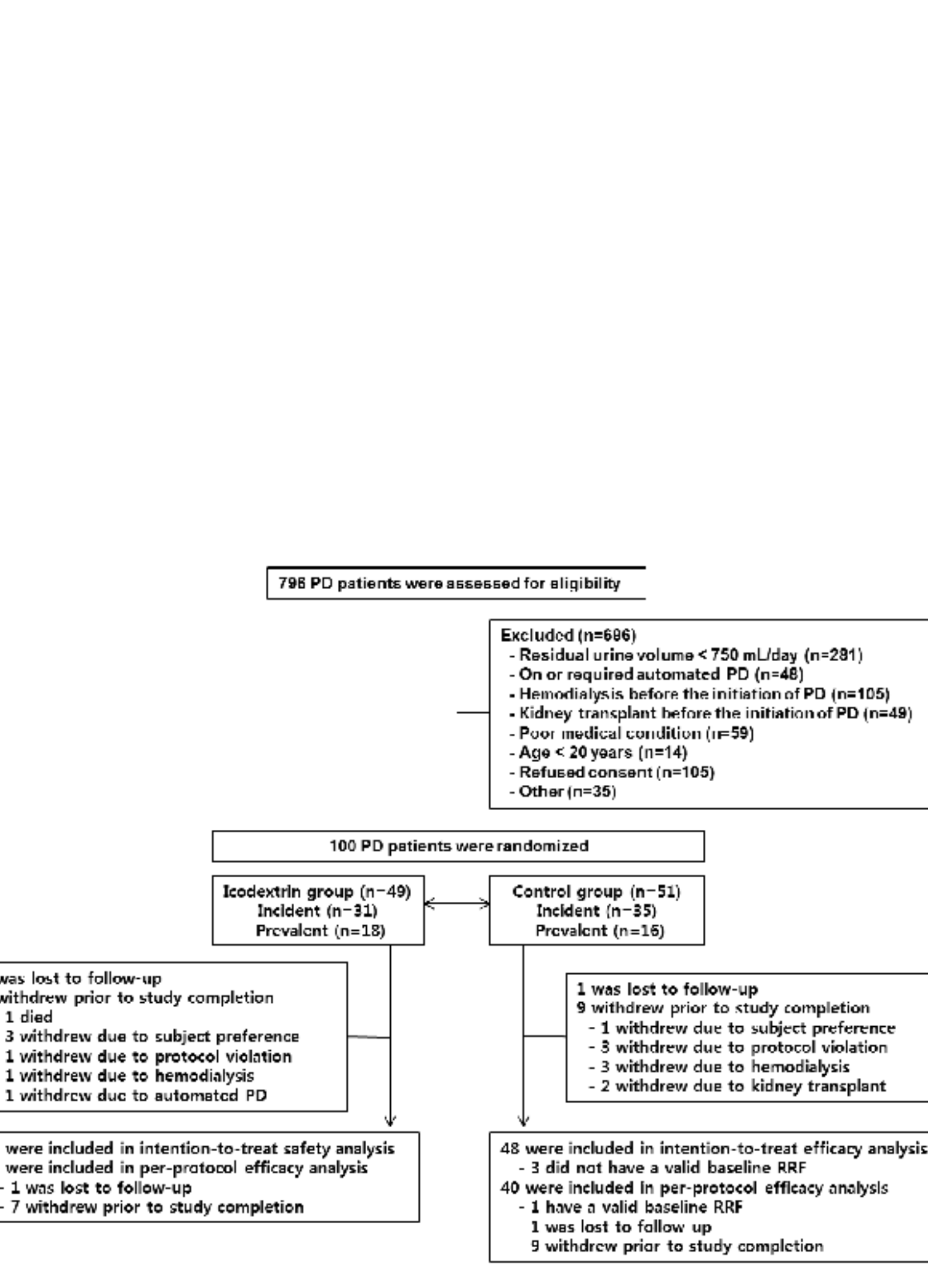
Table 2. Changes of clinical, laboratory, echocardiographic, fluid status, and dialysis parameters by groups

	Control group			Icodextrin group			Difference between groups	
	Baseline (n=51)	Month 6 (n=46)	Month 12 (n=41)	Baseline (n=49)	Month 6 (n=45)	Month 12 (n=41)	Icodextrin-Control (95% CI)	P
Body mass index (kg/m²)	23.6 ± 3.8	24.4 ± 4.3	24.7 ± 4.4	24.5 ± 3.9	25.0 ± 3.7	25.4 ± 3.7	0.9 (-0.7, 2.4)	0.251
Drained body weight (kg)	64 ± 12	66 ± 13	66 ± 13	67 ± 12	68 ± 11	69 ± 11	2.9 (-2, 8)	0.235
Systolic BP (mmHg)	137 ± 18	127 ± 34	134 ± 23.1	130 ± 18	127 ± 36	138 ± 23	-1.4 (-8, 5)	0.672
Diastolic BP (mmHg)	79 ± 11	77 ± 19	78 ± 12	78 ± 12	76 ± 20	81 ± 13	-0.4 (-4, 3)	0.821
Laboratory findings								
Hemoglobin (g/dL)	11.1 ± 1.5	11.2 ± 1.4	11.4 ± 1.8	11.4 ± 1.4	11.0 ± 1.4	10.5 ± 1.4	-0.3 (-0.8, 0.2)	0.297
Protein (g/dL)	6.0 ± 0.7	6.4 ± 0.6	6.1 ± 0.7	6.4 ± 0.5	6.2 ± 0.5	6.2 ± 0.5	0.2 (-0.1, 0.4)	0.193
Albumin (g/dL)	3.3 ± 0.5	3.4 ± 0.5	3.4 ± 0.5	3.3 ± 0.5	3.5 ± 0.4	3.4 ± 0.4	0.02 (-0.2, 0.2)	0.801
Sodium (mmol/L)	138 ± 4	139 ± 4	138 ± 3	139 ± 3	137 ± 3	137 ± 3	-0.9 (-2, 0.3)	0.125
Osmolality (mOsm/kg)	305 ± 8	305 ± 7	305 ± 6	306 ± 8	305 ± 6	306 ± 4	0.8 (-2, 3)	0.515
Total cholesterol (mg/dL)	162 [72-271]	161 [77-231]	174 [57-467]	173 [91-265]	157 [66-214]	160 [101-247]	-0.2 (-13, 13)	0.981
LDL cholesterol (mg/dL)	94 [23-169]	90 [31-156]	160 [20-166]	83 [35-176]	77 [39-134]	86 [37-140]	-10.1 (-27, 7)	0.231
Triglyceride (mg/dL)	116 [53-305]	124 [49-489]	112 [23-504]	139 [27-594]	119 [65-739]	127 [43-739]	27.0 (-7, 61)	0.121
Fasting glucose (mg/dL)	103 [51-466]	113 [74-644]	109 [59-479]	107 [62-430]	100 [42-401]	105 [68-510]	-6.6 (-42, 29)	0.710
HbA1c (%)	6.7 ± 1.5	6.9 ± 1.6	6.6 ± 1.4	6.7 ± 1.5	6.4 ± 1.3	6.3 ± 1.3	-0.2 (-0.8, 0.3)	0.391
Hs-CRP (mg/dL)	0.5 [0-9.2]	0.6 [0-9.8]	0.6 [0-20.2]	0.6 [0-11.5]	0.1 [0-9.9]	0.2 [0-16.8]	0.2 (-0.7, 1.1)	0.625
ANP (pg/mL)	360 [28-2252]	313 [38-2686]	230 [25-2383]	305 [23-2111]	359 [23-2630]	356 [26-2069]	42.3 (-199, 114)	0.593
Echocardiographic parameters								
LA volume index (mL/m ²)	28.8 ± 10.0	26.6 ± 11.9	28.0 ± 12.2	30.6 ± 15.1	28.8 ± 14.2	29.3 ± 11.6	2.3 (-2.4, 7.0)	0.339
LVEDD (mm)	50.2 ± 5.1	49.2 ± 5.3	49.9 ± 5.2	51.1 ± 6.6	49.9 ± 5.1	49.7 ± 4.7	0.9 (-1.1, 3.0)	0.367
LV mass index (g/m ²)	114 ± 32	105 ± 30	106 ± 28	124 ± 49	103 ± 25	99 ± 29	3.9 (-10, 18)	0.583
TR peak velocity (m/sec)	2.3 ± 0.4	2.2 ± 0.3	2.2 ± 0.3	2.4 ± 0.4	2.2 ± 0.4	2.2 ± 0.5	0.04 (-0.1, 0.2)	0.533
IVC diameter (mm)	1.4 ± 0.4	1.4 ± 0.5	1.9 ± 2.3	1.4 ± 0.4	1.5 ± 0.4	1.9 ± 1.8	0.01 (-0.3, 0.4)	0.930
Body composition								
TBW (L)	34.2 ± 6.9	33.9 ± 7.1	34.2 ± 6.5	34.2 ± 6.4	33.9 ± 7.1	35.4 ± 6.5	0.3 (-2.4, 3.0)	0.827
ECF (L)	16.8 ± 3.5	16.3 ± 3.5	16.5 ± 3.6	16.4 ± 3.4	16.2 ± 3.2	16.8 ± 3.3	-0.03 (-1.4, 1.3)	0.965
ECW/TBW ratio	0.49 ± 0.04	0.48 ± 0.04	0.48 ± 0.05	0.48 ± 0.04	0.48 ± 0.08	0.48 ± 0.05	-0.001 (-0.02, 0.02)	0.908
Dialysis parameters								
D/P cr at 4 hours	0.72 ± 0.09	0.70 ± 0.09	0.69 ± 0.10	0.72 ± 0.09	0.77 ± 0.09	0.72 ± 0.12	0.03 (-0.01, 0.06)	0.120
Total Kt/V urea	2.37 ± 0.66	2.38 ± 0.70	2.32 ± 0.72	2.52 ± 0.71	2.32 ± 0.51	2.20 ± 0.69	0.03 (-0.20, 0.24)	0.789
D-glucose exposure (g/day)	110 [68-300]	110 [60-230]	110 [60-160]	60 [45-150]	60 [45-150]	60 [45-185]	-47.7 (-58, -38)	<0.001
Prescribed D-volume (L/day)	6.2 ± 0.7	6.5 ± 1.0	6.4 ± 0.9	6.3 ± 0.8	6.2 ± 0.8	6.4 ± 0.9	-0.1 (-0.4, 0.2)	0.637
Peritoneal UF (mL/day)	275	300	450	425	500	550	71.3 (-182, 324)	0.577

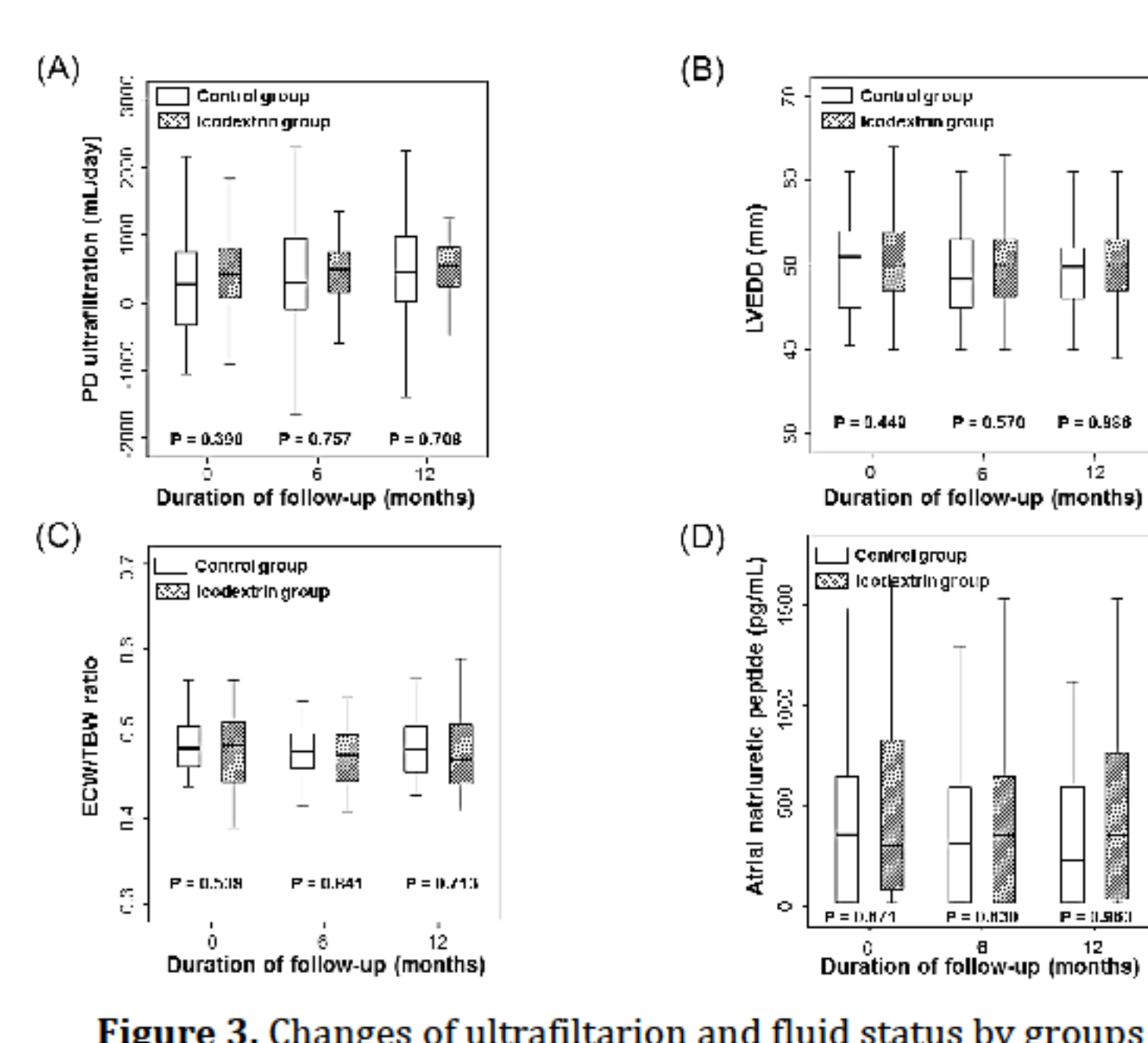
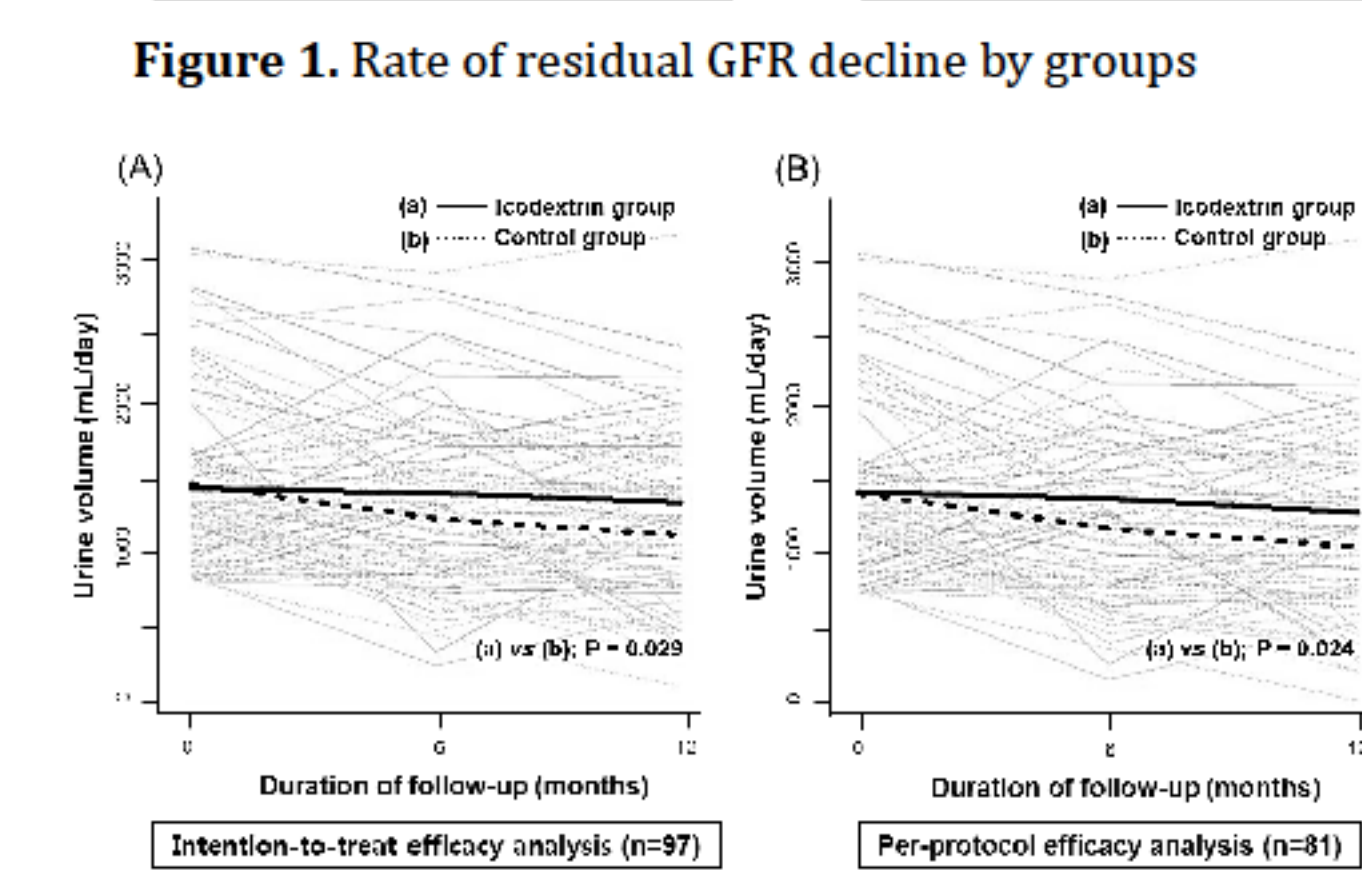
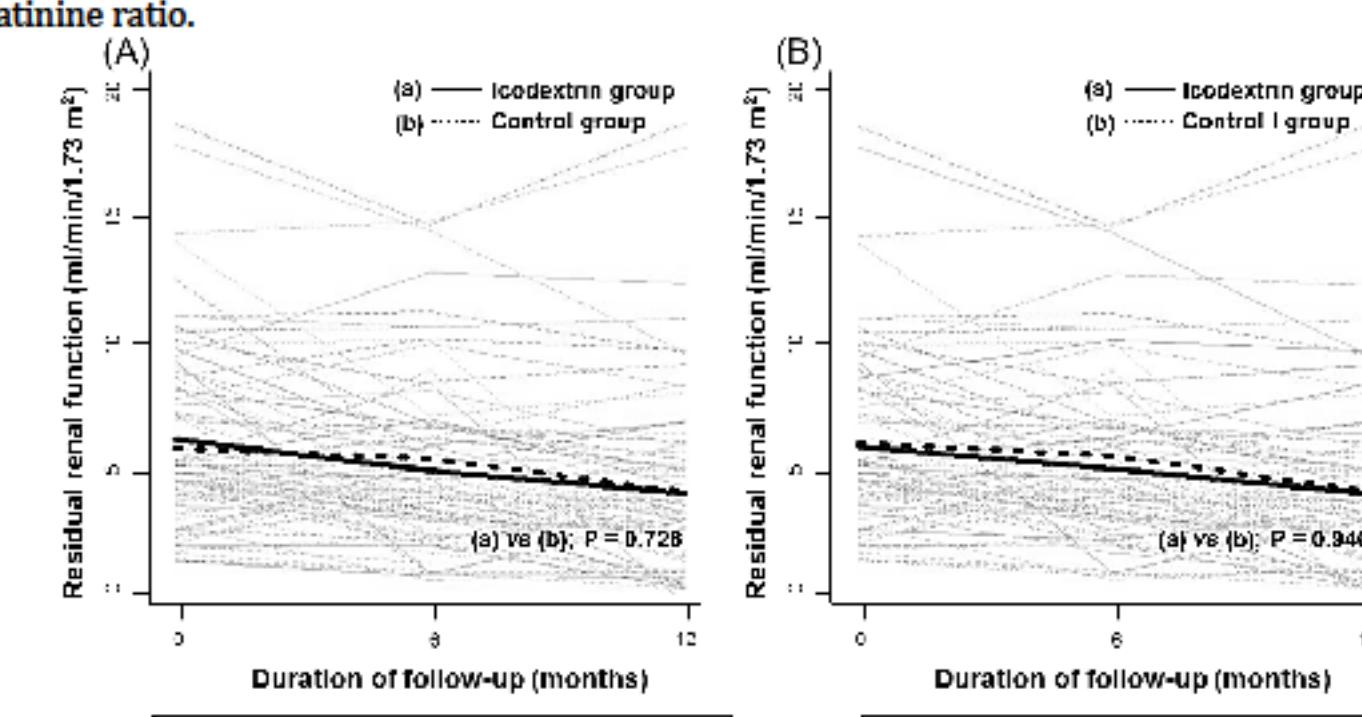
RESULTS

Table 1. Baseline characteristics of the study participants

	Control group (n=51)	Icodextrin group (n=49)	P
Age (years)	55.2 ± 13.0	52.1 ± 11.6	0.216
Gender (Male)	29 (56.9)	30 (61.2)	0.658
Incident patients	35 (68.6)	31 (63.3)	0.571
Body mass index (kg/m²)	23.6 ± 3.8	24.5 ± 3.9	0.258
Diabetic nephropathy	29 (56.9)	23 (46.9)	0.321
Charlson Comorbidity Index score	5.3 ± 2.7	4.8 ± 2.6	0.297
Systolic blood pressure (mmHg)	137.0 ± 17.9	129.9 ± 18.4	0.054
Diastolic blood pressure (mmHg)	81.0 ± 10.9	77.8 ± 11.6	0.159
Laboratory findings			
Hemoglobin (g/dL)	11.1 ± 1.5	11.4 ± 1.4	0.476
Albumin (g/dL)	3.3 ± 0.5	3.3 ± 0.5	0.974
Serum osmolality (mOsm/kg)	304.7 ± 7.8	306.1 ± 8.2	0.438
Fasting serum glucose (mg/dL)	103 [51-466]	107 [62-430]	0.966
HbA1c (%)	6.7 ± 1.5	6.7 ± 1.5	0.950
Atrial natriuretic peptide (pg/mL)	360 [28-2252]	305 [23-2111]	0.671
24-hour urine volume (mL/day)	1250 [750-3060]	1325 [750-3100]	0.727
Residual GFR (mL/min/1.73 m ²)	4.8 [1.9-17.7]	5.5 [1.6-18.6]	0.611
Echocardiographic parameters			
LA volume index (mL/m ²)	28.9 ± 10.0	30.6 ± 15.1	0.491
LV end-diastolic diameter (mm)	50.2 ± 5.1	51.1 ± 6.6	0.449
LV mass index (g/m ²)	114.3 ± 32.3	123.6 ± 48.7	0.271
TR peak velocity (m/sec)	2.3 ± 0.4	2.4 ± 0.4	0.222
Inferior vena cava diameter (mm)	1.4 ± 0.4	1.4 ± 0.4	0.977
Body composition			
TBW (L)	34.23 ± 6.91	34.18 ± 6.44	0.976
ECF (L)	16.75 ± 3.48	16.44 ± 3.40	0.667
ECW/TBW ratio	0.49 ± 0.04	0.48 ± 0.04	0.538
Dialysis parameters			
D/P cr at 4 hours	0.72 ± 0.09	0.72 ± 0.09	0.845
Total Kt/V urea	2.37 ± 0.66	2.52 ± 0.71	0.293
Prescribed dialysate volume (L/day)	6.0 [4.5-8.0]	6.0 [4.5-8.0]	0.731
Peritoneal ultrafiltration (mL/day)	275 [-1050-2150]	425 [-1050-1830]	0.390
Medications			
Angiotensin receptor blockers	39 (76.5)	35 (71.4)	0.566
Diuretics	42 (82.4)	33 (67.3)	0.083
Nonsteroidal anti-inflammatory drugs	3 (5.9)	4 (8.2)	0.712
Dose of furosemide (mg/day)	72.0 ± 54.2	56.7 ± 59.4	0.185



Values for categorical variables are given as a number (percentage); values for continuous variables are given as mean ± standard deviation or median [interquartile range]. GFR, glomerular filtration rate; LA, left atrial; LV, left ventricular; TR, tricuspid regurgitation; TBW, total body water; ECW, extracellular water; D/P cr, dialysate/plasma creatinine ratio.



SUMMARY AND CONCLUSION

1. During follow-up, the slope of decline in residual GFR was -0.170 mL/min/month/ 1.73 m² in icodextrin group, while it was -0.155 mL/min/month/ 1.73 m² in glucose solution group (95% CI, -0.06 to 0.10 ; $p = 0.701$).
2. Daily urine output declined faster in glucose solution group than in icodextrin group (-31.02 vs. -11.88 mL/month; (95% CI, -35.85 to -2.44 ; $p = 0.025$).
3. The results remained unaltered when we analyzed these using per protocol principle.
4. Volume status assessed by echocardiography and bioelectrical impedance analysis, peritoneal ultrafiltration, and peritoneal membrane transport did not differ between the two groups during follow-up.
5. Icodextrin solution attenuated the rate of decline in daily urine output compared to glucose solution, but did not affect residual GFR. Further long-term studies are required to examine whether icodextrin solution may provide a beneficial clinical outcomes via better preservation of urine volume in patients undergoing PD.