# Does Prior Abdominal Surgery Influence Peritoneal Transport Characteristics or Technique Survival of Peritoneal Dialysis Patients?

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**Abstract**

*Introduction*: Prior abdominal surgery may result in peritoneal membrane adhesions and fibrosis, compromising the success of peritoneal dialysis (PD). The impact of this factor on peritoneal membrane function and PD technique survival has not been adequately investigated.

*Methods*: Following an observational, retrospective design, we studied 171 incident PD patients, with the main objective of analyzing the influence of prior abdominal surgical procedures (main study variable) on baseline and evolutionary peritoneal transport characteristics (main outcome) and PD patient and technique survival (secondary outcomes). Abdominal surgeries were categorized according to the degree of presumed injury to the peritoneal membrane. We also considered the additive effect of aggressions to the membrane during the first year on PD therapy.

*Results*: All patients had a baseline peritoneal equilibration test with complete drainage at 60′, and 113 patients had a second study at the end of the first year. Sixty-one patients (35.7%) had a record of prior abdominal surgery, including 29 patients with at least one major intraperitoneal surgery, 22 having undergone minor intraperitoneal procedures, and 21 with a background of major abdominopelvic extraperitoneal surgery. We did not observe differences, at baseline or after 1 year, among patients with or without previous abdominal procedures regarding small solute transport, overall capacity of ultrafiltration, free water transport, small pore ultrafiltration, or peritoneal protein excretion. Stratified analysis, considering prior and first-year-on-PD peritoneal aggressions, did not reveal any differences, although in this case our analysis was hampered by a limited statistical power. Abdominal surgical events did not influence patient or PD technique survival.

*Conclusion*: Prior abdominal surgical procedures do not appear to compromise peritoneal membrane function or technique survival in patients successfully started on PD.

**Keywords** Peritoneal dialysis; Peritoneal transport; Peritoneal equilibration test; Abdominal surgery; Ultrafiltration

## Introduction

The success of peritoneal dialysis (PD) depends critically on the structural and functional integrity of the abdominal cavity and the peritoneal membrane. In fact, uncorrectable discontinuities of the former and irreversible damage to the latter represent formal contraindications for this technique [1]. Intestinal resection, peritoneal adhesions, or membrane fibrosis are occasionally present before PD is started, often as a result of surgical procedures and/or inflammatory (most commonly infectious) injury. It is estimated that selection of PD is dismissed in 6–38% of potential candidates for these reasons [2–6]. A history of catastrophic or recurrent abdominal events or the presence of radiologically evident distortions of the abdomino-peritoneal anatomy are helpful to presume the impracticability of PD, but in many other cases, the feasibility of the technique can only be ascertained after a catheter is inserted and treatment is attempted.

A majority of patients with a background of one or more uncomplicated abdominal surgeries can be successfully treated with PD. However, there is a remarkable lack of data on the characteristics of peritoneal transport in these cases. This paucity of information affects both the baseline conditions of the membrane and its time course on PD. The peritoneal membrane is a subject of continuous (bioincompatibility) and recurrent (peritoneal infections, hemoperitoneum, incident surgical procedures, etc.) injury during PD therapy [7], and a previously damaged peritoneum may be more susceptible to these aggressions. This has not been adequately investigated.

We have performed a retrospective, observational study with the main objectives of disclosing the effect of prior abdominal surgical procedures on peritoneal transport characteristics, both at the inception and during the time course of PD therapy (main) and also on patient and PD technique survival rates (secondary), taking into consideration the potential additive effects of incident injury to the membrane during follow-up.

## Population and Method

*Overall Study Design*

Following a retrospective, observational, single-center design, we reviewed the impact of prior abdominopelvic surgical procedures (main study variable) on the baseline and evolutionary characteristics of the peritoneal transport of water and solutes of incident patients on PD (main outcome). We used peritoneal equilibration tests (PETs) with complete drainage at 60 min as the essential tool to assess membrane function. We also investigated the impact of the main study variable on PD technique and patient survival (secondary outcomes).

The study complied with the principles of the Declaration of Helsinki and the ethical requirements of our center for retrospective observational studies. The protocol was evaluated and approved by a local ethical committee (code 2020/096). Informed consent was requested and obtained from all participants active at the time of initiation of the study.

*Study Population*

- We recorded data from all patients starting PD therapy between January 2008 and December 2018, under 5 main inclusion criteria:
- Age >18 years at the start of PD
- Primary incident on PD
- Clinical records fully available (prior surgeries are routinely recorded before catheter insertion)
- At least one baseline PET study performed during the first 3 months of PD therapy
- Informed consent provided, when feasible.

Expectedly, the fact that PD was attempted implied that no patient had a history of catastrophic abdominal events, including:

- Extensive intestinal resection
- Severe peritonitis with overt intestinal adhesions
- Recurrent, complicated major abdominal surgeries
- Active inflammatory intestinal disease
- Major, uncorrectable discontinuities affecting the diaphragm or the abdominal wall.

*Study Variables*

A history of previous abdominal surgery was the main study variable. Due to an expectedly variable aggressiveness of different procedures, we categorized surgeries as follows:

Major peritoneal aggressions, including intraperitoneal surgeries with a significant risk of membrane injury: open appendicectomy, complicated laparoscopic appendicectomy (peritonitis reported), open cholecystectomy, laparoscopic cholecystectomy due to acute cholecystitis, pancreatic or splenic surgery, limited gastrointestinal resection, exploratory laparotomy, transperitoneal vascular surgery, and transperitoneal urologic procedures.

Minor peritoneal aggressions, including intraperitoneal surgeries with lower risk of peritoneal injury: complicated insertion of the peritoneal catheter (open repositioning or substitution, significant postoperative intraperitoneal bleeding), uncomplicated hernioplasty, uncomplicated laparoscopic cholecystectomy, uncomplicated laparoscopic appendicectomy; and major extraperitoneal surgeries with potential, undetermined peritoneal injury: retroperitoneal nephrectomy, kidney transplant, transplantectomy, other extraperitoneal urological interventions, and gynecologic surgical procedures (including complicated caesarean surgery).

Our main objective was to investigate the impact of surgical procedures preceding initiation of PD, but we also took into consideration surgical procedures undertaken during the first year of PD therapy (same categorization) and other nonsurgical aggressions to the membrane, including infectious peritonitis and severe hemoperitoneum. Given the potential multiplicity of combinations of pre-PD and first-year injuries, we focused our analyses on the effects of pre-PD (overall and major) injury on the baseline and 1-year characteristics of the peritoneal membrane and to the potential additive impact of injury (any type) to the membrane during the first year on PD on the time course of the aforementioned characteristics.

The main outcome variables were the peritoneal functional parameters at baseline (first 3 months on PD therapy) and after 1 year of treatment. We used a standard 3.86/4.25% glucose-based PET with complete drainage at 60′ for this purpose. The scrutinized parameters were as follows: dialysate-to-plasma ratio of Cr at 240″ (D/P Cr), dialysate ratio of glucose at 240′ versus 0′ (D/D0 glucose), ultrafiltration at 60′ and 240′, sodium sieving at 60′, free water transport (corrected for diffusion) [8], small-pore UF, and peritoneal total protein excretion during PET. We also recorded transfer to hemodialysis (technique survival) and mortality as secondary outcome variables. Control variables included the essential ones related to patient's demography, drug therapies, and usual conditions of PD prescription (see Results and Table 1).

*Statistical Analysis*

Variables are expressed as percentages or mean with standard deviation, or as median values with ranges in the presence of a non-normal distribution. We used ANOVA, $\chi^2$ test, and Student's *t* test for contemporary comparisons and paired Student's t-test for evolutionary comparisons. We used multiple regression analyses to control for the imbalances between the study groups regarding age, gender, or the presence of diabetes. Technique and patient survival were explored using Kaplan-Meier plots and compared using the log-rank test. We used the SPSS® software package v.19.0 for the statistical analysis.

## Results

Figure 1 displays the flowchart of patients during the study period. Two hundred forty patients were evaluated, but 69 were excluded from analysis for different reasons; 31 of these (44.9%) had undergone at least 1 abdominal surgical procedure ($p$ = 0.26 vs. included patients, $\chi^2$ test), and 17 (24.6%) had a background of previous intraperitoneal surgery ($p$ = 0.17 vs. included patients). PD could not be effectively started in 6 patients, due to peritoneal adhesions ($n$ = 2) or recurrent catheter malposition/entrapment ($n$ = 4). Two of these patients had a background of previous intraperitoneal abdominal surgery and 2 other of major extraperitoneal abdominal surgery. One hundred seventy-one patients fulfilled the inclusion criteria and were considered for analysis. The median age at the start of PD was 64 years (range 18–91); 113 patients (66.1%) were men, and 58 (32.9%) were women. Diabetes mellitus was present in 61 cases (35.7%). Patients were followed up for a median of 22.7 months (range 3–99). As requested by the inclusion criteria, all patients had a baseline PET, while 113 (66.7%) had a second PET performed at the start of the second year (Fig. 1). Peritoneal catheters were inserted using a semi-surgical, trocar-assisted technique in 141 cases (82.5%), while a minilaparotomy was used in the remaining 30 cases (17.5%). Invasive catheter repositioning or replacement was necessary in 11 cases (6.4%). All patients used bicarbonate-lactate-buffered, low-glucose degradation product-based solutions.

Sixty-one patients (35.7%) had undergone at least one abdominal surgery before initiation of PD (excluding regular peritoneal catheter insertion). Of these, 29 (47.5%) had at least one major intraperitoneal surgery, 22 (36.0%) had at least one minor intraperitoneal surgery, and 21 (34.4%) had at least one major extraperitoneal abdominal surgery. Major intraperitoneal surgeries included open/ complicated cholecystectomy ($n$ = 13), open/complicated appendicectomy ($n$ = 11), nonspecified exploratory laparotomy ($n$ = 4), transperitoneal nephrectomy ($n$ = 3), aorto- bifemoral bypass ($n$ = 2), splenectomy (trauma) ($n$ = 2), hemicolectomy, partial pancreatectomy, and complicated gynecologic surgery (1 case each).

The exact date of remote surgical procedures could not be precisely established in 5 cases. Twenty-three patients underwent abdominal surgery less than 1 year before starting PD and 15 patients did so less than 3 months before inception of PD.

Thirty-nine patients (22.8%) had at least one abdominal surgical procedure during the first year on PD, including 5 major intraperitoneal surgeries (appendicectomy, cholecystectomy, hemicolectomy, and 2 exploratory laparotomies), 32 minor intraperitoneal procedures (11 cases of catheter repositioning/replacement and 21 hernioplasties), and 5 instances of major extraperitoneal abdominal surgery (2 nephrectomies and 3 failed kidney transplant with transplantectomy). Peritoneal rest before restarting PD was less than 2 months in all cases, although 2 patients undergoing major surgery and 2 other undergoing minor surgeries did not restart PD after the procedure. On the other hand, 35 patients (20.5%) suffered at least 1 episode of infectious peritonitis during the first year of follow-up. We recorded a single episode of spontaneous severe hemoperitoneum, during this period.

Other essential clinical and analytical data at the time of the consecutive PET studies are displayed in Table 1. Patients with a background of major intraperitoneal procedures were older (66.9 vs. 60.2 years for patients without prior surgery, $p = 0.019$) and more frequently diabetic (55.2 vs. 31.8%, $p = 0.016$). On the other hand, patients with prior minor intraperitoneal and/or major extraperitoneal procedures were more frequently women (48.9 vs. 31.3%, $p = 0.033$). As expected, open catheter insertion was more common in patients with prior major (41.4%, $p < 0.001$) or minor/extraperitoneal (25.5%, $p = 0.058$) procedures (vs. 8.9% for patients without prior surgery). Other differences regarding demographic or clinical variables (Table 1) were not significant.

Table 2 compares baseline PET parameters in patients with or without abdominal surgery before initiation of PD. No significant differences were detected. Similarly, we observed no apparent differences after comparing the same parameters at the start of the second year (Table 3). Multiple regression analysis added only a minor trend to lower baseline sodium sieving values in patients with a history of major intraperitoneal surgery (mean difference vs. other patients −1.78 mM/L, 95% CI −3.51/0.51, $p = 0.057$), after controlling for age, gender, or the presence of diabetes (other adjusted comparisons at baseline or after 1 year not significant).

We attempted stratified analyses on the influence of pre-PD and/or first year of PD peritoneal aggressions on the time course of peritoneal transport characteristics (Table 4). Small pore UF decreased moderately for the whole sample since baseline to the end of the first year (155 to 129 mL, $p = 0.029$ paired *t* test). This trend was quantitatively similar in all subgroups, but approached statistical significance only in patients without prior surgery, probably as a consequence of the larger size of this subset. On the other hand, D/D0 glucose and free water transport tended to increase only in patients without membrane events during the first year, although the difference reached statistical significance only in the subgroup with prior surgery (Table 4). Overall, these minor changes did not permit consistent conclusions. It must be emphasized that some subgroups (including patients with both pre-PD and first-year injury) were too small to allow reliable comparisons.

At the end of follow-up, 58 patients (33.9%) were still active on PD, 60 (35.1%) had received a kidney transplant, 39 (22.8%) had died, and 14 (8.2%) had been switched to hemodialysis. Survival analysis did not disclose any effect of previous injury to the peritoneal membrane on patient ($p$ = 0.33 log rank, not represented) or technique survival (Fig. 2). The same applied when groups with/without previous overall ($p$ = 0.35) or major abdominal surgery ($p$ = 0.40) were compared.

## Discussion

Loss of a significant fraction of the effective peritoneal surface, as that occurs after intestinal resection, in the presence of extensive adhesions or in case of peritoneal membrane fibrosis, may compromise seriously the feasibility of PD. These complications may be already present at the initiation of therapy, most often as consequences of prior acute or recurrent abdominal events, usually associated with surgical procedures. The impact of these events on the functionality of the peritoneal membrane is not easy to predict, in the individual patient. This may be particularly true in the case of remote events, in which clinical information may be incomplete. The option of PD is often discouraged in patients with this type of background [2–6], although this therapy has proven to be feasible even after seemingly aggressive abdominal procedures, including limited intestinal resections, liver transplantation [9], or bariatric surgery [10]. Computed tomography may identify overt distortions of the peritoneal structure but, in general, lacks sensitivity to detect less obvious cases. At the end, a trial and error strategy (insert catheter and try PD) is a common resource, in doubtful cases.

Once PD is started, the question of how PD performs in patients with prior abdominal surgical procedures has received little attention in the past. In general, this factor has not been considered by the main epidemiologic reports on peritoneal transport characteristics at inception [11–17] or during the course of PD [18, 19]. Aziz and Chaudhary [20] have approached the issue of abdominal surgery and PD, but their review focused on the clinical outcomes of surgical procedures after the initiation of PD. More recently, Cheng et al. [21] observed a high prevalence of intra-abdominal adhesions in PD patients with prior abdominal surgeries; the authors detected a detrimental effect of adhesions on PD adequacy, without an apparent effect on technique survival. Relevant studies investigating the risk profile for PD technique failure do not include previous abdominal surgery in their exploratory analyses [22–24].

The results of our study indicate that peritoneal transport characteristics are not significantly affected by prior abdominal surgical procedures, as long as PD can be effectively started. Neither did small solute transport rates or the capacity of ultrafiltration differ in patients, according to this factor. This absence of differences extended to the second year on PD. Mortality and PD technique survival rates were also similar, in the compared groups. Finally, we could neither demonstrate an additive effect of events affecting the peritoneal membrane during the first year of PD therapy, although in this case our sample seemed clearly underpowered to sustain clear conclusions. These findings are consistent with the notion that noncatastrophic surgical procedures are not harmful for the peritoneal membrane or that the latter has a significant capacity to recover from this type of injury.

Our study suffers some significant limitations, including a single-center, retrospective design. The study population was relatively small, resulting in a shortness of statistical power at the time of creating subgroups for analysis. This was particularly evident at the time of stratified, longitudinal analyses (Table 4). The study flowchart (Fig. 1) did not suggest marked survival or selection biases. However, patients excluded from the study presented nonsignificant trends to a higher prevalence of previous abdominal surgeries. Moreover, 4 out of the 6 patients in whom PD could not be effectively started had undergone some type of abdominal surgery. Our results should not be interpreted in the sense that PD is feasible in all patients with prior abdominal surgical events because we analyzed only patients in whom this therapy could be successfully started. On the other

hand, the study was adequately powered to explore baseline peritoneal transport characteristics, and the analysis of sequential PET studies provided information of the evolutionary characteristics of peritoneal transport.
In summary, our results suggest that patients with a history of prior abdominal surgery, in whom PD can be started, present similar baseline and evolutionary peritoneal transport characteristics, as also patient and PD technique survival rates, when compared to controls without such a background.

## Statement of Ethics

The study complied with the principles of the Declaration of Helsinki and the ethical requirements of our center for retrospective observational studies. The protocol was evaluated and approved by the Coruna-Ferrol Area local ethical committee (approval code 2019/96). Informed consent was requested and obtained from all participants active at the time of initiation of the study.

## Conflict of Interest Statement

The authors declare no conflicts of interest for this study.


## Funding Sources

None specific for this study.


## Author Contributions

A.D.S. and L.G.G. participated in the conception and design of the research and had a major role in the production of the final manuscript. C.R.M. and D.A.J. participated in the study design, data collection, and analysis of results. A.R.C. and T.G.G. contributed to the study design and data analysis. M.P.F. supervised the whole study and participated in data analysis and manuscript production.

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**Table 1**. Clinical, biochemical, and PET-related variables at the time of sequential PET

| | Baseline PET | Second PET |
|---|---|---|
| Patients, *n* | 171 | 113 |
| RKF, mL/min | 8.3±3.8 | 6.5±3.6 |
| Loop diuretic therapy, % | 57.9 | 68.1 |
| RAAS antagonist therapy, % | 38.0 | 35.4 |
| Plasma albumin, g/dL | 3.6±0.4 | 3.7±0.4 |
| Proteinuria, g/day | 1.1 (0–8.5) | 0.6 (0–7.6) |
| Peritoneal protein losses, g/day | 5.9 (0.1–6.2) | 5.7 (1.5–17.0) |
| Automated PD, % | 10.5 | 15.0 |
| Daily glucose load, g/day | 82.7±55.1 | 71.6±44.2 |
| Icodextrin for long dwell, % | 60.2 | 73.5 |
| Daily UF, mL | 748±371 | 876±389 |
| D/P Cr 240′ | 0.72±0.10 | 0.72±0.10 |
| D/D0 glucose 240′ | 0.29±0.09 | 0.29±0.11 |
| Sodium sieving, mM/L | 7.8±4.1 | 8.4±4.3 |
| Noncorrected FWT, mL | 124 (−62 to 655) | 129 (9–422) |
| Corrected FWT, mL | 147 (−37 to 657) | 153 (36–436) |
| Small-pore UF, mL | 155 (−14 to 593) | 115 (−61 to 684) |
| PPE-PET, g | 1.40 (0.07–6.17) | 1.36 (0.19–5.46) |
| Overhydration by BIO, L | 1.0 (−2.7 to 6.5) | 0.64 (−2.7 to 5.4) |
| UF 60′, mL | 296±184 | 272±169 |
| UF 240′, mL | 521±302 | 552±314 |
| UF 240′ <400 mL, % | 28.7 | 35.7 |

Figures denote mean ± SD, median with range (numerical variables) or % of cases (categorized variables). PET, peritoneal equilibration test; RKF, residual kidney function (mean of urea and Cr clearances); RAAS, renin-angiotensin-aldosterone system; PD, peritoneal dialysis; FWT, free water transport; UF, ultrafiltration; PPE-PET, peritoneal protein excretion during the PET; BIO, bioimpedance.

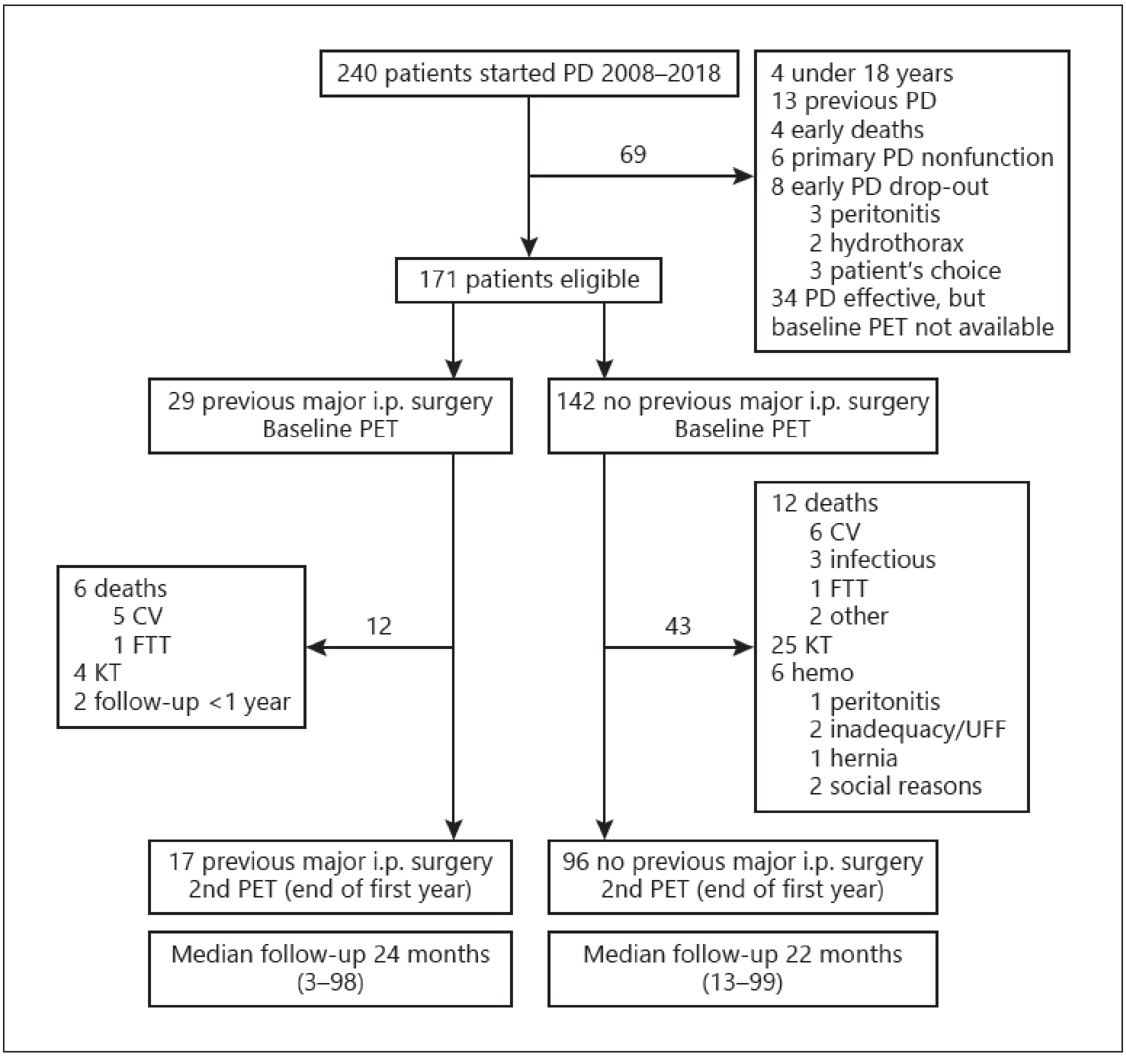


**Fig. 1.** Flowchart of patients during the study period. PD, peritoneal dialysis; PET, peritoneal equilibration test; I.P., intraperitoneal; CV, cardiovascular; FTT, failure to thrive; KT, kidney transplant; UFF, ultrafiltration failure.

**Table 2**. Baseline peritoneal transport characteristics according to prior abdominal surgery

| | Prior abdominal surgery (any) | | | Prior major intraperitoneal surgery | | |
|---|---|---|---|---|---|---|
| | yes | no | *p* value | yes | no | *p* value |
| Patients, *n* | 61 | 110 | | 29 | 142 | |
| D/P Cr 240′ | 0.72±0.10 | 0.72±0.10 | 0.77 | 0.71±0.10 | 0.72±0.09 | 0.87 |
| $D/D_0$ glucose 240′ | 0.29±0.10 | 0.29±0.09 | 0.95 | 0.27±0.08 | 0.29±0.10 | 0.23 |
| Sodium sieving, mM/L | 7.22±3.62 | 8.05±4.14 | 0.21 | 6.58±3.14 | 7.99±4.10 | 0.097 |
| UF 60′, mL | 295±193 | 296±179 | 0.95 | 284±192 | 298±183 | 0.72 |
| UF 240′, mL | 527±350 | 518±274 | 0.86 | 483±280 | 529±307 | 0.45 |
| Noncorrected FWT, mL | 148±95 | 136±71 | 0.34 | 128±64 | 142±84 | 0.40 |
| Corrected FWT, mL | 170±95 | 158±73 | 0.38 | 151±66 | 165±84 | 0.40 |
| SPUF, mL | 159±164 | 153±147 | 0.83 | 164±149 | 161±154 | 0.93 |
| PPE-PET, g | 1.53±0.55 | 1.57±0.76 | 0.66 | 1.51±0.48 | 1.56±0.72 | 0.73 |

Figures denote mean values ± standard deviation. UF, ultrafiltration; FWT, free water transport; SPUF, smallpore ultrafiltration; PPE-PET, peritoneal protein excretion during the peritoneal equilibration test.

**Table 3**. Peritoneal transport characteristics during the second PET according to abdominal surgery before initiation of PD

| | Prior abdominal surgery (any) | | | Prior major intraperitoneal surgery | | |
|---|---|---|---|---|---|---|
| | yes | no | *p* value | yes | no | *p* value |
| Patients, *n* | 38 | 75 | | 17 | 96 | |
| D/P Cr 240′ | 0.71±0.10 | 0.73±0.11 | 0.77 | 0.71±0.10 | 0.73±0.11 | 0.76 |
| $D/D_0$ glucose 240′ | 0.31±0.12 | 0.28±0.10 | 0.95 | 0.30±0.11 | 0.29±0.10 | 0.71 |
| Sodium sieving, mM/L | 8.46±3.70 | 8.37±4.51 | 0.21 | 8.50±3.95 | 8.38±4.30 | 0.91 |
| UF 60′, mL | 285±174 | 264±168 | 0.56 | 271±202 | 272±164 | 0.98 |
| UF 240′, mL | 511±274 | 500±345 | 0.87 | 487±252 | 507±333 | 0.82 |
| Noncorrected FWT, mL | 158±82 | 135±71 | 0.16 | 150±75 | 143±76 | 0.69 |
| Corrected FWT, mL | 179±81 | 158±71 | 0.16 | 172±73 | 164±76 | 0.70 |
| SPUF, mL | 116±195 | 117±155 | 0.97 | 92±258 | 120±50 | 0.52 |
| PPE-PET, g | 1.49±0.62 | 1.56±0.82 | 0.61 | 1.39±0.39 | 1.56±0.79 | 0.41 |

Figures denote mean values ± standard deviation. PET, peritoneal equilibration test; PD, peritoneal dialysis; UF, ultrafiltration; FWT, free water transport; SPUF, small-pore ultrafiltration; PPE-PET, peritoneal protein excretion during the peritoneal equilibration test.

**Table 4**. Changes in peritoneal transport characteristics between the baseline and second PET, according to different patterns of peritoneal injury

| | All | NoPS | Any PS | No PMS | Any PMS | No PMS No FYI | No PMS FYI | PMS FYI | PMS No FYI |
|---|---|---|---|---|---|---|---|---|---|
| Patients, *n* | 113 | 75 | 38 | 96 | 17 | 76 | 18 | 4 | 15 |
| D/P Cr 240′ | 0.97 | 0.63 | 0.48 | 0.92 | 0.83 | 0.79 | 0.43 | 0.71 | 0.98 |
| $D/D_0$ gl. 240′ | 0.65 | 0.88 | 0.35 | 0.98 | 0.29 | 0.09 | 0.86 | 0.26 | (↑) 0.017 |
| Na sieving, mM/L | 0.33 | 0.81 | 0.16 | 0.63 | 0.17 | 0.53 | 0.12 | 0.74 | 0.33 |
| UF 60′, mL | 0.30 | 0.35 | 0.65 | 0.39 | 0.58 | 0.12 | 0.26 | 0.56 | 0.87 |
| UF 240′, mL | 0.74 | 0.86 | 0.72 | 0.86 | 0.67 | 0.13 | 0.24 | 0.18 | 0.34 |
| Noncorrected FWT, mL | 0.28 | 0.51 | 0.38 | 0.52 | 0.24 | 0.11 | 0.50 | 0.79 | (↑) 0.048 |
| Corrected FWT, mL | 0.40 | 0.65 | 0.44 | 0.64 | 0.32 | 0.09 | 0.39 | 0.75 | (↑) 0.046 |
| SPUF, mL | (↓)0.029 | 0.071 | 0.23 | 0.079 | 0.24 | 0.064 | 0.26 | 0.52 | 0.70 |
| PPE-PET, g | 0.66 | 0.56 | 0.35 | 0.88 | 0.24 | 0.89 | 0.55 | 0.39 | 0.50 |

Figures denote *p* value for paired Student's *t* test comparisons. Significant increase (↑) or decrease (↓) since baseline to second PET. PET, peritoneal equilibration test; PS, previous abdominal surgery (any type); PMS, previous major intraperitoneal surgery; FYI, first year membrane injury (major intraperitoneal surgery and/or peritoneal infection and/or hemoperitoneum); UF, ultrafiltration; FWT, free water transport; SPUF, small-pore ultrafiltration; PPE-PET, peritoneal protein excretion during the peritoneal equilibration test.

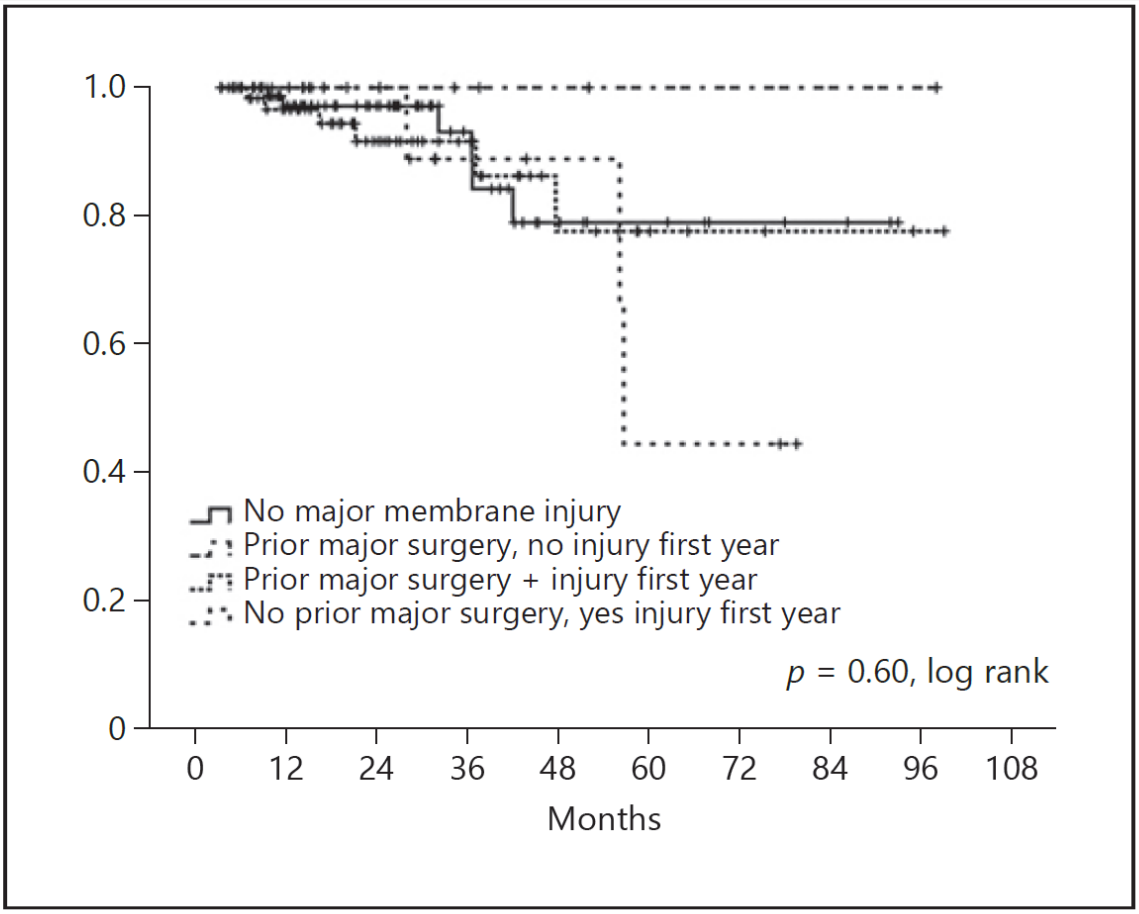


**Fig. 2.** PD technique survival according to prior or first-year peritoneal membrane injury. PD, peritoneal dialysis.